



Australian Government

UEE07 Electrotechnology Training Package

Release: 4.0

CONTENTS

Preliminary Information	4
Overview	28
The Electrotechnology Industry	33
Content of this Training Package	38
Layout of this Training Package.....	39
AQF qualifications in this Training Package	41
Responsibility for Training Package Maintenance	46
Transition to NQC Training Package packaging rules for Flexibility	50
1.1.00 The Electrotechnology Industry Qualifications Framework.....	53
1.1.01 Summary of Industry Qualifications.....	54
1.1.02 Qualification Structures	88
1.1.03 Valuation of Competency Standard Units	93
1.1.04 Qualifications - Completion requirements framework.....	98
1.1.05 Qualifications and Competency - Recognition/Issuance Requirements.....	105
1.1.06 Pathways into Individual Qualifications	106
1.1.07 Maintenance of Qualifications	109
1.1.08 The Australian Qualification Framework.....	110
1.1.09 Electrotechnology Industry Qualification Descriptions	114
1.1.10 Qualification Employability Skills Statements	129
1.1.11 Qualifications Structures.....	158
1.1.12 Schedule of Electives	158
1.2.01 Competency Standards.....	202
1.2.02 Contextualisation of Competency Standard Units by RTOs	203
1.2.03 Components of Units of Competency	203
1.2.04 Employability Skills in Units of Competency	205
1.2.05 Competency Standards for the Electrotechnology Industry	207
1.2.06 Competency Standard Units for the Electrotechnology Industry	207
1.2.07 Maintenance of Competency Standards	210
1.2.08 Index of Competency Standard Units	211
1.2.09 Unit relationships	391
1.2.10 Relationship of UEE07 Electrotechnology Training Package Version 4 to earlier Versions	623
1.2.11 Imported Competency Standard Units	725
1.3.00 Assessment Guidelines	731
1.3.01 Introduction	731
1.3.02 Assessment System Overview.....	732
1.3.03 Assessment Principles within the Electrotechnology Industry	733
1.3.04 Pathways	743
1.3.05 Assessment Processes in the Electrotechnology Industry	753
1.3.06 Assessor Requirements	754
1.3.07 Designing Assessment Tools	761
1.3.08 Assessment Methods	762
1.3.09 Conducting Assessment	767
1.3.10 Guidelines for Designing Assessment Materials.....	775
1.3.11 Maintenance of Assessment Guidelines.....	779
1.3.12 Further Sources of Information.....	779
1.3.13 General Resources.....	780
1.3.13 Further Sources of Information.....	783
1.3.14 Appendix A - Australian Apprenticeships	785

1.3.15 Appendix B - Sample Assessment Instruments	788
2.2.00 EKAS Contextualisation.....	853
2.2.01 Cables, conductors and terminations	854
2.2.02 Common, commercial, processes and enterprise specific knowledge and skills.....	861
2.2.03 Control technologies.....	891
2.2.04 Communications and computer technologies	904
2.2.05 Drawings, diagrams, schedules, manuals, standards and regulations	949
2.2.06 Electrical applications and apparatus.....	958
2.2.07 Electrical installations and systems	1024
2.2.08 Electrical principles	1035
2.2.09 Electronic principles and applications	1070
2.2.10 Electronic communications technology.....	1134
2.2.11 Equipment and tools	1157
2.2.12 Instrumentation.....	1174
2.2.13 Maintenance and repair	1188
2.2.14. Rail signalling	1193
2.2.15 Refrigeration and air conditioning apparatus.....	1198
2.2.16 Refrigeration and air conditioning installations	1219
2.2.17 Refrigeration and air conditioning principles and applications	1239
2.2.18 Safety	1305
2.2.19 Special requirements.....	1325
2.2.20 Sustainable energy and environment	1334
2.2.21 System, control and automated.....	1382
2.2.22 Hazardous Areas.....	1389
2.2.23 HV Switching.....	1412
2 Discipline A - Assembly	1415
2 Discipline B - Broadcast - EKAS for this discipline are yet to be classified.	1415
2 Discipline C – Commercial.....	1415
2 Discipline D - Computerised Systems - EKAS for this discipline are yet to be classified.	1415
2 Discipline E – Cross-Discipline	1415
2 Discipline F - Data and Voice.....	1441
2 Discipline G – Electrical	1442
2 Discipline H - Electronic.....	1483
2 Discipline I - Instrument.....	1490
2 Discipline J - Refrigeration and Air Conditioning.....	1495
2 Discipline K - Renewable and Sustainable.....	1632
2 Discipline L - Imported units - EKAS for this discipline are yet to be classified.	1632
2 Discipline M – Hazardous	1633
2 Discipline N – Rail.....	1633
2 Discipline P - Restricted.....	1633
2 Discipline R - Research.....	1645
Appendix 1 - Unit to Essential Knowledge and Associated Skills Relationship	1645
Appendix 2 - Essential Knowledge and Associated Skills to Unit Relationship	1811
2 Preliminary Information and Glossaries	1862
2.3.1 Reading, Writing and Numeracy.....	1903

Modification History

Please refer to Preliminary Information

Preliminary Information

Preliminary Information

Important Note to Users

Training packages are not static documents; they are amended periodically to reflect the latest industry practices and are version controlled. It is essential that the latest version is always used.

Check the version number before commencing training or assessment.

This Training Package is Version 4 – check whether this is the latest version by going to the National Training Information Service (www.ntis.gov.au) and locating information about the Training Package. Alternatively, contact the ElectroComms and EnergyUtilities Industry Skills Council Ltd. trading as EE-Oz Training Standards <http://www.ee-oz.com.au/> to confirm the latest version number.

Explanation of version number conventions

The primary release Training Package is Version 1. When changes are made to a Training Package, sometimes the version number is changed and sometimes it is not, depending on the extent of the change. When a Training Package is reviewed, it is considered to be a new Training Package for the purposes of version control, and is Version 1. Do not confuse the version number with the training package's national code (which remains the same during its period of endorsement).

Version modification history

The version details of this endorsed Training Package are in the table below. The latest information is at the top of the table.

Version	Release Date	Authorisation	Comments
4		NQC	New Qualifications Embedding of Sustainability Skills units into the core of the following qualifications: Modification of the following qualifications to comply with NQC Packaging Rules. Incorporation of Engineers Australia requirements for accreditation under

Version	Release Date	Authorisation	Comments
			the Dublin Accord New Qualifications UEE20110; UEE32110; UEE32210; UEE42710; UEE42810; UEE42910; UEE51110; UEE51210; UEE62210; UEE62310; UEE62410; UEE62510 Deleted Qualifications UEE20107; UEE21810; UEE30510; UEE31307; UEE41310; UEE42310; UEE42510; UEE50610; UEE60110; UEE60710; UEE61910 New Units Cross Discipline Units Amended Units UEENEEE011C New Units UEENEEE080A; UEENEEE081A; UEENEEE082A; UEENEEE083A; UEENEEE101A; UEENEEE102A; UEENEEE104A; UEENEEE105A; UEENEEE107A; UEENEEE125A; UEENEEE126A; UEENEEE137A; Electrical Units New Units UEENEEG006A; UEENEEG033A; UEENEEG063A; UEENEEG076A; UEENEEG101A; UEENEEG102A; UEENEEG103A; UEENEEG104A; UEENEEG105A; UEENEEG106A; UEENEEG107A; UEENEEG108A; UEENEEG109A; UEENEEG149A; UEENEEG171A; Electronic and Communications Units New Units

Version	Release Date	Authorisation	Comments
			UEENEEH091A; UEENEEH092A Instrumentation Units New Units UEENEEI038A; UEENEEI040A; UEENEEI041A; UEENEEI042A; UEENEEI043A; UEENEEI044A; Refrigeration and Air Conditioning Units New Units UEENEEJ102A; UEENEEJ103A; UEENEEJ104A; UEENEEJ105A; UEENEEJ106A; UEENEEJ107A; UEENEEJ108A; UEENEEJ109A; UEENEEJ110A; UEENEEJ111A; UEENEEJ112A; UEENEEJ113A; UEENEEJ114A; UEENEEJ115A; UEENEEJ116A; UEENEEJ117A; UEENEEJ118A; UEENEEJ119A; UEENEEJ121A; UEENEEJ122A; UEENEEJ123A; UEENEEJ124A; UEENEEJ125A; UEENEEJ126A; UEENEEJ127A; UEENEEJ128A; UEENEEJ129A; UEENEEJ130A; UEENEEJ131A; UEENEEJ132A; UEENEEJ133A; UEENEEJ134A; UEENEEJ135A; UEENEEJ136A; UEENEEJ137A; UEENEEJ138A; UEENEEJ139A; UEENEEJ141A; UEENEEJ142A; UEENEEJ143A; UEENEEJ144A; UEENEEJ145A; UEENEEJ146A; UEENEEJ147A; UEENEEJ148A; UEENEEJ149A; UEENEEJ150A; UEENEEJ151A; UEENEEJ153A; UEENEEJ154A; UEENEEJ155A; UEENEEJ156A; UEENEEJ157A; UEENEEJ158A; UEENEEJ159A; UEENEEJ161A; UEENEEJ162A; UEENEEJ164A; UEENEEJ165A; UEENEEJ166A; UEENEEJ167A; UEENEEJ168A; UEENEEJ170A; UEENEEJ171A; UEENEEJ172A; UEENEEJ173A; UEENEEJ174A; UEENEEJ175A;

Version	Release Date	Authorisation	Comments
			UEENEEJ176A; UEENEEJ177A; UEENEEJ178A; UEENEEJ179A; UEENEEJ180A; UEENEEJ181A; UEENEEJ182A; UEENEEJ183A; UEENEEJ184A; UEENEEJ185A; UEENEEJ186A; UEENEEJ187A; UEENEEJ188A; UEENEEJ189A; UEENEEJ190A; UEENEEJ191A; UEENEEJ192A; UEENEEJ193A; UEENEEJ194A; UEENEEJ195A; UEENEEJ196A; Deleted Units UEENEEJ012B; UEENEEJ014B; UEENEEJ016B; UEENEEJ017B; UEENEEJ022B; UEENEEJ023B; UEENEEJ024B; UEENEEJ025B; UEENEEJ026B; UEENEEJ027B; UEENEEJ028B; UEENEEJ029B; UEENEEJ030B; UEENEEJ031B; UEENEEJ032B; UEENEEJ033B; UEENEEJ034B; UEENEEJ035B; UEENEEJ036B; UEENEEJ037B; UEENEEJ038B; UEENEEJ039B; UEENEEJ041B; UEENEEJ042B; UEENEEJ043B; UEENEEJ044B; UEENEEJ045B; UEENEEJ046B; UEENEEJ047B; UEENEEJ048B; UEENEEJ049B; UEENEEJ050B; UEENEEJ051B; UEENEEJ052B; UEENEEJ054B; UEENEEJ055B; UEENEEJ056B; UEENEEJ057B; UEENEEJ058B; UEENEEJ059B; UEENEEJ061B; UEENEEJ062B; UEENEEJ063B; UEENEEJ064B; UEENEEJ065B; UEENEEJ066B; UEENEEJ068B; UEENEEJ071B; UEENEEJ073B; UEENEEJ074A; UEENEEJ075A; UEENEEJ076B; UEENEEJ077A; UEENEEJ078A; UEENEEJ079A; UEENEEJ080A; UEENEEJ081A; UEENEEJ082A; UEENEEJ083A; UEENEEJ084A; UEENEEJ085A; UEENEEJ086A; UEENEEJ087A; UEENEEJ088A;

Version	Release Date	Authorisation	Comments
			UEENEEJ089A; UEENEEJ090A; UEENEEJ091A; Restricted Electrical Units New Units UEENEED012A; UEENEED017A; UEENEED024A; UEENEED025A; Deleted Units UEENEED009B Rail Signalling New Units UEENEEN021A Deleted Imported Units Rationalisation of Rail Signalling units from TLI07 TLIB5007B; TLIB5107B; TLIB5207B; TLIB5407B; TLIB5507B; TLIB5607B; TLIB5707B; TLIB5907B; TLIB6207B; TLIB6307B; TLIB6407B; TLIB6507B; TLIB6607B; TLIB6707B; TLIB6807B; TLIB6907B; TLIS1007B; TLIS1107B; TLIS707B Addition of the following Imported Units RIIRA1609A; RIIRIS601A; RIIOHS202A; RIIOHS205A; RIIOHS204A; CPCOHS10001A; HLTCPR201A; HLTF301A; TLILIC508A ; TLID3507C; PRMPFES43A; MEM16006A; MEM16008A; MEM30001A; MEM30002A; MEM30003A; MEM30004A; MEM05012C; MEM05007C; Update of Existing Imported units

Version	Release Date	Authorisation	Comments
			BSBWOR502B; BSBMGT516C BSBSMB405A; ICTTEN3056A; ICTTEN5083A; ICTTEN4085A; ICTTEN4081A; ICTTEN3089A;
3.1 UEE07	4 August 2010	EE-Oz ISC Upgrade Authorised by NQC to meet Packaging Rule requirements and the inclusion of Sustainability Skills in qualifications.	Modification of the following qualifications to comply with NQC Packaging Rules. UEE10110 Certificate I in Electrotechnology UEE20510 Certificate II in Computer Assembly and Repair UEE21310 Certificate II in Remote Area Essential Service UEE21610 Certificate II in Security Assembly and Setup UEE21710 Certificate II in Technical Support UEE21910 Certificate II in Electronics UEE22010 Certificate II in Electrotechnology (Career Start) UEE30210 Certificate III in Computer Systems Equipment UEE30310 Certificate III in Custom Electronics Installations UEE30910 Certificate III in Electronics and Communications UEE40110 Certificate IV in Computer Systems UEE40710 Certificate IV in Electronics and Communications UEE41510 Certificate IV in Video and Audio Systems UEE50110 Diploma of Computer Systems Engineering UEE50510 Diploma of Electronics

Version	Release Date	Authorisation	Comments
			and Communications Engineering UEE60210 Advanced Diploma of Electronics and Communications Engineering UEE60410 Advanced Diploma of Computer Systems Engineering Modifications to qualification to meet NQC requirements include: • Stream Core requirement deleted from the above qualifications and stream core units included in core or elective to maintain qualification integrity. • Inclusion of provision for importation of up to one sixth of total qualification points from other qualifications, other Training Packages and accredited courses. • Inclusion of one third of total qualification points as elective. • Creation of an imported and common units group for each qualification. • Creation of elective groups with specific qualification electives for each qualification. • Application of a revised points weighting system for both core and elective units in each qualification. Embedding of Sustainability Skills units into the core of the following qualifications: UEE10110; UEE20510; UEE21310;

Version	Release Date	Authorisation	Comments
			UEE21610; UEE21710; UEE21910 UEE22010; UEE30210; UEE30310 UEE30910; UEE40110; UEE40710; UEE41510; UEE50110; UEE50510; UEE60210; UEE60410 Addition of the following Imported Units ICTTEN2207A Install and configure a home or small office network ICTTEN2208A Install and configure a small to medium business network ICTTEN2209A Build and maintain a secure network ICTTEN4210A Implement and troubleshoot enterprise routers and switches ICTTEN4211A Design, install and configure an internetwork ICTTEN4212A Apply advanced routing protocols to network design ICTTEN4213A Configure and troubleshoot advanced network switching ICTTEN4214A Install and maintain a wide area network
3 UEE07	11 June 2010	NQC	This review includes amendments to the UEE07 Electrotechnology Training Package as follows: 1. Amendments to competency standard units: UEENEEE019C, UEENEEE024C, UEENEEE048C, UEENEEH072C, UEENEEI007C, UEENEEI008C, UEENEEG072C (refer Vol 2, Part 2.1. and Table 2, Vol 2, Part 2), encompassing amendments to: a) Application of unit

Version	Release Date	Authorisation	Comments
			b) essential knowledge and skills clauses within the Cross Discipline (E) units c) Concurrent assessment and relationship with other units 2. Due to the requirement for amendments to a) Prerequisites (and, consequently Prerequisite chains) b) Application of the unit c) essential knowledge and skills clauses d) correction to wording in range statement. 3. Hazardous Areas Units -Deletion of the following competency standard units due to amendments in the endorsed titles UEENEEM001B; UEENEEM002B, UEENEEM003B, UEENEEM004B, UEENEEM005B, UEENEEM006B, UEENEEM007B, UEENEEM008B, UEENEEM009B, UEENEEM010B, UEENEEM011B, UEENEEM012B, UEENEEM013B, UEENEEM014B, UEENEEM015B, UEENEEM016B, UEENEEM017B, UEENEEM018B The deleted competency standard units have been replaced with the following new competency standard units for Hazardous Areas (refer Vol 1, Part 1 and Vol 2, Part 2.1M); namely; UEENEEM019A, UEENEEM020A, UEENEEM021A, UEENEEM022A, UEENEEM023A, UEENEEM024A, UEENEEM025A, UEENEEM026A, UEENEEM027A, UEENEEM028A, UEENEEM029A, UEENEEM030A,

Version	Release Date	Authorisation	Comments
			UEENEEM031A, UEENEEM032A, UEENEEM033A, UEENEEM034A, UEENEEM035A, UEENEEM036A, UEENEEM037A, UEENEEM038A, UEENEEM039A, UEENEEM040A, UEENEEM041A, UEENEEM042A, UEENEEM043A, UEENEEM044A, UEENEEM045A, UEENEEM046A, UEENEEM047A, UEENEEM048A, UEENEEM049A, UEENEEM050A, UEENEEM052A, UEENEEM053A, UEENEEM054A, UEENEEM055A, UEENEEM056A, UEENEEM057A, UEENEEM058A, UEENEEM059A, UEENEEM060A, UEENEEM061A, UEENEEM062A, UEENEEM063A, UEENEEM064A, UEENEEM065A, UEENEEM066A, UEENEEM067A, UEENEEM068A, UEENEEM069A, UEENEEM070A, UEENEEM071A, UEENEEM072A, UEENEEM073A, UEENEEM074A, UEENEEM075A, UEENEEM076A, UEENEEM077A, UEENEEM078A, UEENEEM079A, UEENEEM080A These units provide coverage of endorsements in the unit titles .e.g. coal mining. These contained re-numbered Hazardous Areas essential knowledge and skills clauses 4. Refrigeration and Air Conditioning Units Deletion of one unit UEENEEJ060B. Replaced by new unit UEENEEJ089A Addition of seventeen (17) new competency standard units for Refrigeration and Air Conditioning (refer Vol 1, Part 1 and Vol 2, Part 2.1); namely; UEENEEJ074A; UEENEEJ075A, UEENEEJ076A; UEENEEJ077A, UEENEEJ078A; UEENEEJ079A, UEENEEJ080A; UEENEEJ081A,

Version	Release Date	Authorisation	Comments
			UEENEEJ082A; UEENEEJ083A, UEENEEJ084A; UEENEEJ085A, UEENEEJ086A; UEENEEJ087A, UEENEEJ088A; UEENEEJ090A; UEENEEJ091A, 5. Remote Areas and Renewable Energy Units Deletion of three (3) units: UEENEEK015B, UEENEEK024B, UEENEEK041B Replaced by Units: UEENEEK049A, UEENEEK050A, UEENEEK051A, Addition of two (2) new competency standard unit for Renewable and Sustainable Energy areas (refer Vol 1, Part 1 and Vol 2, Part 2.1); namely; UEENEEK016A; UEENEEK047A, Deletion of two (2) competency standard units for Renewable and Sustainable Energy Areas; namely; UEENEEK018B and UEENEEK019B – imported units for the Water Industry Training Package will cover the deleted units. (refer Vol 1, Part 1 and Vol 2, Part 2.1K) 6. Electrical Units Deletion of three (3) units: UEENEEE040B, UEENEEF001B, UEENEEG014B, These units have been replaced by the new units: UEENEEE079A, UEENEEF016A, UEENEEG075A,

Version	Release Date	Authorisation	Comments
			(refer Vol 2, Part 2.1. and Table 2, Vol 2, Part 2). 7. Instrumentation and Industrial Control Units Addition of one (1) new competency standard unit for Instrumentation and Industrial Control areas: UEENEEE084A; (refer Vol 1, Part 1 and Vol 2, Part 2.1) 8. Electronic and Communications Units Addition of one (1) new competency standard unit for Electronics and Communications areas: UEENEEH090A. 9. Hazardous Area qualifications Amendments to Hazardous Area qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and Prerequisites comprising the qualifications. The qualifications affected include: Revised Qualifications - • UEE31710; UEE31810; UEE31910; UEE61210 Deleted Qualifications

Version	Release Date	Authorisation	Comments
			• UEE41807 New Qualifications • UEE42410, UEE42610, UEE61410 10. Refrigeration and Air conditioning qualifications Amendments to Refrigeration and Air conditioning qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and Prerequisites comprising the qualifications. The qualifications affected include Revised Qualifications UEE21810, UEE30510, UEE40510, UEE41310, UEE50310, UEE50610, UEE60710, Deleted Qualifications UEE41407, UEE60807, New Qualifications UEE42310, UEE42510, UEE61910, 11 Industrial Instrumentation and Control qualifications Amendments to Industrial Instrumentation and Control qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and Prerequisites comprising the qualifications. The qualifications affected include:

Version	Release Date	Authorisation	Comments
			Revised Qualifications UEE31210, UEE40410, UEE40910, UEE50210, UEE50910, UEE60610, New Qualifications UEE42210, UEE51010, UEE61510, 12. Electronics, Communications and Computer Systems qualifications Amendments to Electronics, Communications and Computer Systems qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and Prerequisites comprising the qualifications. The qualifications affected include: Revised Qualifications UEE30310, UEE30910, UEE40110, UEE40710, UEE41510, UEE50110, UEE50510, UEE60210, UEE60410, Deleted Qualifications UEE60307, UEE60507, New Qualifications UEE61710, UEE61810, 13. Remote Areas and Renewable Energy qualifications Amendments to Renewable Energy qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and Prerequisites comprising the qualifications.

Version	Release Date	Authorisation	Comments
			The qualifications affected include: Revised Qualifications UEE21310, UEE21510, UEE32010, UEE41610, UEE41010, UEE41910, UEE42010, UEE50710, UEE60910, Deleted Qualifications UEE61007, New Qualifications UEE62010, 14. Electrical qualifications Amendments to Electrical qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and Prerequisites comprising the qualifications. The qualifications affected include: Revised Qualifications UEE10110, UEE21610, UEE22010, UEE31410, UEE40210, UEE40310, UEE40610, UEE40810, UEE41110, , UEE50410, UEE50810, UEE60110, UEE61110, Deleted Qualifications UEE61307 New Qualifications UEE20810, UEE42110, UEE62110 15. Rail Signalling qualifications Amendments to Electrical qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and

Version	Release Date	Authorisation	Comments
			Prerequisites comprising the qualifications. The qualifications affected include: UEE41710, UEE41210 16. All Qualifications – All pre-requisite competencies required to complete core competencies are explicitly included in core of the relevant qualification. 17. The following Imported Units have been added to UEE07 Version 3. NWP209B ; NWP218B ; NWP226B ; NWP227B ; NWP229B ; NWP243B ; NWP245B ; NWP247A ; NWP253B ; NWP255B ; NWP256B ; NWP257B ; NWP259B ; NWP260A ; NWP261A; NWP262A ; NWP263A; NWP268B ; TLIB3407B; TLIB4007B; TLIB4807B; TLIB5007B; TLIB5107B; TLIB5207B; TLIB5307B; TLIB5407B; TLIB5507B; TLIB5607B; TLIB5707B; TLIB5807B; TLIB5907B; TLIB6207B; TLIB6307B; TLIB6407B; TLIB6507B; TLIB6607B; TLIB6707B; TLIB6807B; TLIB6907B; TLIS507B; TLIS707B; TLIS1007B; TLIS1107B; TLIS807B; TLIS907B; TLIX1107B; TLIX1607B; 18. The following imported units have been undated to the latest version from the parent Training Package. BSBSMB405A; BSBINM501A; BSBINM502A; BSBMGT502B;

Version	Release Date	Authorisation	Comments
			ICTTC056D; ICTTC083D; ICTTC085D; ICTTC088D; ICTTC089D; UETTDRI04B; MSACMS200A; MSACMT220A MSACMT221A; MSACMT240A MSACMT280A; MSACMT281A Inclusion of Skill Sets for Energy Efficiency as follows: • Energy Efficiency Auditor • Identify of Energy Efficiency Strategies • Energy Efficiency Systems Developer • Energy Efficiency Systems Designer • Energy Efficiency Systems Integration Inclusion of existing units in Electives Schedules: Added to Schedule 3 Electives: UEENE002B Schedule 3 Strand 2 UEENE003B Schedule 3 Strand 1
2 UEE07	12 August 2009	NQC	This review includes amendments to the UEE07 Electrotechnology Training Package as follows: Qualifications One new qualification UEE42010 Certificate IV in Electrical – Photovoltaic Systems Units in UEE42010 Certificate IV in Electrical – Photovoltaic Systems include: New Unit UEENEK048A Install, configure and commission grid connected photovoltaic power systems This unit was developed to address the requirements for commercial and

Version	Release Date	Authorisation	Comments
			domestic installations to meet the provisions of new Australian Government Renewable Energy initiatives and the requirements for Clean Energy Council accreditation for installers and/or designers of grid connected solar systems. Modified units UEENEEK025C Solve basic problems in photovoltaic energy apparatus UEENEEK035C Design grid connected power supply systems These units have been modified to address the requirements for commercial and domestic installations to meet the provisions of new Australian Government Renewable Energy initiatives and the requirements for Clean Energy Council accreditation for installers and/or designers of grid connected solar systems. UEENEEG071C Install and setup interval metering Skills Sets Post Trade Skill Sets have been identified for: • Installer of grid connected photovoltaic systems • Designer of grid connected photovoltaic systems • Designer and Installer of grid connected photovoltaic systems These Skill Sets have been designed to meet or exceed the requirements of the Clean Energy Council accreditation for Installer and/or designer of grid connected solar systems

Version	Release Date	Authorisation	Comments
1 UEE07	8 March 2008	NQC	This review includes amendments to the UEE07 Electrotechnology Training Package as follows: 1. Amendments to Electronics and Computer Systems AQF 2 to 6 competency standard units with special emphasis on AQF 5 and 6 (refer Vol 2, Part 2.1H. Vol 2, Part 2.1D and Table 2, Vol 2, Part 2), encompassing amendments to: a) unit structures b) Prerequisites (and, consequently Prerequisite chains) c) essential knowledge and skills clauses within the Electronics (H) and Computer Systems (D) discipline units 2. Amendments to Electronics and Computer systems qualifications (refer Vol 1, Part 1 and Table 1, Vol, Part 1), encompassing: • qualification structures • amendments stemming from changes made to units and Prerequisites comprising the qualifications. The qualifications affected include: • UEE20507 Certificate II in Computer Assembly and Repair • UEE20907 Certificate II in Electronic Assembly • UEE21907 Certificate II in Electronics • UEE30207 Certificate III in Computer Systems Equipment • UEE30307 Certificate III in Custom Electronics Installations • UEE30507 Certificate III in Appliance Servicing • UEE30907 Certificate III in Electronics and Communications

Version	Release Date	Authorisation	Comments
			• UEE31107 Certificate III in Gaming Electronics • UEE40107 Certificate IV in Computer Systems • UEE40707 Certificate IV in Electronics and Communications • UEE50907 Diploma of Industrial Electronics and Control Engineering • UEE60307 Advanced Diploma of Electronic – Technology • UEE60407 Advanced Diploma of Computer Systems Engineering • UEE60507 Advanced Diploma of Computer Systems – Technology • UEE60607 Advanced Diploma of Industrial Electronics and Control Engineering 3. Amendment of unit Prerequisites (refer Table 2, Vol 1, Part 2 and all Vol 2, Part 2.1) 4. Amendment of the Regulatory/ Context of Assessment section in the Assessment Guidelines (refer Vol 1, Part 3) and the ‘Critical Aspects of Evidence’ section in each unit to better reflect jurisdictional regulatory requirements. 5. Addition of two (2) new qualifications and related competency standard units for Renewable Energy (refer Vol 1, Part 1 and Vol 2, Part 2.1K); namely; • UEE32007 Certificate III in Renewable Energy – ELV • UEE41907 Certificate IV in Electrical – Renewable Energy 6. Removal of ‘UEENEEK025A Solve basic problems in photovoltaic energy apparatus’ from core of UEE21507

Version	Release Date	Authorisation	Comments
			Certificate II in Renewable Energy (refer Vol 1, Part 1) 7. Inclusion of competency standard unit 'UEENEEK042A Participate in environmentally sustainable work practices' in the Stream Core of all Certificate II and Certificate III qualifications (refer Vol 1, Part 1) 8. Inclusion of competency standard unit 'UEENEEK045A Implement & monitor, policies & procedures for environmentally sustainable electrotech work practice' in the Stream Core of all Certificate IV qualifications (refer Vol 1, Part 1) 9. Inclusion of four new competency standard units for Renewable Energy and Sustainable Energy: UEENEEK042A; UEENEEK043A, UEENEEK045A, UEENEEK046A 10. Amendment of EKAS alignments in competency standard unit 'UEENEEP001B Disconnect and reconnect fixed wired electrical equipment connected to a Low Voltage supply' (Refer Vol 2, Part 2.1P) 11. Importation of Competitive Manufacturing units: MCMS200A; MCMT220A; MCMT221A; MCMT240A; MCMT280A; MCMT281A (Refer Table 4, Vol 1, Part 2 for list of imported units & Vol 2, Part 2.1L for units) 12. Incorporation of revised Mandatory text to ensure compliance with the November 2006 version of the Training Package Development Handbook (Refer all mandatory text sections

Version	Release Date	Authorisation	Comments
			in both Volumes) 13. Revision of Unit Structures to ensure compliance with the November 2006 version of the Training Package Development Handbook (refer Vol 2, Part 2.1), including: • Removal of all spaces within unit codes • Addition of '1.1 Descriptor' as a new title • Relocation of '3.1 License to practise' to position 1.2 • Relocation of the sub-heading '2.1 Competencies' from the left hand column to the right hand column • Relocation of the sub-heading '2.2 Literacy and Numeracy skills' from the left hand column to the right hand column • Inclusion of the statement <i>"For the full prerequisite chain details for this unit please refer to Table 2 in Volume 1, Part 2"</i> in 2.1 Competencies • Removal of all guidance text from 2) Prerequisite Unit(s), with the exception of the 'M' Hazardous Areas units • Inclusion of '3) Employability Skills' and the statement <i>"The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements."</i> as a whole new

Version	Release Date	Authorisation	Comments
			section • Revision of the numbering of all subsequent sections to accommodate the inclusion of the Employability Skills section at 3) • Inclusion of the statement "<i>All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies</i>" as a new paragraph in '7) Required Skills and Knowledge' • Changing of the number '7' in paragraph "<i>Solve problems in complex polyphase power circuits as described in 7) and including:</i>" in section 9.2 of the unit to 8. • Complete removal of the 'Key Competencies' and 'Skills Enabling Employment' sections. 14. Inclusion in of Employability Skills statement tables for all Qualifications (refer Volume 1, Part 1) 15. Inclusion of full Prerequisite chain details for each unit (refer Table 2, Volume 1, Part 2). 16. Technical and 'Plain English' edit of entire Training Package including minor editorial amendments across Training Package to correct spelling, grammatical and typographical errors. 17. Amendment of all publishing-related information to UEE07, including; title pages, headers, footers, copyright statements, Training Package,

Version	Release Date	Authorisation	Comments
			qualification codes. 18. Amendment of all unit codes to 'UEENEE---B'. This is with the exception of the new units listed above, which have been coded 'UEENEE---A'. 19. Removal of the following text from units UEENEEM002B, UEENEEM004B, UEENEEM006B, UEENEEM007B, UEENEEM008B, UEENEEM009B, UEENEEM010B, UEENEEM011B, UEENEEM012B, UEENEEM014B, UEENEEM016B, UEENEEM017B, "The endorsement(s) for each explosion-protection technique is designated with an [Ex] as a suffix to the unit title". 20. Removal of the definition of 'pre-requisite' from Volume 1, Part 1, page 63. 21. Revision of text within the following sections to ensure currency and accuracy: • Volume 1, Preliminary Information, Industry Coverage, Page 17. • Volume 1, Part 1, Page 4. • Volume 1, Part 1, Pages 42. • Volume 1, Part 2, Page 236. • Volume 1, Part 3, Appendix A. • Volume 1, Part 3, Guide to Assessment Methods Table. • Volume 1, Part 1, Qualifications Framework, Schedule of Electives. • Replacement of all references to 'Skills Clusters' with 'Skills

Version	Release Date	Authorisation	Comments
			Sets Replacement of all references to 'prerequisites' with 'pre-requisites' 22. Improved consistency of Volume 1, Part 3, Assessment Guidelines with Units via replacing 'be consistent with the approved industry simulation policy' with 'be in accordance with industry and regulatory policy'. 23. Inclusion of 'Schedule 6' in the Elective Statement of the Packaging rules for UEE60207 Advanced Diploma of Electronics and Communications Engineering and UEE60407 Advanced Diploma of Computer Systems Engineering.

Explanation of the review date

The review date (shown on the title page and in the footer of each page) indicates when the Training Package is expected to be reviewed in the light of changes such as changing technologies and circumstances. The review date is not an expiry date. Endorsed Training Packages and their components remain current until they are reviewed or replaced.

Overview

Overview

What is a Training Package?

A Training Package is an integrated set of nationally endorsed competency standards, assessment guidelines and Australian Qualifications Framework (AQF) qualifications for a specific industry, industry sector or enterprise.

Each Training Package:

- provides a consistent and reliable set of components for training, recognising and assessing people's skills, and may also have optional support materials
- enables nationally recognised qualifications to be awarded through direct assessment of workplace competencies
- encourages the development and delivery of flexible training which suits individual and industry requirements
- encourages learning and assessment in a work-related environment which leads to verifiable workplace outcomes.

How do Training Packages fit within the National Skills Framework?

The National Skills Framework applies nationally, is endorsed by the Ministerial Council for Vocational and Technical Education, and comprises the Australian Quality Training Framework 2010 (AQTF 2010), and Training Packages endorsed by the National Quality Council (NQC).

How are Training Packages developed?

Training Packages are developed by Industry Skills Councils or enterprises to meet the identified training needs of specific industries or industry sectors. To gain national endorsement of Training Packages, developers must provide evidence of extensive research, consultation and support within the industry area or enterprise.

How do Training Packages encourage flexibility?

Training Packages describe the skills and knowledge needed to perform effectively in the workplace without prescribing how people should be trained.

Training Packages acknowledge that people can achieve vocational competency in many ways by emphasising what the learner can do, not how or where they learned to do it. For example, some experienced workers might be able to demonstrate competency against the units of competency, and even gain a qualification, without completing a formal training program.

With Training Packages, assessment and training may be conducted at the workplace, off-the-job, at a training organisation, during regular work, or through work experience, work placement, work simulation or any combination of these.

Who can deliver and assess using Training Packages?

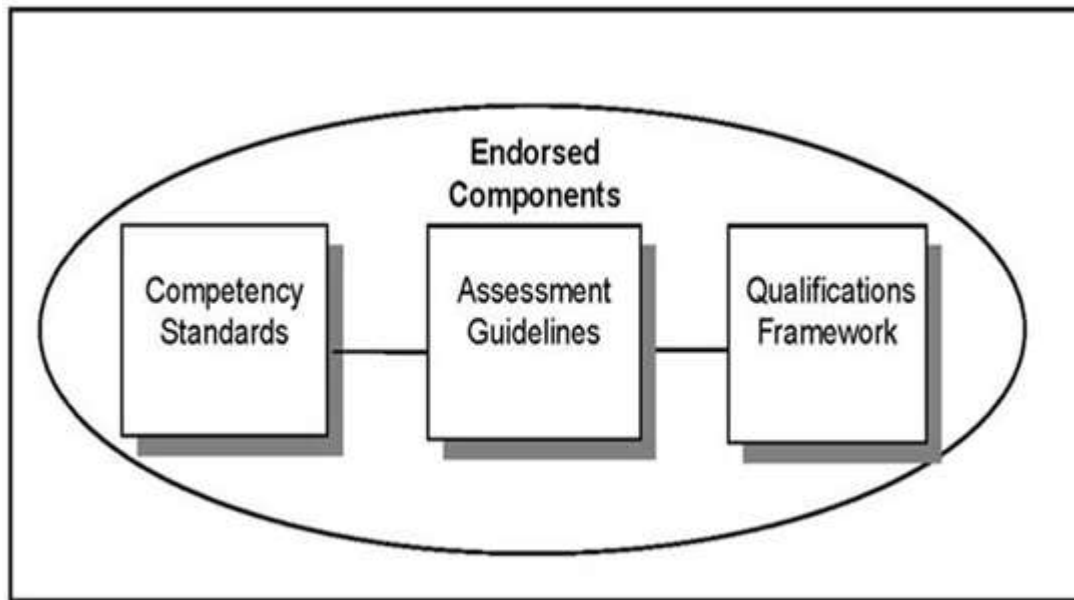
Training and assessment using Training Packages must be conducted by a Registered Training Organisation (RTO) that has the qualifications or specific units of competency on its scope of registration, or that works in partnership with another RTO, as specified in the AQTF 2010.

Training Package Components

Training Packages are made up of mandatory components endorsed by the NQC, and optional support materials.

Training Package Endorsed Components

The nationally endorsed components include the Competency Standards, Assessment Guidelines and Qualifications Framework. These form the basis of training and assessment in the Training Package and, as such, they must be used.



Competency Standards

Each unit of competency identifies a discrete workplace requirement and includes the knowledge and skills that underpin competency as well as language, literacy and numeracy; and occupational health and safety requirements. The units of competency must be adhered to in training and assessment to ensure consistency of outcomes.

Assessment Guidelines

The Assessment Guidelines provide an industry framework to ensure all assessments meet industry needs and nationally agreed standards as expressed in the Training Package and the AQTF 2010. The Assessment Guidelines must be followed to ensure the integrity of assessment leading to nationally recognised qualifications.

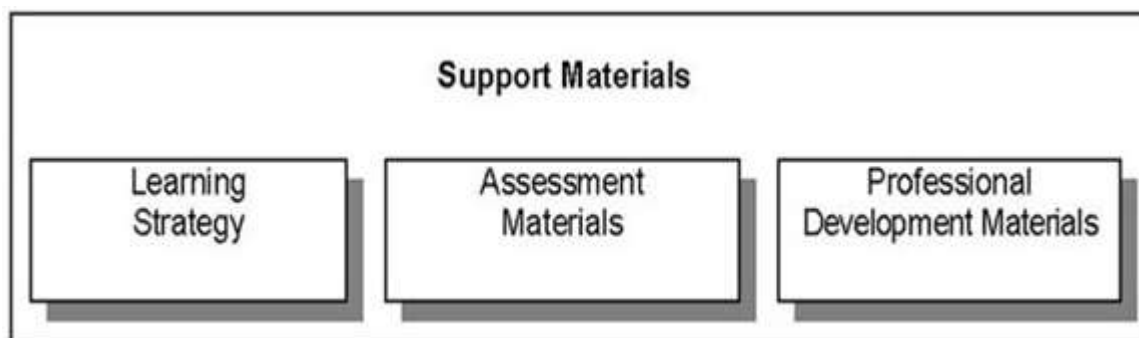
Qualifications Framework

Each Training Package provides details of those units of competency that must be achieved to award AQF qualifications. The rules around which units of competency can be combined to make up a valid AQF qualification in the Training Package are referred to as the 'packaging rules'. The packaging rules must be followed to ensure the integrity of nationally recognised qualifications issued.

Training Package Support Materials

The endorsed components of Training Packages are complemented and supported by optional support materials that provide for choice in the design of training and assessment to meet the needs of industry and learners.

Training Package support materials can relate to single or multiple units of competency, an industry sector, a qualification or the whole Training Package. They tend to fall into one or more of the categories illustrated below.



Training Package support materials are produced by a range of stakeholders such as RTOs, individual trainers and assessors, private and commercial developers and Government agencies.

Training Package, Qualification and Unit of Competency Codes

There are agreed conventions for the national codes used for Training Packages and their components. Always use the correct codes, exactly as they appear in the Training Package, **and with the code always before the title.**

Training Package Codes

Each Training Package has a unique five-character national code assigned when the Training Package is endorsed, for example XYZ08. The first three characters are letters identifying the Training Package industry coverage and the last two characters are numbers identifying the year of endorsement.

Qualification Codes

Within each Training Package, each qualification has a unique eight-character code, for example UEE30107.

- the first three letters identify the Training Package
- the first number identifies the qualification level
- the next two numbers identify the position in the sequence of the qualification at that level. That is, in the case of UEE30107, it is the first AQF 3 qualification in the Training Package Note that this due to deletions and revisions this sequence may not always be complete.
- the last two numbers identify the year in which the qualification was endorsed. Where qualifications are added after the initial Training Package endorsement, the last two numbers may differ from the other Training Package qualifications as they identify the year in which those particular qualifications were endorsed.

Unit of Competency Codes

Within each Training Package, each unit of competency has a unique code. Unit of competency codes are assigned when the Training Package is endorsed, or when new units of competency are added to an existing endorsed Training Package. Unit codes are developed as follows:

- a typical code is made up of 12 characters, normally a mixture of uppercase letters and numbers, as in UEENEEH024A
- the first three characters signify the Training Package – UEE07 Electrotechnology Training Package – in the above example and up to eight characters, relating to an industry sector, function or skill area, follow;
- the last character is always a letter and identifies the unit of competency version. An ‘A’ at the end of the code indicates that this is the original unit of competency. ‘B’, or another incremented version identifier means that minor changes have been made. Typically this would mean that wording has changed in the range statement or evidence guide, providing clearer intent; and
- where changes are made that alter the outcome, a new code is assigned and the title is changed.
- In this Training Package the following approach has been adopted:

Unit Number										
U	E	E	N	E	E	H	0	2	4	A
Industry - EE-Oz Training Standards identifier			Training Package identifier			Discipline ←letters→	Unit Numbers 001 to 999			Version
12 Characters Maximum										

Training Package, Qualification and Unit of Competency Titles

There are agreed conventions for titling Training Packages and their components. Always use the correct titles, exactly as they appear in the Training Package, and with the code always placed before the title.

Training Package Titles

The title of each endorsed Training Package is unique and relates the Training Packages broad industry coverage.

Qualification Titles

The title of each endorsed Training Package qualification is unique. Qualification titles use the following sequence:

- first, the qualification is identified as either Certificate I, Certificate II, Certificate III, Certificate IV, Diploma, Advanced Diploma, Vocational Graduate Certificate, or Vocational Graduate Diploma;
- this is followed by the words ‘in’ for Certificates I to IV, and ‘of’ for Diploma, Advanced Diploma, Vocational Graduate Certificate and Vocational Graduate Diploma;
- then, the industry descriptor, for example Telecommunications; and
- then, if applicable, the occupational or functional stream in brackets, for example (Computer Systems).

For example:

UEE22110 Certificate II in Electrotechnology (Career Start).

Unit of Competency Titles

Each unit of competency title is unique. Unit of competency titles describe the competency outcome concisely, and are written in sentence case.

For example:

- UEENEEA002B Select electronic components
- UEENEEE007B Use drawings, diagrams, schedules and manuals

The Electrotechnology Industry

The Electrotechnology Industry

The rate of technological change within the Electrotechnology industry has never been greater and is expected to increase. For example, the use of 'smart' technology such as home automation and the integration of systems, including voice and data, is now commonplace in many sectors of the industry. The industry continues to expand and develop and its personnel must develop increasingly sophisticated technical skills and problem solving abilities. Apprentices and skilled operatives are expected to build high levels of competency, flexibility and capabilities across a wide range of equipment, technologies, processes and procedures and be prepared for continuous development of their knowledge and skills throughout their working life.

Severe skills shortages currently affecting the Electrotechnology industry are projected to increase as the supply of skilled tradespersons in the industry continues to fall short of market demand and rapid growth in the volume of work continues to exceed the availability of skilled labour, particularly in areas incorporating advanced technologies.

The industry:

- employs approximately 600,000 people, including approximately 170,000 in communication; 142,000 in installation trade services; 100,000 in construction and building maintenance; 25,000 electrical and electronic engineers; and 163,000 computer professionals (repair and servicing)
- covers more than 80 Qualifications from Certificate I through to Advanced Diploma.

Current skill shortages at trade and post-trade technical levels are expected to worsen over the next five years, and are attributed to:

- insufficient numbers employed and in training (apprenticeships, traineeships, cadetships) to replenish the existing stock of employees retiring from the industry
- attrition from the ranks of skilled and experienced workers combined with an ageing work force
- economic and cyclical downturn
- a continued and rapid change in the breadth and skills sets required of post entry level training, caused by a rapidly changing technological environment, especially in; renewable energies, computer systems, medical, speed of new products to market, product lifecycles and equipment servicing; and voice and data communications

- a decline in post-trade training program attendances at RTOs (e.g. TAFE) to upgrade skill sets. At the same time, work is increasingly being transferred from traditional large industry in-house employment with structured career paths to contracted work/small business.
- strong growth in occupations such as computer hardware professional and support technicians, and
- a limited number of women in both traditional and growth occupations.

Within the Electrotechnology industry, the communications sector has grown by about 20 per cent since 1997. At present:

Communications employment is undergoing a major restructure due to the Telco's downsizing and contracting out of services.

A key feature of restructure is the entry of small, specialist companies i.e. existing electrical contractors expanding their scope of work to include communications work.

New communications networks/technologies are being developed based on wireless, microwave and satellite network systems.

New OHS and environmental legislative requirements have impacted on training and retraining needs across these industry sectors, for management, professional, paraprofessional, and operative technical workers, meaning:

Standards and training resources need to be developed and continually updated to meet technological cutting edge requirements and respond to changes such as local and regional expectations. This is also in the case of electronics-based training in regional areas where community numbers are generally declining leading to broader based skills being needed to attend to equipment/technologies that are ageing, broader in range, and new.

More dual trade programs/apprenticeships are needed to compensate for skill shortages, technological change and a shift to systems based solutions.

RTOs (e.g. TAFE) trends reveal that over the past four years enrolments at the associate professional level have dropped by more than 40 per cent.

Customer service and increased demand for new products driving the demand for new training.

Fewer workers are participating in post-trade training and more full-time students are undertaking paraprofessional programs (Diploma and Advanced Diploma) with these programs rarely matching the changing employment market/jobs.

Many existing workers, in related occupations, do not have access to nationally recognised training.

New regulatory and technical standards have led to improvements and changes being made to existing training standards, programs and resources.

Industry Coverage

The Industry of ElectroComms (Electrotechnology-Communications) covers electronics, electrical, communications, control systems, instrumentation, lifts, refrigeration and air conditioning, and renewable/sustainable energy, fire and security, appliances, gaming and rail.

The industry may also include some common technologies typically relevant to parts of telecommunications, data, and information technology and computing.

The Australian Standard Classifications of Occupation (ASCO) defines a number of occupations served by this Training Package.

The Electrotechnology group of skills does not coincide precisely with any of the Australian Bureau of Statistics (ABS) industries defined under the Australian and New Zealand Standard Industrial Classification (ANZSIC). There are several classes (4-digit ANZSIC) where the Electrotechnology skills predominate but there are also skilled Electrotechnology workers distributed across almost all industries. The number of electrical and electronic tradespersons (currently about 195,000) is forecast¹ to increase slightly to around 200,000 over the period to 2011-12. The other main occupational group covered is electrical and electronic associate professionals, with around 23,000 persons currently employed.

¹ Employment forecasts used in this document have been produced by Monash University Centre of Policy Studies

The industry sector that covers the largest group of electrical and electronic workers is the 'Installation trade services' (ANZSIC 423) group within the major industry division of construction. Additionally, a significant number of Electrotechnology workers are employed in the Telecommunications Industry.

Most vocations in this group have an entry level of skill commensurate with an AQF Certificate III or higher qualification. In some instances relevant experience is required in addition to a formal qualification. A large body of the skills and knowledge detailed in the competencies within this Training Package generally reside within the family of Electrotechnology vocations classified and grouped as occupations under ASCO (Australian Standards Classification of Occupation Code) by the Australian Bureau of Statistics (ABS).

Typical groups represented are as follows:

- 2125 Electrical and Electronics Engineers
- 2128-15 Electrical or Electronics Engineering Technologist
- 3123 Electrical Engineering Associate Professionals
- 3124 Electronic Engineering Associate Professionals
- 3294 Computing Support Technicians
- 4311 Electricians
- 4312 Refrigeration and Air-conditioning Mechanics
- 4313 Electrical Distribution Tradespersons
- 4314 Electronic Instrument Tradespersons
- 4315 Electronic and Office Equipment Tradespersons
- 4316 Communications Tradespersons
- 4992-17 Broadcast Transmitter Operator
- 9212 Product Assemblers
- 9918 Electrical and Telecommunications Trades Assistants

The skills and knowledge contained within the Electrotechnology Training Package competencies are diverse and cover many of the Australian and New Zealand Standard Industrial Classifications (ANZSIC). In particular it embraces the following ANZSIC divisions:

- B Mining

- C Manufacturing
- D Electricity, Gas and Water Supply
- E Construction
- J Communication Services

Also represented are the following specific ANZSIC codes:

- 3610 Electricity Supply
- 4122 Non Building Construction
- 4232 Electrical Services
- 4233 Air Conditioning and Heating Services
- 4234 Fire and Security Systems Services
- 4615 Electrical and Electronic Equipment Wholesaling
- 5261 Household Equipment Repair (Electrical)
- 7823 Consultant Engineering Services

The Electrotechnology Training Package describes the skills and knowledge relevant to many vocations within the broad field of Electrotechnology rather than those of a particular industry or sector of industry. The Training Package offers a range of qualifications set out in competency standard units. Workers achieve the qualification through appropriate training or by seeking formal recognition of existing skills and knowledge. The prime objective of the Electrotechnology Training Package is to establish the standards of performance in terms of skills and knowledge required for safe, productive and satisfying work covering a broad range of work activities.

It is recognised that other training pathways may exist.

RTOs can develop appropriate industry approved training programs to meet the objectives of this or other Training Packages. Organisations and personnel seeking formal recognition have a choice of Training Package and of provider/RTO. Australian Apprenticeships which apply choice in relation to funding to RTOs will be facilitated by policy enunciated by State and Territory Training Authorities.

Regulatory arrangements

The Electrotechnology Industry is subject to high levels of legislation, regulation, codes of practice, guidelines and advisory standards, related to: research, assembly, installation, construction, diagnoses, maintenance, commissioning, programming, testing and repair of networks; systems, circuits, equipment, components, appliances and facilities in the field of electricity and communications. The regulatory requirements are typically based on the principle of operation of wiring systems and associated circuits involving equipment, apparatus and systems, public safety, safety and health of individuals who work on lines/circuits, systems and apparatus/equipment and other codes and practices related to the environment in which they are installed, operate and are maintained.

Where possible, relevant and current regulatory requirements have been incorporated into this Training Package to assure outcomes are complementary to regulation. Where regulatory requirements are amended or introduced, such outcomes are to be incorporated in training and assessment programs. Continuous improvement and maintenance arrangements included in this Training Package are designed to keep pace with change.

Statutes, regulations and codes of practice

The Electrotechnology Industry is covered by Federal, State and Territory Electricity, Telecommunications, Occupational Health and Safety and Work Cover Acts and Regulations, as well as other statutes, regulations, industrial instruments, codes of practice, guidelines and advisory standards, Australian/New Zealand and International Standards.

Information relevant to the Electrotechnology Industry can be found on the following Internet sites:

www.fed.gov.au	www.standards.org.au
www.nsw.gov.au	www.erac.gov.au/
www.qld.gov.au	http://www.acma.gov.au
www.sa.gov.au	http://www.dewr.gov.au/
www.nt.gov.au	http://www.ascc.gov.au/
www.act.gov.au	http://www.workplace.gov.au/tra
www.wa.gov.au	http://www.deewr.gov.au/
www.tas.gov.au	http://training.com.au/

Other Industry Standards

It is recognised that the Electrotechnology Standards do not cover all the competencies, likely to be required and applied within Electrotechnology Industry workplaces. Nationally endorsed competency standards from other industries will be used where appropriate and the concept of cross-industry disciplinary standards will be encouraged. Specific rules have been included within this Training Package to address these arrangements.

The Revised Electrotechnology Training Package (UEE07)

This Training Package for the Electrotechnology Industry (UEE07) has been developed on behalf of the ElectroComms Industries and community stakeholders from all States/Territories of Australia by EE-Oz Training Standards, with the support of the Australian National Training Authority (ANTA) and subsequently, the Department of Education, Employment and Workplace Relations (DEEWR). EE-Oz Training Standards operates under a charter from DEEWR as the declared National ElectroComms and EnergyUtilities Industry Skills Council for the ElectroComms and EnergyUtilities Industry. ElectroComms Industry practitioners, regulators, government agencies and community stakeholders contributed much effort, support and knowledge to its development.

The first Electrotechnology Training Package (UTE99) was released in 1999. At that time it broke new ground for setting nationally recognised qualifications comprised of competency standard units as they related to work performance. It assisted in benchmarking the design of training and assessment processes and practices. Since its initial release, it has undergone four version changes.

In its revised form the Electrotechnology Training Package has gone even further in improving currency and relevance to industry by enhancing the range of qualifications and competency standard units available with added flexibility for the industry. It includes an array of new and revised competency standard units, pathways and design features.

The previous competency standard units have been revamped, reorganised and updated to nearly 500 new competency standard units across all six vocational education and training levels of the AQF. The result is a Training Package that is more relevant to the industry. It readily responds to the needs and responsibilities of the future, both in technology and work organisation.

New skilled career pathways have also been developed that suit employment-based new entrants, as well as the existing workforce or those with pre-existing skill sets.

The Training Package will be able to be used by all those involved in the delivery and assessment of competencies that cover, electronics, electrical, communications, control systems, instrumentation, lifts, refrigeration and air conditioning, renewable/sustainable energy, fire and security, gaming, rail signals and gaming. This includes:

- State training and recognition authorities who will use the Training Package as:
the pre-eminent industry advice to government
the minimum requirements to be satisfied by Registered Training Organisations in the delivery of services.
- State/Territory Industry Training Bodies/Industry Skills Councils who will use the Training Package to inform and underpin their relationship with, and support for, the State/Territory training and recognition authorities quality systems, including providing advice.
- Registered Training Organisations who will issue qualifications/Statements of Attainment, based on the requirements outlined in the Training Package which contains the vocational standards for industry.
- Individual candidates/trainees/learners will use the provisions of the Training Package to establish their responsibilities and to protect their prerogatives.
- Organisations in mapping their human resource processes and arrangements to the National Benchmark competency standard units in the Training Package.

Content of this Training Package

Content of this Training Package

The Training Package is made up of two volumes. Volume 1 covers the overall package framework and completion requirements for qualifications. Volume 2 includes the content details of parts and sub-sections of Volume 1. The two volumes form an integrated whole and are not to be used independently of each other.

Volume 1 Structure and Overview

Part 1 – Qualification Framework

This section describes how the qualifications, scope/descriptions, composition and content are structured. Completion and issuance requirements are provided as well as advice on flexibility arrangements, with entry and exit pathways and articulation arrangements. Titles and codes of the qualifications to be issued are also included.

Part 2 – Competency standards

This section describes how the competency standards were developed (in broad terms), the industry coverage they apply to, as well as the format and construction of the individual competency standard units. The Index of Competency Standard Units and their scope/description are included in this part. Matters related to language, literacy and numeracy, access, equity and cultural diversity and regulatory arrangements that may apply are also included. The Definitions, Glossary and Essential Knowledge and Associated Skills sections of the Training Package link directly to the competency standard units and no Unit is to be used in isolation or exported without these interrelated components.

All competency standard units are included in Volume 2, each listed according to their respective industry discipline area.

Part 3 – Assessment guidelines

This section outlines how the assessment guidelines inform a Registered Training Organisation (RTO) on the infrastructure requirements they will need to enable them to carry out training delivery and assessment activities related to the Training Package. The guidelines include assessment systems, the role of RTOs, assessment pathways, recognition arrangements, assessor qualifications and sources of information.

Volume 2 Competency Standard Units – Content and scope

Volume 2 contains the competency standard units in their respective disciplines. Volume 2 also contains the Essential Knowledge and Associated Skills (EKAS), a Matrix mapping the EKAS to the unit and a Definitions/Glossary section, which provides a description of the terms and vocabulary as they are used in this Package. Also included are definitions relating to literacy and numeracy skills.

Layout of this Training Package

Layout of this Training Package

Volume 1

Preliminary Information

The Electrotechnology Industry

Overview of Training Packages

The Electrotechnology Industry Training Package

Part 1 Qualifications Framework

Part 2 Competency Standards Overview and Index

Part 3 Assessment Guidelines

Appendix A – Australian Apprenticeships

Appendix B – Sample Assessment Instruments

Enclosures

- Enclosure A: List of Sample Assessment Instruments
- Enclosure B: Administrative Forms
- Enclosure C: Glossary of Terms

Volume 2

Preliminary Information

Part 1 Definitions/Glossary

Part 2 Competency Standards

2.1 Competency Standard Units

A – Assembly

B – Broadcast

C – Commercial

D – Computer systems

E – Cross discipline

F – Data and voice communications

G – Electrical

H – Electronic

I – Instrument and Control

J – Refrigeration and Air Conditioning

K – Renewable and sustainable energy

L – Imported

M – Hazardous areas

N – Rail systems

P – Restricted and specialist

R – Research

2.2 Essential Knowledge and Associated Skills (EKAS)

2.2.1 Table 1 – Knowledge and Associated Skills Relationship

2.2.2 Appendix 2 – Essential Knowledge and Skills to Unit Matrix

Part 3 Literacy and Numeracy Skills

AQF qualifications in this Training Package

AQF qualifications in this Training Package

The Electrotechnology Training Package Qualifications can be achieved by completing the AQF Qualifications (Certificates I – IV, Diploma or Advanced Diploma) or by completing Skills Sets (i.e.; Independent Units)

1. AQF Qualifications

Below is a summary of the qualifications contained in this Training Package (UEE07):

Note:

Qualifications in italics have been reserved and will be developed as part of the continuous improvement processes associated with this Training Package.

AQF Code	Certificate I Qualifications
UEE10110	Certificate I in ElectroComms Skills
AQF Code	Certificate II Qualifications
UEE20110	Certificate II in Split Air-conditioning and Heat Pump Systems
UEE20207	Certificate II in Business Equipment Servicing
	<i>Certificate II in Electrotechnology Business Support*</i>
UEE20407	Certificate II in Winding and Assembly
UEE20510	Certificate II in Computer Assembly and Repair
UEE20607	Certificate II in Custom Electronics Assembly and Setup
UEE20707	Certificate II in Data and Voice Communications
UEE20810	Certificate II in Electrical Wholesaling
UEE20907	Certificate II in Electronic Assembly
UEE21007	Certificate II in Fire Alarms Servicing
UEE21107	Certificate II in Gaming Machines Servicing
UEE21207	Certificate II in Antennae Equipment
UEE21310	Certificate II in Remote Area Essential Service

UEE21407	Certificate II in Remote Area Power Supply Maintenance

UEE21510	Certificate II in Renewable Energy

UEE21610	Certificate II in Security Assembly and Setup

UEE21710	Certificate II in Technical Support

UEE21910	Certificate II in Electronics

UEE22010	Certificate II in Electrotechnology (Career Start)

UEE22107	Certificate II in Sustainable Energy (Career Start)

AQF Code	Certificate III Qualifications

UEE30107	Certificate III in Business Equipment

UEE30210	Certificate III in Computer Systems Equipment

UEE30310	Certificate III in Custom Electronics Installations

UEE30407	Certificate III in Data and Voice Communications

UEE30607	Certificate III in Electrical Machine Repair

UEE30707	Certificate III in Switchgear and Control Gear

UEE30807	Certificate III in Electrotechnology Electrician

UEE30910	Certificate III in Electronics and Communications

UEE31007	Certificate III in Fire Protection Control

UEE31107	Certificate III in Gaming Electronics

UEE31210	Certificate III in Instrumentation and Control

UEE31410	Certificate III in Security Equipment

UEE31507	Certificate III in Rail – Communications and Networks

	<i>Certificate III in Wireless Communications*</i>

UEE31710	Certificate III in Hazardous areas – Electrician

UEE31810	Certificate III in Hazardous areas – Instrumentation

UEE31910	Certificate III in Explosion-protected equipment overhaul

UEE32010	Certificate III in Renewable Energy - ELV

UEE32110	Certificate III in Appliance Service

UEE32210	Certificate III in Air-conditioning and Refrigeration

AQF Code	Certificate IV Qualifications

UEE40110	Certificate IV in Computer Systems

UEE40210	Certificate IV in Electrical – Data and Voice Communications

UEE40310	Certificate IV in Electrical Installation Inspection and Audits

UEE40410	Certificate IV in Electrical – Instrumentation

UEE40510	Certificate IV in Electrical – Air-conditioning Systems

UEE40610	Certificate IV in Electrotechnology – Systems Electrician

UEE40710	Certificate IV in Electronics and Communications

UEE40810	Certificate IV in Electrical – Fire Protection Control Systems

UEE40910	Certificate IV in Industrial Electronics and Control

UEE41010	Certificate IV in Energy Management and Control

UEE41110	Certificate IV in Electrical – Lift Systems

UEE41210	Certificate IV in Electrical – Rail Signalling

UEE41510	Certificate IV in Video and Audio Systems

UEE41610	Certificate IV in Renewable Energy

UEE41710	Certificate IV in Rail – Communications and Network Systems

UEE41910	Certificate IV in Electrical – Renewable Energy

UEE42010	Certificate IV in Electrical – Photovoltaic Systems

UEE42110	Certificate IV in Electrotechnology – Electrical Contracting

UEE42210	Certificate IV in Instrumentation and Control

UEE42410	Certificate IV in Hazardous areas – Industrial control
UEE42610	Certificate IV in Hazardous areas - Electrical
UEE42710	Certificate IV in Air-conditioning and Refrigeration Servicing
UEE42810	Certificate IV in Air-conditioning Systems Energy Management and Control
UEE42910	Certificate IV in Refrigeration and Air-conditioning Systems

AQF Code	Diploma Qualifications
UEE50110	Diploma of Computer Systems Engineering
UEE50210	Diploma of Electrical and Instrumentation
UEE50310	Diploma of Electrical and Refrigeration and Air-conditioning
UEE50410	Diploma of Electrical Engineering
UEE50510	Diploma of Electronics and Communications Engineering
UEE50710	Diploma of Renewable Energy Engineering
UEE50810	Diploma of Research and Development
UEE50910	Diploma of Industrial Electronics and Control Engineering
UEE51010	Diploma of Instrumentation and Control Engineering
UEE51110	Diploma of Engineering Technology - Refrigeration and Air-conditioning
UEE51210	Diploma of Air-conditioning and Refrigeration Engineering

AQF Code	Advanced Diploma Qualifications
UEE60210	Advanced Diploma of Electronics and Communications Engineering
UEE60410	Advanced Diploma of Computer Systems Engineering
UEE60610	Advanced Diploma of Industrial Electronics and Control Engineering
UEE60710	Advanced Diploma of Refrigeration and Air-conditioning Engineering

UEE60910	Advanced Diploma of Renewable Energy Engineering
UEE61110	Advanced Diploma of Automated Systems Maintenance Engineering
UEE61210	Advanced Diploma of Engineering Explosion protection
UEE61410	Advanced Diploma of Engineering – Explosion protection - Industrial control
UEE61510	Advanced Diploma of Instrumentation and Control Engineering
UEE61710	Advanced Diploma of Engineering Technology - Electronic
UEE61810	Advanced Diploma of Engineering Technology - Computer Systems
UEE62010	Advanced Diploma of Engineering Technology - Renewable Energy
UEE62110	Advanced Diploma of Engineering Technology – Electrical
UEE62210	Advanced Diploma of Electrical – Engineering
UEE62310	Advanced Diploma of Electrical Engineering – Coal Mining
UEE62410	Advanced Diploma of Engineering Technology - Air-conditioning and Refrigeration
UEE62510	Advanced Diploma of Air-conditioning and Refrigeration Engineering

** To be developed as part of continuous improvement*

2. Skill Sets

Identified Skill Sets which meet regulatory or specialist requirements recognised by Statements of Attainment have been included to support required industry outcomes. These outcomes generally support requirements associated with regulatory, safety or specialised/hazardous functions of work.

Mapping Qualifications in this Training Package to the former

Mapping tables in this Training Package provide mapping of current units to previous versions of this Training Package and the former Electrotechnology Training Package (UEE06). These have been included to assist in linking previous units to new units and to assist in minimising any translation issues that may arise.

This information is detailed in Volume 1 Part 1 – Qualifications Framework.

Relationship of Units of Competency to former Training Package and prerequisites

Included in this Training Package is a summary of:

- competency standard units in the Electrotechnology Training Package

- the relationship of the new units to the former competency standard units
- AQF alignment and weighting points of each competency standard unit
- prerequisite requirements.

This information is contained in Volume 1 Part 2 – Competency Standards Index.

List of Imported Units of Competency

Included in this Training Package is a list of units of competency imported from other endorsed training packages into the Electrotechnology Training Package. This advice is detailed in Volume 1 Part 2 – Competency Standards Units Index, Table 2 – section L.

Language, Literacy, Numeracy

The competency standards in this Training Package have been written to reflect the technical and operational needs of industry and include appropriate language and literacy requirements. A new and specific section related to literacy and numeracy skills has been included in the competency standard units for the purposes of providing advice to RTOs on the entry requirements for each unit. It characterises how participants are to be best equipped to achieve the relevant unit, in terms of reading, writing and numeracy skill levels.

Access, Equity and Cultural Diversity

The skills required of employees in the Electrotechnology Industry are comprehensive and are relevant to many different employment situations. The competency standards reflect the range of knowledge and skills and their application, required in the Industry. They are written in a non-exclusive manner so as to increase the participation rates of under-represented groups and to minimise unintentional bias.

As a matter of policy the Electrotechnology Industry and this Training Package excludes no one from participating in competency development, training and employment. This includes encouraging under-represented groups such as indigenous peoples, people with disabilities, women, and people from rural and remote areas or cultural diversity to join the Industry.

Responsibility for Training Package Maintenance

Responsibility for Training Package Maintenance

The Training Package for the Electrotechnology Industry is managed and maintained by the National Electrotechnology Competency Advisory Council (NECAC) supported by technical committees comprised of the National Electrotechnology Training Advisory Group (NETAG) and specific discipline Technical Advisory Committees (TACs). The composition of the committees is determined by the Electrotechnology Sector Council of EE-Oz Training Standards under declared protocols.

NECAC with its technical sub committees is a standing working group of the ElectroComms and Energy Utilities Industry Skills Council Ltd trading as EE-Oz Training Standards, a DEEWR declared Industry Skills Council (ISC). The Group is representative of the Electrotechnology industry, regulators, and related stakeholders. It includes Registered Training Organisations (RTOs) from around Australia and employers and union representatives. EE-Oz Training Standards Board and Sector Council determine its composition. The Board and Sector Council may vary NECAC membership from time to time.

The charter of the NECAC is to monitor, review and maintain the Electrotechnology Training Package. This Charter encompasses the following responsibilities:

- *Maintenance of Competency Standards* – to initiate and respond to the need to review, vary, delete and add to the Electrotechnology competency standard units, as part of the sector's standards inventory
- *Maintenance of Competency Delivery Processes* – to monitor the effectiveness of the delivery of competency and so initiate and respond to issues which may impact on those processes
- *Maintenance of Assessment Guidelines* – to monitor the effectiveness of the Assessment Guidelines and supporting systems; to initiate and respond to issues which impact, or are likely to impact, on the quality of the assessment systems and to promote quality improvement throughout the system
- *Maintenance of the Qualification and Recognition Systems* – to monitor the effectiveness of the application of the Qualification and Recognition Systems contained in the Training Package and to review/revise the system as required
- *Validation of Imported Competency Standard Units* – to monitor the effectiveness and value of imported units for the purpose of their inclusion in the Training Package qualifications framework.

The NECAC meets at least annually to review and plan the Industry maintenance and management processes related to the Training Package. The majority of the considerations by the NECAC will require prompt response and, therefore, business and decisions will normally be handled by electronic mail. Support for the NECAC and its technical sub-committees will be provided by the EE-Oz Training Standards, who will act as the secretariat.

The NECAC is an integral part of the Electrotechnology Industry and EE-Oz Training Standards Electrotechnology Sector Council consultative mechanisms.

Membership of the original National Steering Group

Name	Title	Organisation
Peter Tighe	Chair	EE-Oz Training Standards
Peter Glynn	Chief Executive Officer	National Electrical and Communications Association (National)

John Ingram	Assistant National Secretary	Communications, Electrical and Plumbing Association (National)
Maurice Graham	Chief Executive Officer	VICTECH (Group Training/Private Provider)
James Tinslay	Executive Director	National Electrical and Communications Association (State)
John Karsznia	Network Representative	Electrotechnology Industry Training Advisory Board (Small State)
Ian Neeson	Educational Representative	Technical Consultant
George Adda	Vocational Education and Training Systems Representative	Box Hill Institute (Education)
Jenny Callaghan		National Electrical and Communication Association (Teledata)
Barry Dawson		National Electrical and Communications Association (Group Training)
Bernie Riordon		Electrical Trade Union
Ian McCarthy		Communication, Electrical and Plumbing Union (Communications)
Kevin Fothergill		Telecommunications and Information Technology Advisory Board
Bob Paton		Manufacturing, Engineering and Related Services Industry Training Advisory Board
Christina Zey		Lift Skills Australia
Norm Cahill		Electrotechnology Industry Training Advisory Board (Large State)

John Karsznia		Electrotechnology Industry Training Advisory Board (Small State)
Mike Frew		NSW Technical and Further Education
Warren Miller		Standards Australia
Wolfgang Marshall		Electrotechnology Industry Training Organisation (New Zealand)
Jackie Marks		State/Territories Training Authorities
P J Fleming		National Occupation Health and safety Commission (NOHSC)
Steve Griffiths		Small Business
Neville Palmer		Medium Business
Peter Smith		Large Business
Bob Taylor		Utilities and Light Manufacturing Industry Training Board (Consultant)
Darrel Hills		Technical Consultant
Ian Graham	Regulators Representative	Chair of ERAC
Tony Palladino	Chief Executive Officer	EE-Oz Training Standards
Industry Officers	Observers	DEST
Additional technical representatives were called upon as required		

Acknowledgments

The Board of Directors of the ElectroComms and Energy Utilities Industry Skills Council Ltd trading as EE-Oz Training Standards wishes to acknowledge the important developmental roles played by training advisory and delivery organisations, enterprises, employer and employee representatives, industry practitioners, regulatory authorities, individuals and community stakeholders. Without their level of commitment and support this Training Package would not exist in its current form. The Board acknowledges and thanks the following organisations and individuals:

- National Electrotechnology Sector Council of the EE-Oz Training Standards Board
- The National Electrotechnology Competency Advisory Council (NECAC)
- The National Electrotechnology Training Advisory Group (NETAG) members
- The Chairs of the discipline Training Advisory Committees (TACs) – electrical and data; refrigeration and air conditioning; instrumentation; and electronics and computer systems
- The Chairs, Executive Officers, and Members of the State and Territory Utilities and Electrotechnology Network ITABs and their various sub-committees
- The joint EE-Oz Training Standards/Standards Electrical Equipment in Hazardous Areas Competency Advisory Panel (P12) Australia
- The Electrical Regulatory Advisory Council (ERAC)
- the Australian Communications Authority and the Australian Communications Industry Forum (ACIC)
- The State and Territory Training Authorities
- The State and Territory Regulatory Authorities
- OHS Skills Development and Practical Guidance Team of the National Occupational Health and Safety Commission
- Industry sector registered training organisations and practitioners for contributing to and being supportive of the project
- Industry sector practitioners for contributing to and being supportive of the project.

Transition to NQC Training Package packaging rules for Flexibility

Transition to NQC Training Package packaging rules for Flexibility

The following qualifications have been modified to meet the requirements of the National Quality Council's Training Package packaging rules for flexibility:

UEE10110 Certificate I in Electrotechnology

UEE20110 Certificate II in Split Air-conditioning and Heat Pumps Systems

UEE20510	Certificate II in Computer Assembly and Repair
UEE21310	Certificate II in Remote Area Essential Service
UEE21610	Certificate II in Security Assembly and Setup
UEE21710	Certificate II in Technical Support
UEE21910	Certificate II in Electronics
UEE22010	Certificate II in Electrotechnology (Career Start)
UEE30210	Certificate III in Computer Systems Equipment
UEE30310	Certificate III in Custom Electronics Installations
UEE30910	Certificate III in Electronics and Communications
UEE32110	Certificate III in Appliance Service
UEE32210	Certificate II in Air-conditioning and Refrigeration
UEE40110	Certificate IV in Computer Systems
UEE40710	Certificate IV in Electronics and Communications
UEE41510	Certificate IV in Video and Audio Systems
UEE42710	Certificate IV in Air-conditioning and Refrigeration Servicing
UEE42810	Certificate IV in Air-conditioning Systems Energy Management and Control
UEE42910	Certificate IV in Refrigeration and Air-conditioning Systems
UEE50110	Diploma of Computer Systems Engineering
UEE50510	Diploma of Electronics and Communications Engineering
UEE51110	Diploma of Engineering Technology – Refrigeration and Air-conditioning
UEE51210	Diploma of Air-conditioning and Refrigeration Engineering
UEE60210	Advanced Diploma of Electronics and Communications Engineering
UEE60410	Advanced Diploma of Computer Systems Engineering
UEE62210	Advanced Diploma of Electrical – Engineering
UEE62310	Advanced Diploma of Electrical Engineering - Coal Mining
UEE62410	Advanced Diploma of Engineering Technology – Air-conditioning and

Refrigeration

UEE62510 Advanced Diploma of Air-conditioning and Refrigeration Engineering

Customisation of these qualifications is permitted in order to meet learner's individual needs, their current, intended or future work context, and a variety of possible industry environments.

For this purpose the importation of units up to one sixth of the total points value required for completion of a qualification is permitted from either one or a combination of the following three sources:

- Elsewhere in this Training Package
- Other Training Packages
- Accredited Courses

Units selected for importation under these provisions shall be first packaged in the source Training Package or Accredited Course at the AQF level of the target qualification.

The importation of units from these sources shall be within the boundaries of the integrity of the intended qualification outcomes, the requirements of the Australian Qualifications Framework, the Australian Quality Training Framework and all regulatory requirements applicable to the imported unit and/or the target qualification.

A maximum of 10 weighting points shall be allocated to units imported from sources other than those managed by EE-Oz Training Standards. Higher valuation of units selected for importation from sources other than EE-Oz Training Packages shall be referred to EE-Oz Training Standards for consideration and validation by industry...

Advice should be sought from the relevant state/territory registration and accreditation body to determine if there is a requirement for an extension to a Registered Training Organisation's scope of registration in relation to the imported unit/s.

Advice should be sought from the registration and accreditation body regarding the requirement to record report the inclusion of units imported under these provisions for the purposes of awarding a qualification.

Where units have been imported under these provisions, this shall be reported to EE-Oz Training Standards so that industry is aware of such units and can consider the endorsement of these into the relevant qualification(s).

1.1.00 The Electrotechnology Industry Qualifications Framework

Volume 1 Part 1 – Qualifications Framework

1.0 The Electrotechnology Industry Qualifications Framework

The Electrotechnology Training Package Qualifications Framework provides two outcomes; 1) Qualifications and 2) Possible Skills Set competency standard units.

The qualifications listed in this Training Package follow the advice provided in the *AQF Implementation Handbook*, see the *AQF Implementation Handbook*.

http://www.aqf.edu.au/Portals/0/Documents/Handbook/AQF_Handbook_07.pdf. They have been developed in consultation with the many sectors of the Electrotechnology Industry and in accordance with the following principles the qualifications must:

- competency based
- be made up by clustering or grouping individual competency standard units
- be relevant in terms of both level and scope reflecting the realistic vocational needs of the industry
- facilitate real career pathways
- not have structures designed or intended to be misrepresented for other purposes
- reflect industry work outcomes and not be influenced by the variety of existing qualifications which may have been used in the past for career progression, and
- be constructed so as to enhance the achievement of consistency, equity of effort, transferability and portability within and across industries.

Competency standards are constructed by industry to meet identified industry skill needs. Competency standards are made up of a number of competency standard units (CSUs). These units describe a key function or role in a particular job or occupation.

Research into the Electrotechnology Training Package revealed that many qualified people in the industry seek further training in only one or two units at any one time, following their primary qualification – not an additional qualification. The previous policy prohibited the inclusion of stand-alone competency standard units in their own right. There are occasions when stand-alone or specialist competency standard units are needed by industry for special circumstances and environments. These units do not form a qualification in their own right and cannot always be regarded as an elective or a replacement unit within mainstream qualifications. For instance, the field of Electrical Equipment in Hazardous Areas (EEHA) is a unique environment and often a full qualification is not required. RTOs in this environment are often specialists in discrete areas of EEHA and do not wish to offer full qualifications.

The previous Training Package Development policy limited opportunities for individuals and employers to meet their specialised needs. However, as a result of the High Level Review completed in 2004 these limitations were lifted and in relation to this Training Package the inclusion of Skills Sets provides this opportunity.

The High Level Review findings stated:

Statements of Attainment

A set of related competencies below the level of a full qualification can be highly portable and valuable for individuals. The tool for recognising this achievement, the Statement of Attainment, is an important recognition of personal achievement, and is a legitimate credential in its own right, but has no wider community standing or recognition.

We see a need to enhance the market standing of Statements of Attainment by repositioning and promoting them as an important tool for nationally recognising related skill sets below full qualification level and which will be valued by individuals and by industry.

We also see a need to

- review the current systems for reporting the enrolment in and achievement of individual competency standard units to achieve greater clarity for the issuers, recipients and end users of Statements of Attainment, and to
- clarify and harmonise advice on Statements of Attainment within AQTF 2007 documents and the AQF Implementation Handbook."

Moving on Report of the High Level Review of Training Packages, April 2004 (ANTA)"

This Training Package has included an array of competency standard units as Possible Skills Sets. Typically, they are competency standard units that meet regulatory or specialist requirements. These outcomes generally support requirements associated with regulatory, safety, or specialised/hazardous functions of work.

1.1.01 Summary of Industry Qualifications

1.1 Summary of Industry Qualifications

Qualifications in the Electrotechnology Training Package are summarised below. The full range and completion requirements of the qualifications are detailed at the end of this Volume 1 in section 1.9 – Electrotechnology Industry Qualifications Framework

Note: Qualifications in italics have been reserved and will be developed as part of EE-Oz Training Standards continuous improvement processes associated with this Training Package.

AQF Code	Certificate I Qualifications
UEE10110	Certificate I in ElectroComms Skills

AQF Code	Certificate II Qualifications
UEE20111	Certificate II in Split Air-conditioning and Heat Pump Systems
UEE20207	Certificate II in Business Equipment Servicing
	<i>Certificate II in Electrotechnology Business Support*</i>
UEE20407	Certificate II in Winding and Assembly

UEE20510	Certificate II in Computer Assembly and Repair
UEE20607	Certificate II in Custom Electronics Assembly and Setup
UEE20707	Certificate II in Data and Voice Communications
UEE20810	Certificate II in Electrical Wholesaling
UEE20907	Certificate II in Electronic Assembly
UEE21007	Certificate II in Fire Alarms Servicing
UEE21107	Certificate II in Gaming Machines Servicing
UEE21207	Certificate II in Antennae Equipment
UEE21310	Certificate II in Remote Area Essential Service
UEE21407	Certificate II in Remote Area Power Supply Maintenance
UEE21510	Certificate II in Renewable Energy
UEE21610	Certificate II in Security Assembly and Setup
UEE21710	Certificate II in Technical Support
UEE21910	Certificate II in Electronics
UEE22010	Certificate II in Electrotechnology (Career Start)
UEE22107	Certificate II in Sustainable Energy (Career Start)

AQF Code	Certificate III Qualifications
UEE30107	Certificate III in Business Equipment
UEE30210	Certificate III in Computer Systems Equipment
UEE30310	Certificate III in Custom Electronics Installations
UEE30407	Certificate III in Data and Voice Communications
UEE30607	Certificate III in Electrical Machine Repair
UEE30707	Certificate III in Switchgear and Control Gear
UEE30807	Certificate III in Electrotechnology Electrician

UEE30910	Certificate III in Electronics and Communications
UEE31007	Certificate III in Fire Protection Control
UEE31107	Certificate III in Gaming Electronics
UEE31210	Certificate III in Instrumentation and Control
UEE31410	Certificate III in Security Equipment
UEE31507	Certificate III in Rail – Communications and Networks
<i>Certificate III in Wireless Communications*</i>	
UEE31710	Certificate III in Hazardous areas – Electrician
UEE31810	Certificate III in Hazardous areas – Instrumentation
UEE31910	Certificate III in Explosion-protected equipment overhaul
UEE32010	Certificate III in Renewable Energy – ELV
UEE32111	Certificate III in Appliance Service
UEE32211	Certificate III in Air-conditioning and Refrigeration
AQF Code	Certificate IV Qualifications
UEE40110	Certificate IV in Computer Systems
UEE40210	Certificate IV in Electrical – Data and Voice Communications
UEE40310	Certificate IV in Electrical Installation Inspection and Audits
UEE40410	Certificate IV in Electrical – Instrumentation
UEE40510	Certificate IV in Electrical – Air-conditioning Systems
UEE40610	Certificate IV in Electrotechnology – Systems Electrician
UEE40710	Certificate IV in Electronics and Communications
UEE40810	Certificate IV in Electrical – Fire Protection Control Systems
UEE40910	Certificate IV in Industrial Electronics and Control
UEE41010	Certificate IV in Energy Management and Control

UEE41110	Certificate IV in Electrical – Lift Systems
UEE41210	Certificate IV in Electrical – Rail Signalling
UEE41510	Certificate IV in Video and Audio Systems
UEE41610	Certificate IV in Renewable Energy
UEE41710	Certificate IV in Rail – Communications and Network Systems
UEE41910	Certificate IV in Electrical – Renewable Energy
UEE42010	Certificate IV in Electrical – Photovoltaic Systems
UEE42110	Certificate IV in Electrotechnology – Electrical Contracting
UEE42210	Certificate IV in Instrumentation and Control
UEE42410	Certificate IV in Hazardous areas – Industrial control
UEE42610	Certificate IV in Hazardous areas – Electrical
UEE42711	Certificate IV in Air-conditioning and Refrigeration Servicing
UEE42811	Certificate IV in Air-conditioning Systems Energy Management and Control
UEE42911	Certificate IV in Refrigeration and Air-conditioning Systems

AQF Code	Diploma Qualifications
UEE50110	Diploma of Computer Systems Engineering
UEE50210	Diploma of Electrical and Instrumentation
UEE50310	Diploma of Electrical and Refrigeration and Air-conditioning
UEE50410	Diploma of Electrical Engineering
UEE50510	Diploma of Electronics and Communications Engineering
UEE50710	Diploma of Renewable Energy Engineering
UEE50810	Diploma of Research and Development
UEE50910	Diploma of Industrial Electronics and Control Engineering

UEE51010	Diploma of Instrumentation and Control Engineering
UEE51111	Diploma of Engineering Technology - Refrigeration and Air-conditioning
UEE51211	Diploma of Air-conditioning and Refrigeration Engineering

AQF Code	Advanced Diploma Qualifications
UEE60210	Advanced Diploma of Electronics and Communications Engineering
UEE60410	Advanced Diploma of Computer Systems Engineering
UEE60610	Advanced Diploma of Industrial Electronics and Control Engineering
UEE60910	Advanced Diploma of Renewable Energy Engineering
UEE61110	Advanced Diploma of Automated Systems Maintenance Engineering
UEE61210	Advanced Diploma of Engineering Explosion protection
UEE61410	Advanced Diploma of Engineering – Explosion protection - Industrial control
UEE61510	Advanced Diploma of Instrumentation and Control Engineering
UEE61710	Advanced Diploma of Engineering Technology - Electronic
UEE61810	Advanced Diploma of Engineering Technology - Computer Systems
UEE62010	Advanced Diploma of Engineering Technology - Renewable Energy
UEE62110	Advanced Diploma of Engineering Technology – Electrical
UEE62211	Advanced Diploma of Electrical – Engineering
UEE62311	Advanced Diploma of Electrical Engineering – Coal Mining
UEE62411	Advanced Diploma of Engineering Technology – Air-conditioning and Refrigeration
UEE62511	Advanced Diploma of Air-conditioning and Refrigeration Engineering

Mapping of Qualifications

Table 1 Mapping of UEE07 Training Package Version 4 Qualifications to UEE07 Version 3.1 Qualifications

AQF Code	Certificate II Qualifications (UEE07 – V4)	Training Package (UEE07 – V3.1)	E = Equivalent N = Not Equivalent
UEE20111	Certificate II in Split Air-conditioning and Heat Pumps Systems	Certificate II in Air-conditioning Split Systems	E except for the addition of heat pump systems
	Deleted	Certificate II in Appliance Servicing – Refrigerants	

AQF Code	Certificate III Qualifications (UEE07 – V4)	Training Package (UEE07 – V3.1)	E = Equivalent N = Not Equivalent
UEE32111	Certificate III in Appliance Service	Certificate III in Appliance Servicing	E
UEE32211	Certificate II in Air-conditioning and Refrigeration	Certificate III in Refrigeration and Air-conditioning	E

AQF Code	Certificate IV Qualifications (UEE07 –V4)	Training Package (UEE07 – V3.1)	E = Equivalent N = Not Equivalent
UEE42711	Certificate IV in Air-conditioning and Refrigeration Servicing	Certificate IV in Refrigeration and Air-conditioning Servicing	E
UEE42811	Certificate IV in Air-conditioning Systems Energy Management and Control	Certificate IV in Air-conditioning Energy Management and Control	E
UEE42911	Certificate IV in Refrigeration and Air-conditioning Systems	Certificate IV in Air-conditioning and Refrigeration Systems	E

AQF Code	Diploma Qualifications (UEE07 – V4)	Training Package (UEE07 – V3.1)	E = Equivalent N = Not Equivalent
UEE51111	Diploma of Engineering Technology – Refrigeration and Air-conditioning	New Qualification	
UEE51211	Diploma of Air-conditioning and Refrigeration Engineering	Diploma of Refrigeration and Air-conditioning Engineering	E

AQF Code	Advanced Diploma Qualifications (UEE07 – V4)	Training Package (UEE07 – V3.1)	E = Equivalent N = Not Equivalent
UEE62211	Advanced Diploma of Electrical - Engineering	Advanced Diploma of Electrical Engineering	N
UEE62311	Advanced Diploma of Electrical Engineering – Coal Mining	New Qualification	
UEE62411	Advanced Diploma of Engineering Technology – Air-conditioning and Refrigeration	Advanced Diploma of Engineering Technology - Refrigeration and Air-conditioning	E
UEE62511	Advanced Diploma of Air-conditioning and Refrigeration Engineering	Advanced Diploma of Refrigeration and Air-conditioning Engineering	N

Mapping of Qualifications

Table 2 Mapping of UEE07 Training Package Version 3.1 Qualifications to UEE07 Version 3.0 Qualifications

Detailed below is a summary qualifications mapping of the Version 3.1 Electrotechnology Training Package (UEE07) to the version 3.0 Electrotechnology Training Package (UEE07). This table maps only the Qualifications which have changed between these versions.

AQF Code	Certificate I Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
UEE10110	Certificate I in ElectroComms	UEE10110 Certificate I in	E

AQF Code	Certificate I Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
	Skills	ElectroComms Skills	

AQF Code	Certificate II Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
UEE20510	Certificate II in Computer Assembly and Repair	UEE20507 Certificate II in Computer Assembly and Repair	E
UEE21310	Certificate II in Remote Area Essential Service	UEE21310 Certificate II in Remote Area Essential Service	E
UEE21610	Certificate II in Security Assembly and Setup	UEE21610 Certificate II in Security Assembly and Setup	E
UEE21710	Certificate II in Technical Support	UEE21710 Certificate II in Technical Support	E
UEE21910	Certificate II in Electronics	UEE21907 Certificate II in Electronics	E
UEE22010	Certificate II in Electrotechnology (Career Start)	UEE22010 Certificate II in Electrotechnology (Career Start)	E

AQF Code	Certificate III Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
UEE30210	Certificate III in Computer Systems Equipment	UEE30207 Certificate III in Computer Systems Equipment	E
UEE30310	Certificate III in Custom Electronics Installations	UEE30310 Certificate III in Custom Electronics Installations	E
UEE30910	Certificate III in Electronics and Communications	UEE30910 Certificate III in Electronics and Communications	E

AQF Code	Certificate IV Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
UEE40110	Certificate IV in Computer Systems	UEE40110 Certificate IV in Computer Systems	E
UEE40710	Certificate IV in Electronics and Communications	UEE40710 Certificate IV in Electronics and Communications	E
UEE41510	Certificate IV in Video and Audio Systems	UEE41507 Certificate IV in Video and Audio Systems	E
UEE41610	Certificate IV in Renewable Energy	UEE41610 Certificate IV in Renewable Energy	E

AQF Code	Diploma Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
UEE50110	Diploma of Computer Systems Engineering	UEE50110 Diploma of Computer Systems Engineering	E
UEE50510	Diploma of Electronics and Communications Engineering	UEE50510 Diploma of Electronics and Communications Engineering	E

AQF Code	Advanced Diploma Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
UEE60210	Advanced Diploma of Electronics and Communications Engineering	UEE60210 Advanced Diploma of Electronics and Communications Engineering	E
UEE60410	Advanced Diploma of Computer Systems Engineering	UEE60407 Advanced Diploma of Computer Systems Engineering	E
UEE62010	Advanced Diploma of Engineering Technology - Renewable Energy	UEE61007 Advanced Diploma of Renewable Energy – Technology	E

AQF Code	Advanced Diploma Qualifications (UEE07 – V3.1)	Training Package (UEE07 – V3.0)	E = Equivalent N = Not Equivalent
UEE62110	Advanced Diploma of Engineering Technology - Electrical	UEE61307 Advanced Diploma of Electrical – Technology	E

Table 3 Mapping of UEE07 Training Package Version 3 Qualifications to UEE07 Version 2 Qualifications

Detailed below is a summary qualifications mapping of the Version 3 Electrotechnology Training Package (UEE07) to the version 2 Electrotechnology Training Package (UEE07). This table maps only the Qualifications which have changed between these versions.

AQF Code	Certificate I Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE10110	Certificate I in ElectroComms Skills	UEE10107 Certificate I in ElectroComms Skills	E

AQF Code	Certificate II Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE20810	Certificate II in Electrical Wholesaling	New Qualification	
UEE21310	Certificate II in Remote Area Essential Service	UEE21307 Certificate II in Remote Area Essential Service	N
UEE21510	Certificate II in Renewable Energy	UEE21507 Certificate II in Renewable Energy	E
UEE21610	Certificate II in Security Assembly and Setup	UEE21607 Certificate II in Security Assembly and Setup	E
UEE21810	Certificate II in Appliance Servicing – Refrigerants	UEE21807 Certificate II in Appliance Servicing – Refrigerants	E

AQF Code	Certificate II Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE22010	Certificate II in Electrotechnology (Career Start)	UEE22007 Certificate II in Electrotechnology (Career Start)	E

AQF Code	Certificate III Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE30310	Certificate III in Custom Electronics Installations	UEE30307 Certificate III in Custom Electronics Installations	E
UEE30510	Certificate III in Appliance Servicing	UEE30507 Certificate III in Appliance Servicing	E
UEE30910	Certificate III in Electronics and Communications	UEE30907 Certificate III in Electronics and Communications	E
UEE31210	Certificate III in Instrumentation and Control	UEE31207 Certificate III in Instrumentation and Control	N
UEE31410	Certificate III in Security Equipment	UEE31407 Certificate III in Security Equipment	E
UEE31710	Certificate III in Hazardous areas – Electrician	UEE31707 Certificate III in Hazardous areas – Electrician	E
UEE31810	Certificate III in Hazardous areas – Instrumentation	UEE31807 Certificate III in Hazardous areas – Instrumentation	N
UEE31910	Certificate III in Explosion-protected equipment overhaul	UEE31907 Certificate III in Explosion-protected equipment overhaul	E
UEE32010	Certificate III in Renewable Energy - ELV	UEE32007 Certificate III in Renewable Energy – ELV	E

AQF Code	Certificate IV Qualifications (UEE07 –V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE40110	Certificate IV in Computer Systems	UEE40107 Certificate IV in Computer Systems	E
UEE40210	Certificate IV in Electrical – Data and Voice Communications	UEE40207 Certificate IV in Electrical – Data and Voice Communications	E
UEE40310	Certificate IV in Electrical Installation Inspection and Audits	UEE40307 Certificate IV in Electrical Installation Inspection and Audits	E
UEE40410	Certificate IV in Electrical – Instrumentation	UEE40407 Certificate IV in Electrical – Instrumentation	E
UEE40510	Certificate IV in Electrical – Air-conditioning Systems	UEE40507 Certificate IV in Electrical – Air-conditioning Systems	E
UEE40610	Certificate IV in Electrotechnology – Systems Electrician	UEE40607 Certificate IV in Electrotechnology – Systems Electrician	E
UEE40710	Certificate IV in Electronics and Communications	UEE40707 Certificate IV in Electronics and Communications	E
UEE40810	Certificate IV in Electrical – Fire Protection Control Systems	UEE40807 Certificate IV in Electrical – Fire Protection Control Systems	E
UEE40910	Certificate IV in Industrial Electronics and Control	UEE40907 Certificate IV in Industrial Electronics and Control – Option 1 only	E
UEE41010	Certificate IV in Energy Management and Control	UEE41007 Certificate IV in Energy Management and Control – Option 2 only	E
UEE41110	Certificate IV in Electrical – Lift Systems	UEE41107 Certificate IV in Electrical – Lift Systems	E
UEE41210	Certificate IV in Electrical – Rail Signalling	UEE41207 Certificate IV in Electrical – Rail Signalling	E

AQF Code	Certificate IV Qualifications (UEE07 –V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE41310	Certificate IV in Refrigeration and Air-conditioning Servicing	UEE41307 Certificate IV in Refrigeration and Air-conditioning Servicing	E
UEE41510	Certificate IV in Video and Audio Systems	UEE41507 Certificate IV in Video and Audio Systems	E
UEE41610	Certificate IV in Renewable Energy	UEE41607 Certificate IV in Renewable Energy	E
UEE41710	Certificate IV in Rail – Communications and Network Systems	UEE41707 Certificate IV in Rail – Communications and Network Systems	E
UEE41910	Certificate IV in Electrical – Renewable Energy	UEE41907 Certificate IV in Electrical – Renewable Energy	E
UEE42010	Certificate IV in Electrical – Photovoltaic Systems	UEE42009 Certificate IV in Electrical – Photovoltaic Systems	E
UEE42110	Certificate IV in Electrotechnology – Electrical Contracting	New Qualification	
UEE42210	Certificate IV in Instrumentation and Control	UEE40907 Certificate IV in Industrial Electronics and Control – Option 2 only	N
UEE42310	Certificate IV in Air-conditioning Energy Management and Control	UEE41007 Certificate IV in Energy Management and Control – Option 1 only	E
UEE42410	Certificate IV in Hazardous areas – Industrial control	UEE41807 Certificate IV in Hazardous areas – Option 2 only	N
UEE42510	Certificate IV in Air-conditioning and Refrigeration Systems	UEE41407 Certificate IV in Refrigeration and Air-conditioning Systems	E
UEE42610	Certificate IV in Hazardous areas - Electrical	UEE41807 Certificate IV in Hazardous areas – Option 1 only	E

AQF Code	Diploma Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE50110	Diploma of Computer Systems Engineering	UEE50107 Diploma of Computer Systems Engineering	E
UEE50210	Diploma of Electrical and Instrumentation	UEE50207 Diploma of Electrical and Instrumentation	E
UEE50310	Diploma of Electrical and Refrigeration and Air-conditioning	UEE50307 Diploma of Electrical and Refrigeration and Air-conditioning	E
UEE50410	Diploma of Electrical Engineering	UEE50407 Diploma in Electrical Engineering	E
UEE50510	Diploma of Electronics and Communications Engineering	UEE50507 Diploma of Electronics and Communications Engineering	E
UEE50610	Diploma of Refrigeration and Air-conditioning Engineering	UEE50607 Diploma of Refrigeration and Air-conditioning Engineering	E
UEE50710	Diploma of Renewable Energy Engineering	UEE50707 Diploma of Renewable Energy Engineering	E
UEE50810	Diploma of Research and Development	UEE50807 Diploma of Research and Development	E
UEE50910	Diploma of Industrial Electronics and Control Engineering	UEE50907 Diploma of Industrial Electronics and Control Engineering – Option 1 only	E
UEE51010	Diploma in Instrumentation and Control Engineering	UEE50907 Diploma of Industrial Electronics and Control Engineering – Option 2 only	N

AQF Code	Advanced Diploma Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent

AQF Code	Advanced Diploma Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE60110	Advanced Diploma of Electrical Engineering	UEE60107 Advanced Diploma in Electrical Engineering	E
UEE60210	Advanced Diploma of Electronics and Communications Engineering	UEE60207 Advanced Diploma of Electronics and Communications Engineering	E
UEE60410	Advanced Diploma of Computer Systems Engineering	UEE60407 Advanced Diploma of Computer Systems Engineering	E
UEE60610	Advanced Diploma of Industrial Electronics and Control Engineering	UEE60607 Advanced Diploma of Industrial Electronics and Control Engineering – Option 1 only	E
UEE60710	Advanced Diploma of Refrigeration and Air-conditioning Engineering	UEE60707 Advanced Diploma of Refrigeration and Air-conditioning Engineering	E
UEE60910	Advanced Diploma of Renewable Energy Engineering	UEE60907 Advanced Diploma of Renewable Energy Engineering	E
UEE61110	Advanced Diploma of Automated Systems Maintenance Engineering	UEE61107 Advanced Diploma of Automated Systems Maintenance Engineering	E
UEE61210	Advanced Diploma of Engineering – Explosion protection	UEE61207 Advanced Diploma of Engineering – Explosion protection	E
UEE61410	Advanced Diploma of Engineering Explosion protection – Industrial control	UEE61207 Advanced Diploma of Engineering – Explosion protection – Option 2 only	N
UEE61510	Advanced Diploma of Instrumentation and Control Engineering	UEE60607 Advanced Diploma of Industrial Electronics and Control Engineering – Option 2 only	N

AQF Code	Advanced Diploma Qualifications (UEE07 – V3)	Training Package (UEE07 – V2)	E = Equivalent N = Not Equivalent
UEE61710	Advanced Diploma of Engineering Technology - Electronic	UEE60307 Advanced Diploma of Electronic –Technology	E
UEE61810	Advanced Diploma of Engineering Technology - Computer Systems	UEE60507 Advanced Diploma of Computer Systems – Technology	E
UEE61910	Advanced Diploma of Engineering Technology - Refrigeration and Air-conditioning	New Qualification	
UEE62010	Advanced Diploma of Engineering Technology - Renewable Energy	UEE61007 Advanced Diploma of Renewable Energy – Technology	E
UEE62110	Advanced Diploma of Engineering Technology - Electrical	UEE61307 Advanced Diploma of Electrical – Technology	E

Table 4 Mapping of UEE07 Training Package Version 2 Qualifications to UEE07 Version 1 Qualifications

AQF Code	Qualifications in UEE07 version 2	Nature of Relationship to Previous UEE07 Version 1 Training Package	Equivalent – full, part, or no
	All Existing Qualifications in UEE07 Version 1	All existing qualifications in UEE07 version 1 remain unchanged	Refer to table mapping UEE07 Version 1 qualifications to UEE06 Version 1 for equivalences
UEE42009	Certificate IV in Electrical - Photovoltaic Systems New Qualification	Qualification designed to meet industry, regulatory and Clean Energy Council accreditation requirements for the design and/or installation of grid connected solar systems on domestic and	New

AQF Code	Qualifications in UEE07 version 2	Nature of Relationship to Previous UEE07 Version 1 Training Package	Equivalent – full, part, or no
		commercial premises.	

Table 5 Mapping of UEE07 Training Package Version 1 Qualifications to UEE06 Qualifications

Detailed below is a summary qualifications mapping of the former Electrotechnology Training Package (UEE06) to the new Electrotechnology Training Package (UEE07).

AQF Code	Certificate I Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE10107	Certificate I in ElectroComms Skills	UEE10106 Certificate I in ElectroComms Skills	Full

AQF Code	Certificate II Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE20107	Certificate II in Air-conditioning Split Systems	UEE20106 Certificate II in Air-conditioning Split Systems	Full
UEE20207	Certificate II in Business Equipment Servicing	UEE20206 Certificate II in Business Equipment Servicing	Full
<i>Reserved</i>	<i>Certificate II in Electrotechnology Business Support</i>	<i>Certificate II in Electrotechnology Business Support UTE20199</i>	
UEE20407	Certificate II in Winding and Assembly	UEE20406 Certificate II in Winding and Assembly	Full
UEE20507	Certificate II in Computer Assembly and Repair	UEE20506 Certificate II in Computer Assembly and Repair	Part – All Pre-requisites removed from UEENEED002B

AQF Code	Certificate II Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE20607	Certificate II in Custom Electronics Assembly and Setup	UEE20606 Certificate II in Custom Electronics Assembly and Setup	Full
UEE20707	Certificate II in Data and Voice Communications	UEE20706 Certificate II in Data and Voice Communications	Full
<i>Reserved</i>	<i>Certificate II in Electrical Wholesaling</i>		
UEE20907	Certificate II in Electronic Assembly	UEE20906 Certificate II in Electronic Assembly	Part – Removal of Pre-requisites from UEENEEH002B
UEE21007	Certificate II in Fire Alarms Servicing	UEE21006 Certificate II in Fire Alarms Servicing	Full
UEE21107	Certificate II in Gaming Machines Servicing	UEE21106 Certificate II in Gaming Machines Servicing	Full
UEE21207	Certificate II in Antennae Equipment	UEE21206 Certificate II in Antennae Equipment	Full
UEE21307	Certificate II in Remote Area Essential Service	UEE21306 Certificate II in Remote Area Essential Service	Full
UEE21407	Certificate II in Remote Area Power Supply Maintenance	UEE21406 Certificate II in Remote Area Power Supply Maintenance	Full
UEE21507	Certificate II in Renewable Energy	UEE21506 Certificate II in Renewable Energy	Part – Removal of UEENEEK025B from Core.
UEE21607	Certificate II in Security Assembly and Setup	UEE21606 Certificate II in Security Assembly and Setup	Full
UEE21707	Certificate II in Technical Support	UEE21706 Certificate II in Technical Support	Part – All Pre-requisites removed from UEENEEE022B
UEE21807	Certificate II in	UEE21806 Certificate II in	Full

AQF Code	Certificate II Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
	Appliance Servicing – Refrigerants	Appliance Servicing – Refrigerants	
UEE21907	Certificate II in Electronics	UEE21906 Certificate II in Electronics	Part – Removal of Pre-requisites from UEENEEH002B
UEE22007	Certificate II in Electrotechnology (Career Start)	UEE22000 Certificate II in Electrotechnology (Career Start)	Full
UEE22107	Certificate II in Sustainable Energy (Career Start)	UEE22106 Certificate II in Sustainable Energy (Career Start)	Full

AQF Code	Certificate III Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE30107	Certificate III in Business Equipment	UEE30106 Certificate III in Business Equipment	Part – Removal of Pre-requisites from UEENEEH002B and UEENEEH011B and UEENEEH012B and UEENEEH013B and UEENEEH039B and Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE30207	Certificate III in Computer Systems Equipment	UEE30206 Certificate III in Computer Systems Equipment	Part – All Pre-requisites removed from UEENEEH002B
UEE30307	Certificate III in Custom Electronics Installations	UEE30306 Certificate III in Custom Electronics Installations	Part - Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE30407	Certificate III in Data and Voice	UEE30406 Certificate III in Data and Voice	Part - Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite

AQF Code	Certificate III Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
	Communications	Communications	statement
UEE30507	Certificate III in Appliance Servicing	UEE30506 Certificate III in Appliance Servicing	Part – Removal of Pre-requisite from UEENEEJ054B and amendment of EKAS alignments in UEENEEP001B
UEE30607	Certificate III in Electrical Machine Repair	UEE30606 Certificate III in Electrical Machine Repair	Part – All Pre-requisites removed from UEENEEG001B and UEENEEG002B and amendment of EKAS alignments in UEENEEP001B
UEE30707	Certificate III in Switchgear and Control Gear	UEE30706 Certificate III in Switchgear and Control Gear	Part – All Pre-requisites removed from UEENEEG001B and UEENEEG002B and amendment of EKAS alignments in UEENEEP001B
UEE30807	Certificate III in Electrotechnology Electrician	UEE30806 Certificate III in Electrotechnology Electrician	Part – All Pre-requisites removed from UEENEEG001B and UEENEEG002B
UEE30907	Certificate III in Electronics and Communications	UEE30906 Certificate III in Electronics and Communications	Part – Removal of Pre-requisites from UEENEEH002B and UEENEEH011B and UEENEEH012B and UEENEEH013B and UEENEEH039B and Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE31007	Certificate III in Fire	UEE31006 Certificate III in Fire Protection	Part - Inclusion of ‘or UEENEEH069B’ in

AQF Code	Certificate III Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
	Protection Control	Control	UEENEEH014B Pre-requisite statement
UEE31107	Certificate III in Gaming Electronics	UEE31106 Certificate III in Gaming Electronics	Part – Removal of Pre-requisites from UEENEEH002B and UEENEEH011B and UEENEEH012B and UEENEEH013B and UEENEEH018B and UEENEEH039B and Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE31207	Certificate III in Instrumentation and Control	UEE31206 Certificate III in Instrumentation and Control	Part - Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE31307	Certificate III in Refrigeration and Air-conditioning	UEE31306 Certificate III in Refrigeration and Air-conditioning	Part – All Pre-requisite units removed from unit UEENEEC025B and amendment of EKAS alignments in UEENEEP001B
UEE31407	Certificate III in Security Equipment	UEE31406 Certificate III in Security Equipment	Part - Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE31507	Certificate III in Rail – Communications and Networks	UEE31506 Certificate III in Rail – Communications and Networks	Part – Removal of Pre-requisites from UEENEEH002B and UEENEEH011B and UEENEEH012B and UEENEEH013B and UEENEEH039B and Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite

AQF Code	Certificate III Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
			statement
Reserved	<i>Certificate III in Wireless Communications</i>	<i>Certificate III in Wireless Communications</i>	
UEE31707	Certificate III in Hazardous areas – Electrician	UEE31706 Certificate III in Hazardous areas – Electrician	Part – All Pre-requisites removed from UEENEEG001B and UEENEEG002B and amendment of Pre-requisite statement in UEENEEM001B
UEE31807	Certificate III in Hazardous areas – Instrumentation	UEE31806 Certificate III in Hazardous areas – Instrumentation	Part - Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement and amendment of Pre-requisite statement in UEENEEM001B
UEE31907	Certificate III in Explosion-protected equipment overhaul	UEE31906 Certificate III in Explosion-protected equipment overhaul	Part – All Pre-requisites removed from UEENEEG001B and UEENEEG002B and amendment of Pre-requisite statement in UEENEEM007B
UEE32007	Certificate III in Renewable Energy - ELV	New	No

AQF Code	Certificate IV Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE40107	Certificate IV in Computer Systems	UEE40106 Certificate IV in Computer Systems	Part – All Pre-requisites removed from UEENEED002B
UEE40207	Certificate IV in Electrical – Data and Voice Communications	UEE40206 Certificate IV in Electrical – Data and Voice Communications	Full

AQF Code	Certificate IV Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE40307	Certificate IV in Electrical Installation Inspection and Audits	UEE40306 Certificate IV in Electrical Installation Inspection and Audits	Full
UEE40407	Certificate IV in Electrical – Instrumentation	UEE40406 Certificate IV in Electrical – Instrumentation	Full
UEE40507	Certificate IV in Electrical – Air-conditioning Systems	UEE40506 Certificate IV in Electrical – Air-conditioning Systems	Full
UEE40607	Certificate IV in Electrotechnology – Systems Electrician	UEE40606 Certificate IV in Electrotechnology – Systems Electrician	Full
UEE40707	Certificate IV in Electronics and Communications	UEE40706 Certificate IV in Electronics and Communications	Part – Removal of Pre-requisites from UEENEEH002B and UEENEEH011B and UEENEEH012B and UEENEEH013B and UEENEEH039B and Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE40807	Certificate IV in Electrical – Fire Protection Control Systems	UEE40806 Certificate IV in Electrical – Fire Protection Control Systems	Full
UEE40907	Certificate IV in Industrial Electronics and Control	UEE40906 Certificate IV in Industrial Electronics and Control	Part – Removal of Pre-requisites from UEENEEH043B and UEENEEH044B
UEE41007	Certificate IV in Energy Management and Control	UEE41006 Certificate IV in Energy Management and Control	Full

AQF Code	Certificate IV Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE41107	Certificate IV in Electrical – Lift Systems	UEE41106 Certificate IV in Electrical – Lift Systems	Part – Removal of Pre-requisites from UEENEEH043B and UEENEEH044B
UEE41207	Certificate IV in Electrical – Rail Signalling	UEE41206 Certificate IV in Electrical – Rail Signalling	Full
UEE41307	Certificate IV in Refrigeration and Air-conditioning Servicing	UEE41306 Certificate IV in Refrigeration and Air-conditioning Servicing	Full
UEE41407	Certificate IV in Refrigeration and Air-conditioning Systems	UEE41406 Certificate IV in Refrigeration and Air-conditioning Systems	Full
UEE41507	Certificate IV in Video and Audio Systems	UEE415076 Certificate IV in Video and Audio Systems	Part – Removal of Pre-requisites from UEENEEH002B and UEENEEH011B and UEENEEH012B and UEENEEH013B and UEENEEH039B and Inclusion of ‘or UEENEEH069B’ in UEENEEH014B Pre-requisite statement
UEE41607	Certificate IV in Renewable Energy	UEE41606 Certificate IV in Renewable Energy	Part – All Pre-requisites removed from UEENEEG002B
UEE41707	Certificate IV in Rail – Communications and Network Systems	UEE41706 Certificate IV in Rail – Communications and Network Systems	Part – Removal of Pre-requisites from UEENEEH002B and UEENEEH011B and UEENEEH012B and UEENEEH013B and UEENEEH039B and Inclusion of ‘or

AQF Code	Certificate IV Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
			UEENEEH069B' in UEENEEH014B Pre-requisite statement
UEE41807	Certificate IV in Hazardous areas	UEE41806 Certificate IV in Hazardous areas	Part – amendment of Pre-requisite statement in UEENEEEM004A
UEE41907	Certificate IV in Electrical – Renewable Energy	New	No

AQF Code	Diploma Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE50107	Diploma of Computer Systems Engineering	UEE50106 Diploma in Computer Systems Engineering	Full
UEE50207	Diploma of Electrical and Instrumentation	UEE50206 Diploma of Electrical and Instrumentation	Full
UEE50307	Diploma of Electrical and Refrigeration and Air-conditioning	UEE50306 Diploma of Electrical and Refrigeration and Air-conditioning	Full
UEE50407	Diploma of Electrical Engineering	UEE50406 Diploma in Electrical Engineering	Full
UEE50507	Diploma of Electronics and Communications Engineering	UEE50506 Diploma of Electronics and Communications Engineering	Full
UEE50607	Diploma of Refrigeration and Air-conditioning Engineering	UEE50606 Diploma of Refrigeration and Air-conditioning Engineering	Full
UEE50707	Diploma of Renewable Energy Engineering	UEE50706 Diploma of Renewable Energy	Full

AQF Code	Diploma Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
		Engineering	
UEE50807	Diploma of Research and Development	UEE50806 Diploma of Research and Development	Full
UEE50907	Diploma of Industrial Electronics and Control Engineering	UEE50906 Diploma of Industrial Electronics and Control Engineering	Part – Removal of Pre-requisites from UEENEEH043B and UEENEEH044B

AQF Code	Advanced Diploma Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE60107	Advanced Diploma of Electrical Engineering	Advanced Diploma in Electrical Engineering	Full
UEE60207	Advanced Diploma of Electronics and Communications Engineering	UEE60206 Advanced Diploma of Electronics and Communications Engineering	Full
UEE60307	Advanced Diploma of Electronic – Technology	UEE60306 Advanced Diploma of Electronic – Technology	Part – Pre-requisites removed from UEENEEH002B and UEENEEH025B, and UEENEEH011B and UEENEEH012B and UEENEEH039B
UEE60407	Advanced Diploma of Computer Systems Engineering	UEE60406 Advanced Diploma of Computer Systems Engineering	Part – All Pre-requisites removed from UEENEEH052B
UEE60507	Advanced Diploma of Computer Systems – Technology	UEE60506 Advanced Diploma of Computer Systems – Technology	Part – Pre-requisites removed from UEENEEH002B and UEENEEH012B
UEE60607	Advanced Diploma of Industrial Electronics and Control Engineering	UEE60606 Advanced Diploma of Industrial Electronics and Control Engineering	Part – All Pre-requisites removed from UEENEEH025B

AQF Code	Advanced Diploma Qualifications (UEE07)	Former Training Package (UEE06)	Equivalent – full, part, or no
UEE60707	Advanced Diploma of Refrigeration and Air-conditioning Engineering	UEE60706 Advanced Diploma of Refrigeration and Air-conditioning Engineering	Full
UEE60807	Advanced Diploma of Refrigeration and Air-conditioning – Technology	UEE60806 Advanced Diploma of Refrigeration and Air-conditioning – Technology	Part – All Pre-requisites removed from UEENEEE025B
UEE60907	Advanced Diploma of Renewable Energy Engineering	UEE60906 Advanced Diploma of Renewable Energy Engineering	Full
UEE61007	Advanced Diploma of Renewable Energy – Technology	UEE61006 Advanced Diploma of Renewable Energy – Technology	Part – All Pre-requisites removed from UEENEEED002B and UEENEEE025B
UEE61107	Advanced Diploma of Automated Systems Maintenance Engineering	UEE61106 Advanced Diploma of Automated Systems Maintenance Engineering	Part – All Pre-requisites removed from UEENEEE025B
UEE61207	Advanced Diploma of Engineering – Explosion protection	UEE61206 Advanced Diploma of Engineering – Explosion protection	Part – All Pre-requisites removed from UEENEEE025B and amendment of Pre-requisite statements in UEENEEM010B and UEENEEM015B
UEE61307	Advanced Diploma of Electrical – Technology	UEE61306 Advanced Diploma of Electrical – Technology	Part – All Pre-requisites removed from UEENEED001B and UEENEED002B

Allied Qualifications

Allied Qualifications relevant to the Electrotechnology Industry that reside in other nationally endorsed Training Packages.

AQF Code	Relates to	Training Package
UEG10109	Certificate I in Utilities Industry Operations	Gas Industry (UEG06)
UET20109	Certificate II in ESI Vegetation Control	ESI – Transmission, Distribution and Rail Sector (UET06)
UET20209	Certificate II in ESI Transmission Line Assembly	ESI – Transmission, Distribution and Rail Sector (UET06)
UET30109	Certificate III in ESI – Transmission (Powerline)	ESI – Transmission, Distribution and Rail Sector (UET06)
UET30209	Certificate III in ESI – Distribution (Powerline)	ESI – Transmission, Distribution and Rail Sector (UET06)
UET30309	Certificate III in ESI – Rail Traction	ESI – Transmission, Distribution and Rail Sector (UET06)
UET30409	Certificate III in ESI – Cable Jointing	ESI – Transmission, Distribution and Rail Sector (UET06)
UET40109	Certificate IV in ESI – Power Systems	ESI – Transmission, Distribution and Rail Sector (UET06)
UET40209	Certificate IV in ESI – Substation	ESI – Transmission, Distribution and Rail Sector (UET06)
UET50109	Diploma of ESI – Power Systems	ESI – Transmission, Distribution and Rail Sector (UET06)
UET60109	Advanced Diploma of ESI – Power Systems	ESI – Transmission, Distribution and Rail Sector (UET06)
UEG20106	Certificate II in Utilities Industries Operations	Gas Industry (UEG06)
UEP40506	Certificate IV in ESI Generation Maintenance (Electrical/Electronic)	ESI Generation Sector (UEP06)
UEP50406	Diploma of ESI Generation (Electrical/Electronic)	ESI Generation Sector (UEP06)

List of Possible Skills Set CSUs

Unit Code

Unit Title

Unit Code	Unit Title
UEENEEA006B	Apply lead-free soldering techniques
UEENEEB001B	Operate and maintain an amateur radio communication station
UEENEEED007B	Develop, enter and verify programs for programmable logic controllers using ladder instruction set
UEENEEED031B	Develop and validate basic integrated systems
UEENEEED032B	Design integrated systems
UEENEEED033B	Design complex integrated systems
UEENEEEE006B	Apply methods to maintain currency of industry developments
UEENEEEE008B	Lay wiring/cabling and terminate accessories for extra-low voltage circuits
UEENEEEE021B	Plan an integrated cabling system
UEENEEEE025B	Solve problems in complex multiple path circuits
UEENEEEE026B	Provide computational solutions to basic engineering problems
UEENEEEE029B	Solve electrotechnical problems
UEENEEEE030B	Provide solutions to and report on routine electrotechnology problems
UEENEEEE038B	Participate in development and follow a personal competency development plan
UEENEEF006B	Solve problems in data and voice communications circuits
UEENEEG075A	Develop compliance policies and plans to conduct a contracting business
UEENEEJ168A	Maintain microbial control of refrigeration and air conditioning systems
UEENEEM080A	Report on the integrity of explosion-protected equipment in a hazardous area

Unit Code	Unit Title
UEENEEM076A	Use and maintain the integrity of a portable gas detection device
UEENEEM077A	Install and maintain the integrity of fixed gas detection equipment
UEENEEM078A	Manage compliance of hazardous areas
UEENEEM079A	Design of gas detection systems
UEENEEM020A	Attend to breakdowns in hazardous areas — gas atmospheres
UEENEEM021A	Attend to breakdowns in hazardous areas — dust atmospheres
UEENEEM022A	Attend to breakdowns in hazardous areas — pressurisation
UEENEEM023A	Install explosion-protected equipment and wiring systems — coal mining
UEENEEM024A	Install explosion-protected equipment and wiring systems — gas atmospheres
UEENEEM025A	Install explosion-protected equipment and wiring systems — dust atmospheres
UEENEEM026A	Install explosion-protected equipment and wiring systems — pressurisation
UEENEEM028A	Maintain equipment in hazardous areas — gas atmospheres
UEENEEM029A	Maintain equipment in hazardous areas — dust atmospheres
UEENEEM030A	Maintain equipment in hazardous areas — pressurisation
UEENEEM032A	Overhaul and repair of explosion-protected equipment — flameproof enclosures
UEENEEM033A	Overhaul and repair of explosion-protected equipment — gas atmospheres
UEENEEM034A	Overhaul and repair of explosion-protected equipment — dust atmospheres

Unit Code	Unit Title
UEENEEM036A	Conduct a conformity assessment of explosion-protected equipment — gas atmospheres
UEENEEM037A	Conduct a conformity assessment of explosion-protected equipment — dust atmospheres
UEENEEM039A	Conduct testing of hazardous area installations — gas atmospheres
UEENEEM040A	Conduct testing of hazardous area installations — dust atmospheres
UEENEEM041A	Conduct testing of hazardous area installations — pressurisation
UEENEEM042A	Conduct visual inspection of hazardous areas installations
UEENEEM044A	Conduct detailed inspection of hazardous areas installations — gas atmospheres
UEENEEM045A	Conduct detailed inspection of hazardous areas installations — dust atmospheres
UEENEEM046A	Conduct detailed inspection of hazardous areas installations — pressurisation
UEENEEM048A	Develop and manage maintenance programs for hazardous areas electrical equipment — gas atmospheres
UEENEEM049A	Develop and manage maintenance programs for hazardous areas electrical equipment — dust atmospheres
UEENEEM050A	Develop and manage maintenance programs for hazardous areas electrical equipment — pressurisation
UEENEEM052A	Classify hazardous areas — gas atmospheres
UEENEEM053A	Classify hazardous areas — dust atmospheres
UEENEEM054A	Plan electrical installations for hazardous areas — gas atmospheres

Unit Code	Unit Title
UEENEEM055A	Plan electrical installations for hazardous areas — dust atmospheres
UEENEEM056A	Plan electrical installations for hazardous areas — pressurisation
UEENEEM057A	Design explosion-protected electrical systems and installations — gas atmospheres
UEENEEM058A	Design explosion-protected electrical systems and installations — dust atmospheres
UEENEEM059A	Design explosion-protected electrical systems and installations — pressurisation
UEENEEM061A	Carry out overhaul and repair of explosion-protected equipment — flameproof enclosures
UEENEEM062A	Carry out overhaul and repair of explosion-protected equipment — gas atmospheres
UEENEEM063A	Carry out overhaul and repair of explosion-protected equipment — dust atmospheres
UEENEEM065A	Conduct audit of hazardous areas installations — gas atmospheres
UEENEEM066A	Conduct audit of hazardous areas installations — dust atmospheres
UEENEEM068A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — gas atmospheres
UEENEEM069A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — dust atmospheres
UEENEEM070A	Repair reeling, trailing and flexible cables
UEENEEM071A	Test reeling, trailing and flexible cables
UEENEEM072A	Inspect and fit plugs/couplers for reeling, trailing and flexible cables
UEENEEM073A	Verify compliance of repaired reeling, trailing and flexible cables
UEENEEM001B	Disconnect and reconnect fixed wired electrical equipment connected to a Low Voltage supply

Unit Code	Unit Title
UEENEEP002B	Attach cords and plugs to electrical equipment for connection to a single phase 250 Volt supply
UEENEEP003B	Attach cords and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply
UEENEEP004B	Disconnect and reconnect explosion-protected electrical equipment connected to Low Voltage supply
UEENEEP005B	Disconnect and reconnect 3.3 kV electric propulsion components of self-propelled earth moving vehicles
UEENEEP006B	Attach flexible cables and plugs to electrical equipment connected to a high voltage supply
UEENEEP007B	Locate and rectify faults in electrical low voltage equipment following prescribed procedures
UEENEEP008B	Conduct in-service safety testing of electrical cord assemblies and cord connected equipment

Skill Sets

Definition

Skill sets are defined as single units of competency, or combinations of units of competency from an endorsed Training Package, which link to a licence or regulatory requirement, or defined industry need.

Wording on Statements of Attainment

Skill sets are a way of publicly identifying logical groupings of units of competency which meet an identified need or industry outcome. Skill sets are not qualifications.

Where skill sets are identified in a Training Package, the Statement of Attainment can set out the competencies a person has achieved in a way that is consistent and clear for employers and others. This is done by including the wording ‘these competencies meet [insert skill set title or identified industry area] need’ on the Statement of Attainment. This wording applies only to skill sets that are formally identified as such in the endorsed Training Package. See the 2010 edition of the AQF Implementation Handbook for advice on wording on Statements of Attainment. http://www.aqf.edu.au/Portals/0/Documents/Handbook/AQF_Handbook_07.pdf

Skill Sets in this Training Package

This section provides information on Skill Sets within this Training Package, with the following important disclaimer: Readers should ensure that they have also read the part of the Training Package that outlines licensing and regulatory requirements.

Identified Skill Sets

Skill Set - Designer of Grid Connected Photovoltaic Systems

Skill Set –Installer of Grid Connected Photovoltaic Systems

Skill Set – Designer/Installer of Grid Connected Photovoltaic Systems

Skill Set – Energy Efficiency Auditor

Skill Set – Energy Efficiency Systems Developer

Skill Set – Energy Efficiency Systems Designer

Skill Set – Identify Energy Efficiency Strategies

Skill Set –Energy Efficiency Systems Integration

Skill Set – Plan the installation of integrated systems

Skill Set – Develop integrated systems

Skill Set – Develop a integrated system interface for access through a touch screen

Skill Set – Develop access control of integrated systems using logic-based programming tools

Skill Set – Develop interfaces for multiple access methods to monitor, schedule and control an integrated system

Skill Set – Design Complex Carbon Dioxide Refrigeration Systems

Skill Set – Design Secondary Refrigeration Systems

Skill Set – Design Hydrocarbon Refrigeration Systems

Skill Set – Design Ammonia Refrigeration Systems

Skill Set – Service and Repair Hydrocarbon Refrigeration and Air Conditioning Systems

Skill Set – Service and Repair Carbon Dioxide Refrigeration and Heat Pump Systems

Skill Set – Install and Commission Hydrocarbon Refrigeration Systems, Major Components and Associated Equipment

Skill Set – Service and Repair Ammonia Refrigeration Systems

Skill Set – Install and Commission Ammonia Refrigeration Systems

Skill Set – Service and Repair Secondary Refrigeration Systems

Skill Set – Service and Repair Carbon Dioxide Refrigeration Systems

Skill Set – Install and Commission Carbon Dioxide Refrigeration Systems

Skill Set – Operate Ammonia Refrigeration Plant

Skill Set – Attend to Breakdowns in Hazardous Areas - Coal Mining

Skill Set – Install Explosion-Protected Equipment and Wiring Systems - Coal Mining

Skill Set – Maintain Equipment in Hazardous Areas - Coal Mining

Skill Set – Overhaul and Repair of Explosion-Protected Equipment - Coal Mining

Skill Set – Conduct a Conformity Assessment of Explosion-Protected Equipment - Coal Mining

Skill Set – Conduct Testing of Hazardous Areas Installations - Coal Mining

Skill Set – Conduct Detailed Inspection of Hazardous Areas Installations - Coal Mining

Skill Set – Develop and Manage Maintenance Programs for Hazardous Areas Electrical Equipment - Coal Mining

Skill Set – Carry Out Overhaul and Repair of Explosion-Protected Equipment - Coal Mining

Skill Set – Conduct Audit of Hazardous Areas Installations - Coal Mining

Skill Set – Plan Electrical Installations in Hazardous Areas - Coal Mining

Skill Set – Design Explosion-Protected Electrical Systems - Coal Mining

Skill Set – Restricted Telecommunications Cabler Registration - ACMA

Skill Set – ACMA Restricted Telecommunications Cabling Registration

Skill Set – ACMA ‘Open’ Cabling Provider

Skill Set – Install and Modify Performance Data Communication Structured Cabling

Skill Set – Install and Modify Performance Data Communication Optical Fibre Cabling

Skill Set – Install Aerial Communication Cables

Skill Set – Install Below Ground Communication Cables

Skill Set – Install and Set Up Interval Metering

1.1.02 Qualification Structures

1.2 Qualification Structures

Qualification structures have been developed to satisfy flexibility, quality of outcomes, equity and consistency, while achieving valid alignment with the Australian Qualifications Framework (AQF). This provides a range of purpose-built qualifications at the various AQF levels that align to specific and well recognised workplace outcomes. It also identifies a range of emerging new areas within the Electrotechnology industry.¹

¹ Consideration has been given to the relationship of the Electrotechnology Training Package with the suite of EE-Oz Training Standards EnergyUtilities and other allied Training Packages in ESI – Generation Sector; ESI – Transmission, Distribution and Rail Sector and the Gas Industry, as well as Metals and Engineering; Telecommunications and others.

Following significant research with key industry stakeholders, regulators, RTOs and industry practitioners, qualification titles were chosen to meet the needs of the market now and into the future.

Recommendations followed on how best to structure and determine the completion requirements of a qualification, and a system was introduced which supports flexibility in selecting elective units. The resulting design:

- includes purpose-built qualifications that meet the need of the Industry
- facilitates flexibility by maximising the range of options available within the purpose built qualifications structures
- satisfies quality requirements by ensuring the integrity of the AQF in terms of balance between equity and flexibility within and across competency levels
- takes into account any prevailing regulatory requirements
- achieves consistency of outcomes across the range of qualifications on offer at all AQF levels.

It was decided to ‘cluster’ or package the competency standard units in three groups – Core, Stream Core and Elective – aligned to an AQF level. For the Elective group, a Unit Strand Electives system was developed and adopted to facilitate choice. In this system elective units are valued (relative to other units and their work outcomes for the qualification) by placing them in pre-defined levels, known as Strands.

The Strand Elective system ensures that characteristics and distinguishing features as defined by the AQF are met for each qualification outcome. It reflects realistic enterprise work outcomes across the respective AQF levels and equity in actual worth, breadth, depth and complexity of performance outcomes.

The structuring, composition and required completion rules for the qualifications were determined with the following in mind.

Core	<i>Core Units are compulsory units required for the industry.</i> They represent a substantive and/or technical focus part of the overall group of competency standard units that make up the qualification and, its intended outcome. Being compulsory the core units are not valued for the purpose of the qualification completion requirements.
Stream Core	<i>Stream Core Units are units required for supporting enterprise outcomes.</i> They represent those units that provide flexibility related to particular enterprise quality assurance arrangements including administrative matters related to enterprise practices and work outcomes. Being compulsory the stream core units are not valued for the purpose of the qualification completion requirements.

Electives *Elective Units are those units that provide the flexibility required specifically for enterprise work outcomes.*

They represent the particular needs associated with more specific work contexts. They are included to meet these particular work organisation and skill requirements of enterprises whilst contributing to the completion requirements of the qualification. Elective Units are treated as complementary and as key building blocks in enhancing the contextualisation and relevance of outcomes of the Core Units within the qualification. They are included in a Schedule of Electives for each AQF level and assigned a Unit Strand Total to facilitate flexibility.

Note: Certain Core Units in one qualification may appear as Elective Units in another and so a Unit Strand Total is assigned to them all.

Each qualification stands alone but different qualifications may share some common units.

Contextualisation

The need for contextualising competency standard units is acknowledged, but is acceptable/valid only if:

- the contextualisation does not weaken the units relationship with prevailing legislation in any jurisdiction, regulatory codes of practice, guidelines and advisory standard requirements mandated by a relevant State/Territory electricity or regulatory authority
- all pre-requisites are included
- industry or enterprise-developed competency standard units that are added to the elective group of units within the qualification framework:
 - are an allied skills set which is complementary to the core competency standard units
 - do not change the intended vocational outcome or equity of the overall qualification
 - are submitted to the ElectroComms and EnergyUtilities Industry Skills Council Ltd trading as EE-Oz Training Standards for approval and inclusion into this Training Package in accordance with the importation rules and continuous improvement arrangements defined by the National Quality Council.

Regulatory arrangements

The development of qualifications in this Training Package has taken account of the requirements of the licensing and regulatory authorities using qualifications in the Package. In constructing the qualifications due consideration has been given to the link between issuing of a qualification and any licensing/registration implication. Every effort has been made to ensure currency in regulatory requirements is included and RTOs must ensure these are observed. This includes utilising any recommended industry training program designed to meet the competency standard units and qualification outcome(s) related to licensing/registration applications.

It is expected that the assessment and preferred training regime, which meets the competency outcomes of the qualification will also meet the regulatory requirements. For instance, the Electrical Regulatory Authorities Council (ERAC) promulgated a policy in March 2001 important to both RTOs and apprentice electricians to ensure that persons being trained and assessed as electricians have met national licensing requirements.

The ERAC policy required that where a Training Program is recommended by the industry it shall be delivered by an RTO. The policy stated that, *"Failure by an RTO to provide evidence (to the satisfaction of the relevant licensing authority) that the training (including assessment) delivered to a licence applicant satisfies the stated requirements and forms an integral part of an approved Training Package qualification², which means the applicant has successfully passed a 'electrical safety assessment' in accordance with specified requirements, will result in the applicant being required to undertake further assessments at the discretion of the licensing authority."*

¹ Approved Training Package means a National Quality Council (NQC) endorsed Training Package qualification, that includes the 'electrical safety assessment' as approved by ERAC/NUELAC, within the respective industry's Training Program where recommended (ERAC Policy released 1st July 2001).

It must be remembered that an RTO registered under the Australian Quality Training Framework (AQTF 2007) is given full responsibility for deeming a learner/apprentice competent for the competency standard units making up a Training Package qualification. Where the learner/apprentice is deemed competent and is to be issued the qualification/statement for the competency standard units, the RTO must also provide all the necessary documentation required by the regulatory authority to support an application of eligibility.

Statutory/Regulatory requirements may apply at the qualification, Skill Set or individual unit level. Where a component has a regulatory requirement it is identified in the following sections:

- Competency Standard – Unit Descriptor 1.2) License to practice
- Identified Skill Set – Target Group
- Qualification – Scope

Users should be aware that Statutory/Regulatory requirements may apply to pre-requisite units and ensure that these are taken into account.

Current information on national and jurisdictional licensing requirements can be obtained from:

<http://www.licensinglinenews.com/> or the relevant authority in their jurisdiction:

State Electrical Regulatory Bodies		
Jurisdiction	Organisation	Website

Australian Capital Territory	ACT Planning and Land Authority	www.actpla.act.gov.au
New South Wales	Office of Fair Trading	www.fairtrading.nsw.gov.au
Northern Territory	Electrical Workers and Contractors Licensing Board	www.electricallicensing.nt.gov.au
Queensland	Department of Employment and Industrial Relations	www.deir.qld.gov.au
South Australia	Office of Consumer and Business Affairs	www.ocba.sa.gov.au
Tasmania	Workplace Standards Tasmania	www.wst.tas.gov.au
Victoria	Energy Safe Victoria	www.esv.vic.gov.au
Western Australia	Department of Consumer and Employment Protection	www.energysafety.wa.gov.au

Statutory Authorities		
Jurisdiction	Organisation	Website
Australia	australia.gov.au	www.australia.gov.au/306
Australian Capital Territory	ACT Legislation Register	www.legislation.act.gov.au
New South Wales	Parliamentary Counsel's Office	www.legislation.nsw.gov.au
Northern Territory	Department of the Chief Minister	www.nt.gov.au/dcm/legislation/current.html
Queensland	Office of the Queensland Parliamentary Counsel	www.legislation.qld.gov.au/oqpchome.htm
South	Parliament of South Australia	www.legislation.sa.gov.au

Australia		
Tasmania	Tasmanian Legislation	www.thelaw.tas.gov.au/index.w3p
Victoria	Victorian Legislation and Parliamentary Documents	www.legislation.vic.gov.au
Western Australia	State Law Publisher	www.slp.wa.gov.au

Flexibility – Schedules of Electives

The Qualification Framework Structures provide maximum flexibility permissible within the regulated context of the Industry and for all parties using the qualifications. It includes a range of imported units.

The qualifications have been structured to meet the needs of the industry and enhance flexibility for enterprise outcomes. Particular regard has been given to allowing sufficient access for all employers and their employees.

The qualifications contain a core and stream core requirement supplemented by a broad range of electives, broad enough to reflect and respond to diverse approaches to work requirements and organisation needs. A wide range of elective competency standard units are distributed across a selection of discipline areas.

A process to facilitate flexibility in the choice of electives has been developed. Units are placed in Schedules that are aligned to an AQF level. Each qualification references the relevant Schedule and advises as to the unit strand total required for completion. In this way many qualifications at the same AQF level can access a common bank and defined group of electives. Within each schedule relevant units have been placed into **strands** to facilitate work outcomes for the qualification, as specified by industry stakeholders.

1.1.03 Valuation of Competency Standard Units

1.3 Valuation of Competency Standard Units

Competency Standard Units – Valuation processes and procedures

‘The "size" of a Competency standard unit is a reflection of the complexity of skills and knowledge incorporated, or the range of activities undertaken, which may vary’. (Training Package Developer’s Handbook Part 2 Section 1)

To ensure optimisation of flexibility and equity of the AQF vocational outcomes across qualifications and to maintain the integrity of the Core AQF alignment within the qualification, values for each of the elective unit(s) have been attributed relative to the Core Units. The greater the breadth and complexity, the higher the relative weighting.

Each Elective Unit is assigned a strand value that reflects its level of content, breadth, complexity, autonomy, context, and comparative effort of application related to work performance, relative to the Core Units of the qualification. For each AQF level there is one Schedule of Electives from which the electives are selected.

The completion guidelines for the Elective Units (unit strand totals) are based on an industry-developed competency standard valuing system which takes into account the total electives required to 'facilitate' the completion of a qualification and typically meet workplace needs.

The elective units selected for completion of the qualification require relevant pre-requisites to be attained and these too may require a 'weighting' relative to the core of the qualification.

The unit valuation process does not provide a perfect solution for all situations however the relative weighting assigned to elective units has been determined by the industry and coordinated by EE-Oz Training Standards.

Elective Strand Selection

Qualification completion requirements allow the completion of units from *up to eight (8) Strands* within each qualification Schedule. Each Schedule provides further advice on how to achieve any one of a variety of outcomes.

Below is an example of how elective units can be selected from the relevant Schedule of Electives and associated Strands.

Certificate III in Data and Voice Communications – UEE30407

Core Competency Standard Units	Must do all CSUs listed
Stream Core Competency Standard Units	Must do at least the required number of CSUs from a given selection
Elective CSU selection:	Must achieve a minimum Unit Strand Total (UST) of 18 for this qualification.
The unit strand total required for each qualification appears in the qualifications structures, at 1.11.2. For example for UEE30910 Certificate III in Electronics and Communications a minimum of 18 is required.	Important: The qualification references Schedule 3 of the Schedule of Electives and is to be used for selecting electives. Schedule 3 is aligned to AQF3 and forms an integral part of the qualification structure. Units are selected as required to meet workplace outcomes using one Strand or several or a combination of strands to achieve a total of 18 as per below.
Alternatively the minimum UST can be found at section 1.5.2 Qualification completion unit strand totals.	

Note:

1. Pre-requisite pathways are to be identified and met for all elective units selected.
2. In selecting elective units consideration is to be given to career planning advice such that they form part of a pre-requisite pathway for the progression to achieve particular competencies or qualification at a higher level.

Selecting Elective Units using the Unit Strand Total (UST) requirement

UST required for qualification on completion = at least 11	Can use the following combinations from Schedule 3 Electives to achieve the outcome. <i>That is, by selecting relevant and available units in respective Strands</i>						UST
	UST 6	UST 5	UST 4	UST 3	UST 2	UST 1	
Option 1	1 x Strand 6	1 x Strand 5					11
Option 2		1 x Strand 5	1 x Strand 4		1 x Strand 2		11
Option 3			2 x Strand 4			1 x Strand 3	11
Option 4			2 x Strand 4		1 x Strand 2	1 x Strand 1	11
Option 5				2 x Strand 3	1 x Strand 2	1 x Strand 1	11
Option 6						11 x Strand 1	11
Option 7		1 x Strand 5				6 x Strand 1	11
An array of other combinations can be used provided the sum value of the Unit Strand Total is at least eleven (11).							11

Example Schedule

Schedule of Electives – 3

Competency standard units have been put into strands to facilitate work outcomes for the qualification, as specified by industry stakeholders. This design feature has been developed to enhance flexibility for enterprise outcomes.

Strand 6

UEENEEA010B Assemble, mount and connect switchgear and controlgear

UEENEEH012B Support computer hardware and software

This is only a sample and more Competency Standard Units apply

Strand 5

UEENEEH051B Install large wired and wireless security systems

UEENEEJ053B Find and rectify faults in appliance motors and associated controls

This is only a sample and more Competency Standard Units apply

Strand 4

UEENEEH012B Troubleshoot digital subsystems

UEENEEH018B Find and repair faults in electronic apparatus

UEENEEP001B Disconnect and reconnect fixed wired electrical equipment connected to a Low Voltage supply

This is only a sample and more Competency Standard Units apply

Strand 3

UEENEEA012B Make up and assemble bus bars

UEENEEA013B Assemble and wire control panels

UEENEEH007B Develop, enter and verify programs for programmable logic controllers using ladder instruction set

This is only a sample and more Competency Standard Units apply

Strand 2

UEENEEA004B Rework electronic sub assemblies

UEENEEG057B Conduct electrical tests on low voltage electrical machines

UEENEEG059B Conduct mechanical tests of electrical machines

UEENEEH024B Carry out repairs of predictable faults in audio components

UEENEEJ067B Solve problems in central air conditioning systems

UEENEEJ068B Maintain microbial control of air and water systems

This is only a sample and more Competency Standard Units apply

Strand 1

UEENEEA002B Select electronic components

UEENEEE005B Fix and secure equipment

This is only a sample and more Competency Standard Units apply

Imported units

To further enhance flexibility the Electrotechnology Training Package has imported a number of nationally endorsed competency standard units from other training packages. Many of these have been identified for use in the elective range of the qualifications on offer. They have been valued in accordance with the valuation rules determined for this Training Package.

It is important that all parties, especially regulators and users of this Training Package are aware of the need to import new competency standard units to meet new technology, shared/converging technology, specialist or other changing needs. Given the high degree of imported units already included in this Package, it is anticipated that this option is not likely to occur frequently.

The importing process

RTOs and enterprises may submit units for inclusion into the Training Package. Units submitted for importation are processed and valued in accordance with the Training Package requirements.

Where enterprises or RTOs wish to have CSUs included in the elective group of units or in the core of a particular qualification(s), they can do so in accordance with the ‘*Process for importation and valuation*’ section (below).

Imported units may be:

- those from other industries, which have been nationally endorsed by the National Quality Council (NQC) **and/or**
- those developed at an enterprise or local level and submitted for inclusion in the range of Electrotechnology Industry Competency Standards.

All imported units are to be valued against the same criteria as applied to the Electrotechnology Industry Competency Standards.³

¹ The process for inclusion and valuation of imported units is coordinated by the EE-Oz Training Standards, the DEEWR-declared Industry Skill Council for ElectroComms and EnergyUtilities Industry. Where assistance is required in this regard, contact EE-Oz Training Standards.

1.1.04 Qualifications - Completion requirements framework

1.4 Qualifications – Completion requirements framework

Qualifications have been structured to provide an appropriate mix of competency standard units to enhance flexibility while assuring equity of work and quality of outcomes.

The requirements for individuals to complete each qualification are outlined in the Qualification Structure. Each qualification describes the minimum requirement for the issuing of the qualification. Individuals may undertake additional elective unit's concurrent with or after the completion of the qualification.

Typically the trigger for a qualification contained in the Electrotechnology Industry Qualifications Structure is the completion of elective units and Stream Core Units in addition to the required Core Units.

In delivering approved training plans, RTOs must provide advice and ensure that all the critical aspects of evidence are present on completion of the units that make up the qualification.

Any units taken in addition to the minimum requirements of the qualification are not to be reported with those completion requirements; they are to be appended.

Endorsements

In some instances there may be a requirement for a formal statement of '*endorsement*' to be issued to individuals for a particular range of outcomes within a competency standard unit. Individuals are required to confirm this for compliance with regulatory or industry duty-of-care purposes. The information required to be reported on is detailed in the relevant unit and confirms the context in which the individual was deemed competent.

In such cases included in this Training Package further information will be provided. Examples of this are:

UEENEPP001B is the unit *Disconnect and reconnect fixed wire electrical equipment connected to supplies up to 1000 Volts a.c. or 1500 Volts d.c.* which has several endorsed categories of work – Pre-assembled types 1 and 2 cold cathode neon signs (N); Composite equipment incorporating one or more current-using devices and/or controls (P); Control devices (Q); Electrical water heaters (R); Motors (S) The alpha letter following each category of work is for references purposes and does not need to be reported. However, this competency standard unit does require the respective endorsed category of work to be reported. For example in the case of Motors, the endorsement is (*motors*).

The transcript of record(s) and report(s) is to appear as:

UEENEPP001B Disconnect and reconnect fixed wired electrical equipment connected to supplies up to 1000 Volts a.c. or 1500 Volts d.c. (*motors*)

Unit Strand Totals (USTs) for qualification completion

The following tables detail the full range of qualifications, including their respective structure, composition and requirements. The completion rules that apply for each qualification are included in the Qualifications Structure below.

AQF Code	Certificate I Qualifications	Core UST	Stream Core UST	Elective UST
UEE10110	Certificate I in ElectroComms Skills	6	Nil	3

AQF Code	Certificate II Qualifications	Core UST	Stream Core UST	Elective UST
UEE20111	Certificate II in Air-conditioning Split and Heat Pump Systems	17	Nil	1
UEE20207	Certificate II in Business Equipment Servicing	16	Nil	2
	<i>Certificate II in Electrotechnology Business Support*</i>	–	<i>Nil</i>	–
UEE20407	Certificate II in Winding and Assembly	14	Nil	2
UEE20507	Certificate II in Computer Assembly and Repair	17	Nil	2
UEE20607	Certificate II in Custom Electronics Assembly and Setup	17	Nil	1
UEE20707	Certificate II in Data and Voice Communications	20	Nil	0
UEE20810	Certificate II in Electrical Wholesaling	15	Nil	2
UEE20907	Certificate II in Electronic Assembly	13	Nil	6
UEE21007	Certificate II in Fire Alarms Servicing	19	Nil	2
UEE21107	Certificate II in Gaming Machines Servicing	14	Nil	4
UEE21207	Certificate II in Antennae Equipment	16	Nil	2

AQF Code	Certificate II Qualifications	Core UST	Stream Core UST	Elective UST
UEE21310	Certificate II in Remote Area Essential Service	6	Nil	18
UEE21407	Certificate II in Remote Area Power Supply Maintenance	7	Nil	11
UEE21510	Certificate II in Renewable Energy	19	Nil	3
UEE21610	Certificate II in Security Assembly and Setup	18	Nil	1
UEE21707	Certificate II in Technical Support	17	Nil	2
UEE21907	Certificate II in Electronics	11	Nil	8
UEE22010	Certificate II in Electrotechnology (Career Start)	9	Nil	7
UEE22107	Certificate II in Sustainable Energy (Career Start)	11	Nil	6

AQF Code	Certificate III Qualifications	Core UST	Stream Core UST	Elective UST
UEE30107	Certificate III in Business Equipment	47	Nil	6
UEE30207	Certificate III in Computer Systems Equipment	27	Nil	26
UEE30310	Certificate III in Custom Electronics Installations	34	Nil	19
UEE30407	Certificate III in Data and Voice Communications	44	Nil	9
UEE30607	Certificate III in Electrical Machine Repair	46	Nil	9
UEE30707	Certificate III in Switchgear and Control Gear	48	Nil	5
UEE30807	Certificate III in Electrotechnology	47	Nil	6

AQF Code	Certificate III Qualifications	Core UST	Stream Core UST	Elective UST
	Electrician			
UEE30910	Certificate III in Electronics and Communications	35	Nil	18
UEE31007	Certificate III in Fire Protection Control	40	Nil	13
UEE31107	Certificate III in Gaming Electronics	44	Nil	9
UEE31210	Certificate III in Instrumentation and Control	49	Nil	4
UEE31410	Certificate III in Security Equipment	48	Nil	5
UEE31507	Certificate III in Rail – Communications and Networks	34	Nil	19
	<i>Certificate III in Wireless Communications*</i>	–	Nil	–
UEE31710	Certificate III in Hazardous areas – Electrician	48	Nil	5
UEE31810	Certificate III in Hazardous areas – Instrumentation	50	Nil	3
UEE31910	Certificate III in Explosion-protected equipment overhaul	49	Nil	4
UEE32010	Certificate III in Renewable Energy - ELV	37	Nil	16
UEE32111	Certificate III in Appliance Service	42	Nil	11
UEE32211	Certificate III in Air-conditioning and Refrigeration	50	Nil	3
AQF Code	Certificate IV Qualifications	Core UST	Stream Core UST	Elective UST
UEE40110	Certificate IV in Computer Systems	27	Nil	37
UEE40210	Certificate IV in Electrical – Data and Voice Communications	62	Nil	2

AQF Code	Certificate IV Qualifications	Core UST	Stream Core UST	Elective UST
UEE40310	Certificate IV in Electrical Installation Inspection and Audits	51	Nil	13
UEE40410	Certificate IV in Electrical – Instrumentation	56	Nil	8
UEE40510	Certificate IV in Electrical – Air-conditioning Systems	54	Nil	10
UEE40610	Certificate IV in Electrotechnology – Systems Electrician	46	Nil	18
UEE40710	Certificate IV in Electronics and Communications	34	Nil	30
UEE40810	Certificate IV in Electrical – Fire Protection Control Systems	57	Nil	7
UEE40910	Certificate IV in Industrial Electronics and Control	52	Nil	12
UEE41010	Certificate IV in Energy Management and Control	52	Nil	12
UEE41110	Certificate IV in Electrical – Lift Systems	58	Nil	6
UEE41210	Certificate IV in Electrical – Rail Signalling	47	Nil	17
UEE41510	Certificate IV in Video and Audio Systems	47	Nil	17
UEE41610	Certificate IV in Renewable Energy	59	Nil	5
UEE41710	Certificate IV in Rail – Communications and Network Systems	35	Nil	29
UEE41910	Certificate IV in Electrical – Renewable Energy	56	Nil	8
UEE42010	Certificate IV in Electrical – Photovoltaic Systems	54	Nil	8
UEE42110	Certificate IV in Electrotechnology – Electrical Contracting	50	Nil	14
UEE42410	Certificate IV in Hazardous areas – Industrial control	49	Nil	15

AQF Code	Certificate IV Qualifications	Core UST	Stream Core UST	Elective UST
UEE42610	Certificate IV in Hazardous areas - Electrical	47	Nil	17
UEE42711	Certificate IV in Air-conditioning and Refrigeration Servicing	55	Nil	9
UEE42811	Certificate IV in Air-conditioning Systems Energy Management and Control	56	Nil	8
UEE42911	Certificate IV in Refrigeration and Air-conditioning Systems	61	Nil	3

AQF Code	Diploma Qualifications	Core UST	Stream Core UST	Elective UST
UEE50110	Diploma of Computer Systems Engineering	5	Nil	75
UEE50210	Diploma of Electrical and Instrumentation	71	Nil	9
UEE50310	Diploma of Electrical and Refrigeration and Air-conditioning	71	Nil	9
UEE50410	Diploma of Electrical Engineering	48	Nil	32
UEE50510	Diploma of Electronics and Communications Engineering	5	Nil	75
UEE50710	Diploma of Renewable Energy Engineering	48	Nil	32
UEE50810	Diploma of Research and Development	30	Nil	50
UEE50910	Diploma of Industrial Electronics and Control Engineering	54	Nil	26
UEE51010	Diploma of Instrumentation and Control Engineering	56	Nil	24
UEE51111	Diploma of Engineering Technology – Refrigeration and Air-conditioning	49	Nil	31
UEE51211	Diploma of Air-conditioning and Refrigeration Engineering	73	Nil	7

AQF Code	Advanced Diploma Qualifications	Core UST	Stream Core UST	Elective UST
UEE60210	Advanced Diploma of Electronics and Communications Engineering	13	Nil	80
UEE60410	Advanced Diploma of Computer Systems Engineering	13	Nil	80
UEE60610	Advanced Diploma of Industrial Electronics and Control Engineering	96	Nil	12
UEE60910	Advanced Diploma of Renewable Energy Engineering	63	Nil	45
UEE61110	Advanced Diploma of Automated Systems Maintenance Engineering	28	Nil	80
UEE61210	Advanced Diploma of Engineering Explosion protection	62	Nil	46
UEE61410	Advanced Diploma of Engineering – Explosion protection - Industrial control	62	Nil	46
UEE61510	Advanced Diploma of Instrumentation and Control Engineering	70	Nil	38
UEE61710	Advanced Diploma of Engineering Technology - Electronic	46	Nil	46
UEE61810	Advanced Diploma of Engineering Technology - Computer Systems	45	Nil	45
UEE62010	Advanced Diploma of Engineering Technology - Renewable Energy	37	Nil	53
UEE62110	Advanced Diploma of Engineering Technology - Electrical	58	Nil	50
UEE622211	Advanced Diploma of Electrical – Engineering	84	Nil	24
UEE62311	Advanced Diploma of Electrical Engineering – Coal Mining	92	Nil	16
UEE62411	Advanced Diploma of Engineering Technology – Air-conditioning and Refrigeration	67	Nil	41
UEE62511	Advanced Diploma of Air-conditioning and	96	Nil	12

AQF Code	Advanced Diploma Qualifications	Core UST	Stream Core UST	Elective UST
	Refrigeration Engineering			

** To be developed as part of continuous improvement*

1.1.05 Qualifications and Competency - Recognition/Issuance Requirements

1.5 Qualifications and Competency – Recognition/Issuance Requirements

Formal recognition of competency achievement may be in the form of:

- a full qualification in accordance with the criteria established under the Electrotechnology Industry Qualifications Framework and Structure.
- a Statement of Attainment, and where appropriate an authorised entry in an individual's Statement of Competency or Industry Skills Passport or other approved instrument, which recognises the attainment of one or more individual competency standard units.

Formal recognition of these types is to be issued by an RTO. The recognition is to be recorded in formats established by these requirements and/or relevant State Training Authorities and is to include additional items which have been agreed to by industry and/or regulators together with the Industry Skill Council for the ElectroComms and EnergyUtilities Industry or its nominated representatives. As a minimum, the formal recognition is to include:

- the name of the recipient
- the title of the qualification or Statement of Attainment
- the title and logo of the RTO
- the logos of the relevant State/Territory Training and Recognition Authorities, the Nationally Recognised Training logo and, preferably, the logo of the Industry Skill Council
- an attached transcript of information that is meaningful for maximum recognition and skills transfer. Generally this would be the individual competency standard unit titles and any endorsement or subset thereof, as well as detailed formal advice about the achieved results of the interrelated essential knowledge and associated skills. In this Training Package the successful attainment of the specified essential knowledge and associated skills for each unit forms a critical part of the unit outcome. Where regulated requirements advise the use of training support material(s) and it is used to provide the essential knowledge and skills specified in the unit, details of the support material(s) and their achievement should form part of the statement of results attached to the qualification or statement of attainment.
- any endorsements for regulatory outcomes/recognition.

1.1.06 Pathways into Individual Qualifications

1.6 Pathways into Individual Qualifications

Within the Electrotechnology Industry three (3) ‘learning pathways’ have been identified and listed in Part 2 Assessment Guidelines. Within these, six (6) ‘qualifications pathways’ are available for individuals. These are:

- entry-level contracted employment as a Australian Apprenticeship including School Based Australian Apprenticeships for appropriate qualifications.
- employees whose current occupation needs to be upgraded to a new Electrotechnology Industry Qualification (including those trained outside Australia)
- allied occupations wishing to multi-skill by seeking to obtain an Electrotechnology Industry Qualification (including those trained outside Australia)
- employees of a telecommunication company who have limited data-communications skills seeking to obtain an Electrotechnology Industry Qualification (including those trained outside Australia)
- a pathway utilising an institution-only delivery model that produces quality outcomes to the standard of performance specified in the CSUs in the Training Package
- others with related and allied skill sets.

The pathways identify how competence is developed and how evidence is gathered for the assessment of competence. In general these pathways will include outcomes equivalent to a combination of on-and off-the job training strategies, supported by the industry and regulators, and leading to the achievement and demonstration of competence.

While there are historically established norms relating to the duration of apprentices’ learning and particularly for new entry-level contracted employment entrants, some reduction in this time could be achieved through comprehensive structured arrangements in a workplace/institution. This can be achieved by reducing peripheral activities that occur naturally in an actual workplace; however it is the responsibility of the institute/skill centre, assisted by an employer where appropriate, to ensure the required outcomes are met. The use of realistic simulation of the work environment is likely to involve considerable cost, possibly prohibitive, and is a matter for the relevant parties. The industry-preferred arrangement is a combination of an off-and on-the-job pathway for new entrants. It is clearly a more cost-effective method than an institutional pathway or a totally on-the-job approach.

It is acknowledged that all pathways are possible and only limited by costs. The RTO determines where the training and assessment is provided and where work performance evidence is gathered, however the decision must be made in consultation and in accord with the industry and employer/learner.

This must not limit in any way opportunities for entry into the qualifications for those considered under-represented or from identified disadvantaged groups. These groups include persons from non-English speaking backgrounds, women, indigenous persons or persons with a disability. Appropriate measures should be used to accommodate reasonable adjustments for entry into and completion of the qualifications.

The RTO must carry out such activity in accordance with the criteria established by the relevant State/Territory Training Authority, the current AQTF 2007 Standards for RTOs to affect a realistic assessment outcome, and as outlined in the relevant parts of this Training Package, including any prevailing regulatory requirements.

The industry acknowledges that the institutional pathway is more expensive as the workplace needs to be replicated by the RTO.

All evidence relating to performance requirements and critical aspects of evidence must be present for competence to be attributed. Assessment processes and methodologies must ensure that best practice is implemented in assessment and the process of making judgement about attributing competence remains valid and reliable.

Articulation pathways

Qualification articulation, and entry and exit arrangements are based on the specific training and education requirements endorsed by the industry. The construction of individual competency standard units and the groups of units that make up individual qualifications are of particular significance to the operational, regulatory and safety arrangements of the industry. Each qualification provides a unique vocational outcome that can be used for new apprentices as entry-level contracted employees.

New Apprenticeship arrangements apply to all qualifications; however, they are subject to State/Territory statutory requirements, prescriptions within industrial instruments and policies of State/Territory training authorities.

Open entry is available to all qualifications provided the prospective learner's general education and competency level is equivalent to the outcome of four to five years of secondary school. Additionally, open access provides an option for potential learners to choose a qualification suited to their needs while providing flexibility for recruitment action by employers. Entry requirements must be met. Where entry requirements are not met, a bridging program would be developed by an RTO in consultation with EE-Oz Training. Entry into all qualifications is available through Recognised Prior Learning (RPL) arrangements.

School Based Australian Apprenticeships

Australian Apprenticeships are declared in each State or Territory according to the particular processes of the jurisdiction and requirements identified by industry in the State or Territory.

Declarations for particular qualifications as either Traineeships or Apprenticeships are made accordingly and therefore the same qualification may be classified differently between jurisdictions.

Whilst EE-Oz has no control over these processes and declarations, it would recommend that the following qualifications be considered when addressing School based Australian Apprenticeships:

AQF Code	Qualification Title
UEE10110	Certificate I in ElectroComms Skills
UEE22010	Certificate II in Electrotechnology (Career Start)
UEE22107	Certificate II in Sustainable Energy (Career Start)

Access, Equity and Cultural Diversity

The skills required of employees in the Electrotechnology Industry are relevant to many work positions/roles. The qualifications in this Training Package reflect this range of competencies and are written in a non-exclusive manner to increase equity of participation for all disadvantaged groups and to minimise unintentional bias.

Language, Literacy and Numeracy

A new section related to language, literacy and numeracy skills has been included in each competency standard unit. It provides RTOs, industry and career aspirants with relevant language, literacy and numeracy entry-level advice, to maximise the prospects of successful completion of the unit and any qualification(s).

The language, literacy and numeracy definitions and requirements are described in more detail in Volume 2, Part 3 Language, Literacy and Numeracy Skills. Each Competency Standard Unit in Volume 2 references the respective language, literacy and numeracy skills that apply.

Australian Apprenticeship – application

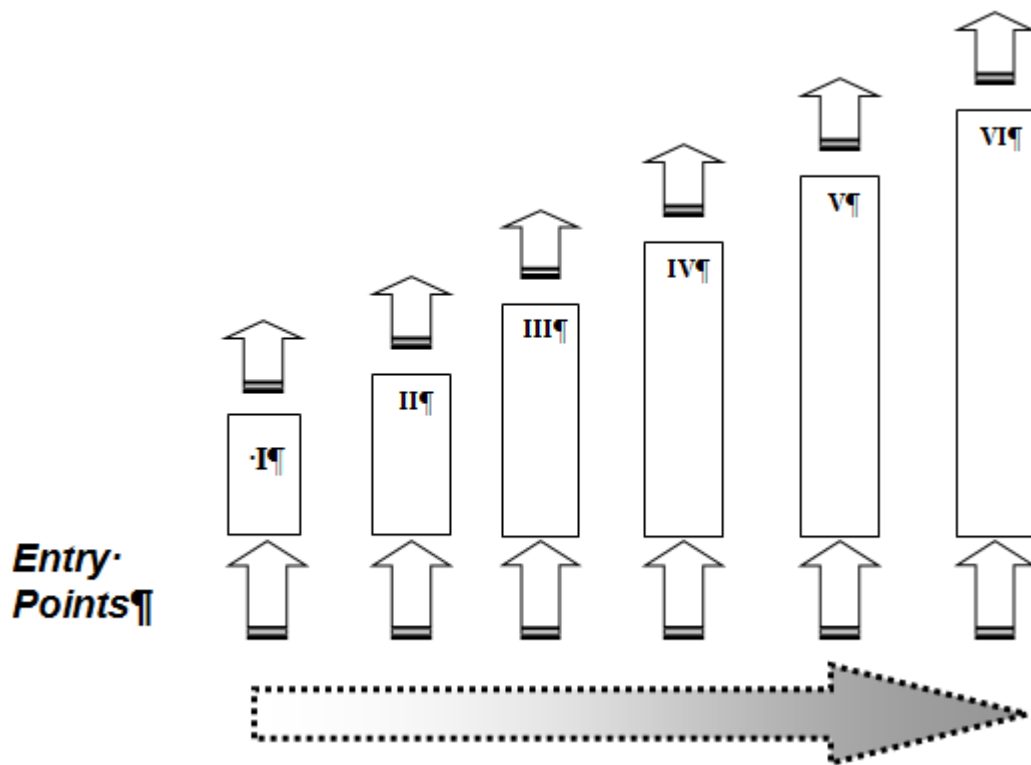
Australian Apprenticeships are work-related competency programs designed for entry-level contracted employment for new entrants to the industry. For further information regarding Australian Apprenticeships and their application in relation to this Training Package, refer to Appendix A, Australian Apprenticeship – application. Appendix A is located at the end of Volume 1.

Pre-requisite Competency Standard Units

A pre-requisite requirement statement applies to each qualification structure and **all of any pre-requisite requirements must be acquired**. Pre-requisites are listed in each competency standard unit, as well as in Table 2 *Summary of CSUs, Relationship to Former Training Package and Pre-requisites* in Volume 1 Part 2 Competency Standards.

Qualification Pathways

This Training Package provides open entry at each of the AQF levels.



For more information on the latest Training Package vocational standards qualifications and qualification pathways visit or contact ElectroComms and EnergyUtilities Industry Skills Council Ltd trading as EE-Oz Training Standards at www.ee-oz.com.au

1.1.07 Maintenance of Qualifications

1.7 Maintenance of Qualifications

The Electrotechnology Industry which developed the Qualifications structure will contribute to its maintenance. The Qualifications structure must be maintained so that it reflects the ongoing needs of the industry sector and responds in a timely manner to changed technologies, work organisation, skills development and related circumstances.

Responsibility for maintaining the Qualifications structure is shared by the parties who constitute the sector.

- Qualification maintenance will be coordinated and managed by EE-Oz Training Standards in its role as a declared Industry Skills Council for ElectroComms and EnergyUtilities
- Suggestions and proposals for changes from all parties are welcome. These should be documented and submitted to the Industry Skills Council.

1.1.08 The Australian Qualification Framework

1.8 The Australian Qualification Framework

What is the Australian Qualifications Framework?

A brief overview of the Australian Qualifications Framework (AQF) follows. For a full explanation of the AQF, see the *AQF Implementation Handbook*.

http://www.aqf.edu.au/Portals/0/Documents/Handbook/AQF_Handbook_07.pdf

The AQF provides a comprehensive, nationally consistent framework for all qualifications in post-compulsory education and training in Australia. In the vocational education and training (VET) sector it assists national consistency for all trainees, learners, employers and providers by enabling national recognition of qualifications and Statements of Attainment.

Training Package qualifications in the VET sector must comply with the titles and guidelines of the AQF. Endorsed Training Packages provide a unique title for each AQF qualification which must always be reproduced accurately.

Qualifications

Training Packages can incorporate the following eight AQF qualifications.

- Certificate I in ...
- Certificate II in ...
- Certificate III in ...
- Certificate IV in ...
- Diploma of ...
- Advanced Diploma of ...
- Vocational Graduate Certificate of ...
- Vocational Graduate Diploma of ...

On completion of the requirements defined in the Training Package, a Registered Training Organisation (RTO) may issue a nationally recognised AQF qualification. Issuance of AQF qualifications must comply with the advice provided in the *AQF Implementation Handbook* and the *AQTF 2010 Essential Standards for Initial and Continuing Registration*.

Note: There are no Vocational Graduate Certificate or Vocational Graduate Diploma level qualifications in this Training Package

Statement of Attainment

A Statement of Attainment is issued by a Registered Training Organisation when an individual has completed one or more units of competency from nationally recognised qualification(s)/course(s). Issuance of Statements of Attainment must comply with the advice provided in the current *AQF Implementation Handbook* and the *AQTF 2010 Essential Standards for Initial and Continuing Registration*.

Under the AQTF 2010, RTOs must recognise the achievement of competencies as recorded on a qualification or Statement of Attainment issued by other RTOs. Given this, recognised competencies can progressively build towards a full AQF qualification.

AQF Guidelines and Learning Outcomes

The *AQF Implementation Handbook* provides a comprehensive guideline for each AQF qualification. A summary of the learning outcome characteristics and their distinguishing features for each VET related AQF qualification is provided below.

Certificate I

Characteristics of Learning Outcomes

Knowledge and skills to perform a defined range of routine and predictable activities.

Applications may include a variety of employment-related skills, including preparatory access and participation skills, broad based induction skills and/or specific workplace skills. They may also include participation in a team or work group.

Distinguishing Features of Learning Outcomes

Do the competencies enable an individual with this qualification to:

- demonstrate knowledge by recall in a narrow range of areas
- demonstrate basic practical skills, such as the use of relevant tools
- perform a sequence of routine tasks given clear direction
- receive and pass on messages/information?

Certificate II

Characteristics of Learning Outcomes

Knowledge and skills to perform a prescribed range of functions in clearly defined contexts with limited complexity in the range of operations, and involving known routines and procedures.

Applications may include some complex or non-routine activities involving individual responsibility or autonomy and/or collaboration with others as part of a group or team, and some accountability for the quality of outcomes.

Distinguishing Features of Learning Outcomes

Do the competencies enable an individual with this qualification to:

- demonstrate basic operational knowledge in a moderate range of areas
- apply a defined range of skills
- apply known solutions to a limited range of predictable problems
- perform a range of tasks where choice between a limited range of options is required
- assess and record information from varied sources
- take limited responsibility for own outputs in work and learning?

Certificate III**Characteristics of Learning Outcomes**

Knowledge and competencies to perform a defined range of skilled operations, within a range of broader related activities and involving known routines, methods and procedures.

Performance would occur across a range of roles and in a variety of contexts. Some discretion and judgement would be required in the selection of equipment, services or contingency measures, within known time constraints, and with some complexity in the extent and choice of options available.

Application will involve selecting, adapting and transferring skills and knowledge to new environments and providing technical advice and some leadership in resolution of specified problems.

Applications may involve some responsibility for others. Participation in teams including group or team coordination may be involved.

Distinguishing Features of Learning Outcomes

Do the competencies enable an individual with this qualification to:

- demonstrate some relevant theoretical knowledge
- apply a range of well developed skills
- apply known solutions to a variety of predictable problems
- perform processes that require a range of well developed skills where some discretion and judgement is required
- interpret available information, using discretion and judgement
- take responsibility for own outputs in work and learning
- take limited responsibility for the output of others?

Certificate IV**Characteristics of Learning Outcomes**

Knowledge and competencies covering a broad range of activities performed in a variety of complex and non-routine contexts. Leadership and guidance are involved in organising activities. In the application and planning of the skills and in contributing to technical solutions in non-routine or contingency situations.

Applications will include evaluating and analysing current practices, developing new criteria and procedures for current practices, as well as responsibility for and limited organisation of others.

Distinguishing Features of Learning Outcomes

Do the competencies enable an individual with this qualification to:

- demonstrate understanding of a broad knowledge base incorporating some theoretical concepts
- apply solutions to a defined range of unpredictable problems
- identify and apply skill and knowledge areas to a wide variety of contexts, with depth in some areas
- identify, analyse and evaluate information from a variety of sources
- take responsibility for own outputs in relation to specified quality standards
- take limited responsibility for the quantity and quality of the output of others?

Diploma**Characteristics of Learning Outcomes**

Planning and initiating alternative approaches to the application of knowledge and skills across a broad range of contexts/situations, e.g. technical and/or management, evaluation and coordination.

Performance involves self directed application of knowledge and skills, in substantial depth in some areas, and judgement is required in planning and selecting appropriate equipment, services and techniques for self and others.

Applications involve participation in development of strategic initiatives as well as personal responsibility and autonomy in performing complex technical operations or organising others. It may involve participation in teams, including teams concerned with planning and evaluation functions. Group or team coordination may be involved.

The degree of emphasis on breadth as against depth of knowledge and skills may vary between qualifications granted at this level.

Distinguishing Features of Learning Outcomes

Do the competencies or learning outcomes enable an individual with this qualification to:

- demonstrate understanding of a broad knowledge base incorporating theoretical concepts, with substantial depth in some areas
- analyse and plan approaches to technical problems or management requirements
- transfer and apply theoretical concepts and/or technical or creative skills to a range of situations
- evaluate information, using it to forecast for planning or research purposes

take responsibility for own outputs in relation to broad quantity and quality parameters
take some responsibility for the achievement of group outcomes?

Advanced Diploma

Characteristics of Learning Outcomes

Analysis, design, planning, execution and evaluation across a range of technical and/or management functions, including development of new criteria or applications or knowledge or procedures.

The application of a significant range of fundamental principles and complex techniques across a wide and often unpredictable variety of contexts in relation to either varied or highly specific functions. Contribution to the development of a broad plan, budget or strategy is involved and accountability and responsibility for self and others in achieving the outcomes is involved.

Applications involve significant judgement in planning, design, technical or leadership/guidance functions related to products, services, operations or procedures.

The degree of emphasis on breadth as against depth of knowledge and skills may vary between qualifications granted at this level.

Distinguishing Features of Learning Outcomes

Do the competencies or learning outcomes enable an individual with this qualification to:

- demonstrate understanding of specialised knowledge with depth in some areas
- analyse, diagnose, design and execute judgements across a broad range of technical or management functions
- generate ideas through the analysis of information and concepts at an abstract level
- demonstrate a command of wide ranging, highly specialised technical, creative or conceptual skills
- demonstrate accountability for personal outputs within broad parameters
- demonstrate accountability for personal and group outcomes within broad parameters?

1.1.09 Electrotechnology Industry Qualification Descriptions

1.9 Electrotechnology Industry Qualification Descriptions

On the following pages is a description of each Electrotechnology Industry qualification and its application, as well as possible employment outcomes.

Electrotechnology Industry Qualifications

AQF Code	Certificate I Qualifications	Descriptions and Scopes
UEE10110	Certificate I in ElectroComms Skills	Perform basic work activities, including identifying and using a range of components, accessories, materials, tools, equipment, technologies, and customs for carrying out work in the Electrotechnology-Communications Industry. Sectors in the industry are electronics, electrical, communications including telecommunications – voice, data, video and information technology, computer systems, instrumentation, lifts, refrigeration and air conditioning, and renewable/sustainable energy.

Electrotechnology Industry Qualifications

AQF Code	Certificate II Qualifications	Descriptions and Scopes
UEE20111	Certificate II in Split Air-conditioning and Heat Pump Systems	The installation, commissioning and de-commissioning of single head, split air conditioning and heat pump systems to a prescribed routine where the maximum plant capacity for each system does not exceed 18 kW_r. This includes wall hung, floor and ceiling suspended, cassette and ducted fan coil split systems and water heating heat pump systems. This qualification excludes competencies required for service, repair, maintenance, diagnostic/fault finding and electrical work or the safe and proper installation of commercial refrigeration and air conditioning and heat pump plant and equipment. Note: 1. The letter "r" denotes "refrigeration" or cooling capacity, not electrical input power. 2. The Ozone Protection and Synthetic Greenhouse Gas Legislation Amendment Bill 2003 and the Ozone Protection and Synthetic Gas Management Regulations apply to this qualification. Prior to planning the delivery of any training and/or assessment activities all

Electrotechnology Industry Qualifications		
AQF Code	Certificate II Qualifications	Descriptions and Scopes
		legislative and regulatory requirements shall be identified and included.
UEE20207	Certificate II in Business Equipment Servicing	Base level servicing and maintenance of photocopiers, fax machines etc
	<i>Certificate II in Electrotechnology Business Support *</i>	<i>Maintain documentation, process purchase orders, answer customer inquiries etc</i>
UEE20407	Certificate II in Winding and Assembly	Wind, place and connect coils for small armatures, transformers and solenoids following prescribed routines
UEE20510	Certificate II in Computer Assembly and Repair	Select components and assemble computer to customer specifications and carry out routine hardware repairs (generally by replacement) of known faulty components following prescribed routines.
UEE20607	Certificate II in Custom Electronics Assembly and Setup	Assemble and set up of surround sound, home theatre systems. It covers the scope of CEDIA certification level 1.
UEE20707	Certificate II in Data and Voice Communications	Select, assemble, set up and maintain simple equipment and systems to a prescribed routine Certification of telecommunication cabling in buildings and premises. It includes ACMA requirements for Open Cabler Registration.
UEE20810	Certificate II in Electrical Wholesaling	Take and process orders, check and accept stock deliveries, maintain shelf stock and service customers.
UEE20907	Certificate II in Electronic Assembly	Select components, set up and operate component placement machines and carry out rework to a prescribed routine.
UEE21007	Certificate II in Fire Alarms Servicing	Select, assemble and set up of base level fire protection systems in domestic and commercial premises.
UEE21107	Certificate II in Gaming Machines Servicing	Base level servicing and set up of gaming machines to a prescribed standard in registered clubs and hotels and dedicated games machines in electronic game venues.

Electrotechnology Industry Qualifications		
AQF Code	Certificate II Qualifications	Descriptions and Scopes
UEE21207	Certificate II in Antennae Equipment	Select, assemble, connect and set up TV and radio reception antennae and multiple antenna outlets in buildings and premises
UEE21310	Certificate II in Remote Area Essential Service	Select, assemble, set up and maintain simple equipment and systems following prescribed routines reformat existing units
UEE21407	Certificate II in Remote Area Power Supply Maintenance	Routine maintenance of remote area power supplies consisting of battery banks, generator sets, photovoltaic arrays and wind generators – primarily for use by, but not exclusive to, indigenous communities.
UEE21510	Certificate II in Renewable Energy	Select, assemble, set up and maintain simple equipment and systems to a prescribed routine
UEE21610	Certificate II in Security Assembly and Setup	Select, assemble and set up of wired and wireless base level security systems following prescribe routines.
UEE21707	Certificate II in Technical Support	Collect/receive and store stock at work sites, set up and store equipment and tools, assist in installation, fault finding, maintenance and repair activities.
UEE21910	Certificate II in Electronics	Select, assemble, set up and maintain electronic devices following prescribed routines.
UEE22010	Certificate II in Electrotechnology (Career Start)	Work entry program providing grounding in safety and basic skills and knowledge for work in any Electrotechnology discipline.
UEE22107	Certificate II in Sustainable Energy (Career Start)	Work entry program providing grounding in safety and adopted and emerging sustainable energy systems.

Electrotechnology Industry Qualifications		
AQF Code	Certificate III Qualifications	Descriptions and Scopes

Electrotechnology Industry Qualifications		
AQF Code	Certificate III Qualifications	Descriptions and Scopes
UEE30107	Certificate III in Business Equipment	Install, set up, test, fault find, repair and maintain photocopiers, fax machines etc
UEE30210	Certificate III in Computer Systems Equipment	Select, install, set up, test, fault find, repair and maintain computer equipment for data storage, personal computer and networks, measurement/analysis and control.
UEE30310	Certificate III in Custom Electronics Installations	Select, install, set up and test surround sound, home theatre and integration aspects for 'intelligent houses'. It covers the scope of CEDIA certification level 2
UEE30407	Certificate III in Data and Voice Communications	Select, install, set up, test, fault find, repair and maintain telecommunications and high performance data services in buildings and premises. It includes ACMA requirements for Open Cabler Registration.
UEE30607	Certificate III in Electrical Machine Repair	Motor, transformer and control gear overhaul and repair, including rewinding
UEE30707	Certificate III in Switchgear and Control Gear	Construction, assembly and wiring of switchboards and control panels
UEE30807	Certificate III in Electrotechnology Electrician	Select, install, set up, test, fault find, repair and maintain electrical systems and equipment in building and premises. It includes ERAC requirements for an 'Electrician's licence'.
UEE30910	Certificate III in Electronics and Communications	Select, install, set up, test, fault find, repair and maintain electronic equipment and devices at component/sub-assembly level with options in communications, audio, video and TV, personal computer and networks, security and custom installations
UEE31007	Certificate III in Fire Protection Control	Installation and set up of fire protection systems in multiple, commercial and industrial premises.
UEE31107	Certificate III in Gaming Electronics	Select, install, set up, test, fault find, repair and maintain gaming machines used in registered clubs and hotels and dedicated games machines used in electronic game

Electrotechnology Industry Qualifications		
AQF Code	Certificate III Qualifications	Descriptions and Scopes
		venues.
UEE31210	Certificate III in Instrumentation and Control	Select, install, set up, test, fault find, repair and maintain systems and devices for measurement and recording of physical/chemical phenomenon and related process control
UEE31410	Certificate III in Security Equipment	Installation and pre-commissioning set up of wired and wireless security systems in multiple, commercial industrial premises.
UEE31507	Certificate III in Rail – Communications and Networks	Select, install, commission, fault find and maintain radio and dedicated telecommunications networks in rail equipment.
	<i>Certificate III in Wireless Communications *</i>	<i>Pending</i>
UEE31710	Certificate III in Hazardous areas – Electrician	Select, install, set up, test, fault find, repair and maintain electrical systems and equipment in building and premises. It includes ERAC requirements for an ‘Electrician’s licence’ and competencies to work with explosion-protected electrical equipment in areas where flammable materials are present and designated as hazardous areas.
UEE31810	Certificate III in Hazardous areas – Instrumentation	Select, install, set up, test, fault find, repair and maintain systems and devices for measurement and recording of physical/chemical phenomenon and related process control. It includes competencies to a work with explosion-protected instrumentation/control equipment in areas where flammable materials are present and designated as hazardous areas.
UEE31910	Certificate III in Explosion-protected equipment overhaul	Motor, transformer and control gear overhaul and repair including rewinding and the overhaul of explosion-protected equipment
UEE32010	Certificate III in Renewable Energy - ELV	Select, install, set up, test, fault find, repair and maintain renewable energy equipment and systems. It does not include electrical work covered by licensing requirements declared by the Electrical Regulators

Electrotechnology Industry Qualifications		
AQF Code	Certificate III Qualifications	Descriptions and Scopes
		Advisory Council (ERAC) for an 'Electrician's licence'.
UEE32111	Certificate III in Appliance Service	Set up, service and repair electrical, and refrigerated appliances with electives in gas appliances Note: The Ozone Protection and Synthetic Greenhouse Gas Legislation Amendment Bill 2003 may apply to this qualification. Prior to planning the delivery of any training and/or assessment activities all legislative and regulatory requirements shall be identified and included.
UEE32211	Certificate III in Air-conditioning and Refrigeration	Select components, install, set up, test, fault find, repair and maintain refrigeration systems and equipment that apply to food storage and preservation and air conditioning and air distribution equipment in buildings and premises. It includes regulatory requirements for purchasing and handling refrigerants.
Electrotechnology Industry Qualifications		
AQF Code	Certificate IV Qualifications	Descriptions and Scopes
UEE40110	Certificate IV in Computer Systems	Select, install, commission, fault find and maintain data processing, communications and control aspects of systems used for monitoring and control of systems for access, surveillance, safety and effective operation of manufacturing, buildings, structures, premises, precincts and personal computer and networks
UEE40210	Certificate IV in Electrical – Data and Voice Communications	Select, install, commission, fault find and maintain electrical and communications systems and equipment in building and premises. It includes ERAC requirements for an 'Electrician's licence' and ACMA requirements for Open Cabler Registration.
UEE40310	Certificate IV in Electrical Installation Inspection and Audits	Mandatory and contractual inspections of electrical systems and auditing of entities for compliance with electrical safety requirements

Electrotechnology Industry Qualifications		
AQF Code	Certificate IV Qualifications	Descriptions and Scopes
UEE40410	Certificate IV in Electrical – Instrumentation	Select, install, commission, fault find and maintain electrical and instrumentation equipment in buildings and premises and instrumentation systems and core instrumentation equipment for process and control. It includes ERAC requirements for an ‘Electrician’s licence’.
UEE40510	Certificate IV in Electrical – Air-conditioning Systems	Select, install, commission, fault find and maintain electrical systems and equipment in buildings and premises and core refrigeration/air conditioning equipment. It includes ERAC requirements for an ‘Electrician’s licence’ and regulatory requirements for purchasing and handling refrigerants.
UEE40610	Certificate IV in Electrotechnology – Systems Electrician	Select, install, commission, fault find and maintain electrical systems and equipment with options, typically in explosion protection; electrical machines; electrical inspection; safety auditing; contracting; lifts; energy supply/distribution
UEE40710	Certificate IV in Electronics and Communications	Select, install, commission, fault find and maintain audio/video and data systems, computer and network hardware, security systems, wireless and communications systems and electronic aspects of medical equipment
UEE40810	Certificate IV in Electrical – Fire Protection Control Systems	Select, install, commission, fault find and maintain fire protection control systems in buildings. It includes ERAC requirements for an ‘Electrician’s licence’.
UEE40910	Certificate IV in Industrial Electronics and Control	Select, install, commission, fault find and maintain equipment and systems for the control of plant, machines and processes
UEE41010	Certificate IV in Energy Management and Control	This qualification provides competencies to develop strategies for the reduction of energy in buildings and to recommend changes in the way in which energy is controlled in the building either by the installation of new control equipment or by the modification or re-programming of that existing.

Electrotechnology Industry Qualifications		
AQF Code	Certificate IV Qualifications	Descriptions and Scopes
UEE41110	Certificate IV in Electrical – Lift Systems	Select, install, commission, fault find and maintain of lifts, escalators and associated equipment. It includes ERAC requirements for an ‘Electrician’s licence’.
UEE41210	Certificate IV in Electrical – Rail Signalling	Select, install, commission, fault find and maintain rail signalling equipment and systems. It includes ERAC requirements for an ‘Electrician’s licence’.
UEE41510	Certificate IV in Video and Audio Systems	Service high end audio, video, display systems and HDTV
UEE41610	Certificate IV in Renewable Energy	Select, install, commission, fault find and maintain multiple renewable energy sources and equipment for control of energy use
UEE41710	Certificate IV in Rail – Communications and Network Systems	Select, install, commission, fault find and maintain radio and dedicated telecommunications networks in rail systems
UEE41910	Certificate IV in Electrical – Renewable Energy	Select, install, set up, test, fault find, repair and maintain electrical systems and equipment in buildings and premises. It includes ERAC requirements for an ‘Electrician’s licence’ and competencies to select, install, set up, test, fault find, repair and maintain renewable energy equipment and systems.
UEE42010	Certificate IV in Electrical – Photovoltaic Systems	Select, install, set up, test, fault find, repair and maintain electrical systems and equipment in buildings and premises. It includes ERAC requirements for an ‘Electrician’s licence’ and competencies to select, install, set up, test, fault find, repair and maintain photovoltaic systems and associated equipment
UEE42110	Certificate IV in Electrotechnology – Electrical Contracting	This qualification provides competencies to set up and manage an electrical contracting business. It includes competencies required by regulations for an electrical contracting licence.
UEE42210	Certificate IV in Instrumentation and Control	This qualification provides competencies to select, install, set up, test, fault find, repair, maintain and commission systems and devices for measurement and recording of physical/chemical phenomenon and

Electrotechnology Industry Qualifications		
AQF Code	Certificate IV Qualifications	Descriptions and Scopes
		related process control systems.
UEE42410	Certificate IV in Hazardous areas – Industrial control	This qualification provides competencies to supervise selection, installation, commissioning maintenance and testing of explosion-protected equipment and systems for control and monitoring of plant and processes. The qualification provides competencies in working with explosion protections techniques with elections in how they apply to coal mining, gas and dust atmospheres.
UEE42610	Certificate IV in Hazardous areas - Electrical	This qualification provides competencies to supervise selection, installation, commissioning maintenance and testing of explosion-protected equipment and systems for control and monitoring of plant and processes. The qualification provides competencies in working with explosion protections techniques with elections in how they apply to coal mining, gas and dust atmospheres. It includes ERAC requirements for an ‘Electrician’s licence’ and competencies to select, install, set up, test, fault find, repair and maintain stand alone renewable energy equipment and systems.
UEE42711	Certificate IV in Refrigeration and Air-conditioning Servicing	High level fault diagnosis and rectification, commissioning and maintenance of refrigeration systems and equipment that apply to commercial food storage and preservation and air conditioning and air distribution equipment and special applications. It includes regulatory requirements for purchasing and handling refrigerants.
UEE42811	Certificate IV in Air-conditioning Systems Energy Management and Control	This qualification provides competencies to develop strategies for the reduction of energy in buildings and to recommend changes in the way in which energy is controlled in the building either by the installation of new control equipment or by the modification or re-programming of that existing. It includes regulatory requirements for purchasing and handling refrigerants.
UEE42911	Certificate IV in Refrigeration and	This qualification provides the competencies to determine heat loads and select equipment for basic

Electrotechnology Industry Qualifications

AQF Code	Certificate IV Qualifications	Descriptions and Scopes
	Air-conditioning Systems	commercial refrigeration or residential air conditioning applications. It includes regulatory requirements for purchasing and handling refrigerants.

Electrotechnology Industry Qualifications

AQF Code	Diploma Qualifications	Descriptions and Scopes
UEE50110	Diploma of Computer Systems Engineering	Develop, select, install, commission and maintain computer equipment, networks and systems
UEE50210	Diploma of Electrical and Instrumentation	Select, install, commission, maintain and diagnose faults/malfunctions on electrical, instrumentation and control equipment and systems. It includes ERAC requirements for an 'Electrician's licence'.
UEE50310	Diploma of Electrical and Refrigeration and Air-conditioning	Select, install, commission, maintain and diagnose faults/malfunctions on refrigeration systems and equipment that apply to commercial food storage and preservation and air conditioning and air distribution equipment and special applications and associated electrical systems. It includes ERAC requirements for an 'Electrician's licence' and regulatory requirements for purchasing and handling refrigerants.
UEE50410	Diploma of Electrical Engineering	Develop, select, commission, maintain and diagnose faults/malfunctions on advanced electrical equipment and systems. It includes ERAC requirements for an 'Electrician's licence'.
UEE50510	Diploma of Electronics and Communications Engineering	Develop, select, commission, maintain and diagnose faults/malfunctions of electronic components/sub-assemblies, apparatus and systems
UEE50710	Diploma of Renewable Energy Engineering	Develop, select, commission, maintain and diagnose faults/malfunctions on large scale renewable energy equipment and systems

Electrotechnology Industry Qualifications

UEE50810	Diploma of Research and Development	Assist professional in planning, research and development of electrotechnology products and services
UEE50910	Diploma of Industrial Electronics and Control Engineering	Develop, select, commission, maintain and diagnose faults/malfunctions of equipment and systems for the monitoring and control of plant, machines and processes
UEE51010	Diploma of Instrumentation and Control Engineering	This qualification provides competencies to install, set up, test, develop, select, commission, maintain and diagnose faults/malfunctions of equipment and systems for the measurement, recording, monitoring and control of physical/chemical phenomenon and related process control systems.
UEE51111	Diploma of Engineering Technology - Refrigeration and Air-conditioning	This qualification provides enabling competencies to develop systems and select equipment for heating, ventilation, air conditioning and/or refrigeration systems.
UEE51211	Diploma of Air-conditioning and Refrigeration Engineering	Develop systems, select equipment, and commission, maintain and diagnose faults/malfunctions of refrigeration systems and equipment that apply to commercial food storage and preservation and air conditioning and air distribution equipment and special applications. It includes regulatory requirements for purchasing and handling refrigerants.

Electrotechnology Industry Qualifications

AQF Code	Advanced Diploma Qualifications	Descriptions and Scopes
UEE60210	Advanced Diploma of Electronics and Communications Engineering	Design and validate/evaluate electronics and communications equipment and systems, computer and network based systems, manage risk, estimate and manage projects and provide technical advice/sales
UEE60410	Advanced Diploma of Computer Systems	Design, install/validate/evaluate and administer computer networks and systems, manage risk, estimate

Electrotechnology Industry Qualifications		
AQF Code	Advanced Diploma Qualifications	Descriptions and Scopes
	Engineering	and manage projects and provide technical advice/sales.
UEE60610	Advanced Diploma of Industrial Electronics and Control Engineering	Design and validate/evaluate control equipment and systems, manage risk, estimate and manage projects and provide technical advice/sales.
UEE60910	Advanced Diploma of Renewable Energy Engineering	Design and validate/evaluate renewable energy equipment and systems, manage risk, estimate and manage projects and provide technical advice/sales.
UEE61110	Advanced Diploma of Automated Systems Maintenance Engineering	Monitor/validate/evaluate automated equipment and systems, manage risk, develop and manage maintenance programs, and provide technical advice
UEE61210	Advanced Diploma of Engineering – Explosion protection	Design and validate/evaluate electrical or control equipment and systems, manage risk, estimate and manage projects and provide technical advice/sales. It includes competencies in explosion-protection necessary for areas where flammable materials are present.
UEE61410	Advanced Diploma of Engineering – Explosion protection - Industrial control	This qualification provides competencies to assess and manage risk associated with hazardous areas, design and validate/evaluate explosion protection aspects of industrial control systems, audit explosion-protected installations and provide explosion protection technical advice/sales.
UEE61510	Advanced Diploma of Instrumentation and Control Engineering	This qualification provides competencies to design and validate/evaluate process control equipment and systems, manage risk, estimate and manage projects and provide technical advice/sales. It's also provides competencies to install, set up, test, develop, select, commission, maintain, diagnose faults/malfunctions of equipment and systems
UEE61710	Advanced Diploma of Engineering Technology -	Prepare to design and validate/evaluate electronics and communication equipment and systems and provide technical advice/sales.

Electrotechnology Industry Qualifications		
AQF Code	Advanced Diploma Qualifications	Descriptions and Scopes
	Electronic	
UEE61810	Advanced Diploma of Engineering Technology - Computer Systems	Prepare to design, install/validate/evaluate and administer computer networks and systems and provide technical advice/sales.
UEE62010	Advanced Diploma of Engineering Technology - Renewable Energy	Prepare to design and validate/evaluate renewable energy equipment and systems and provide technical advice/sales
UEE62110	Advanced Diploma of Engineering Technology - Electrical	Prepare to design and validate/evaluate electrical equipment and systems and provide technical advice/sales.
UEE62211	Advanced Diploma of Electrical – Engineering	This qualification provides competencies to design and validate/evaluate electrical equipment and systems, manage risk, estimate and manage projects and provide technical advice/sales. It develops competencies in the ethical and responsible application of mathematics, science, engineering techniques, Standards and Codes of Practice, engineering design practices, supervision and management of physical, human and financial resources in engineering. The core competencies of this qualification meet the prescribed requirements for Engineering Associate membership of Engineers Australia and ERAC requirements for an ‘Electrician’s licence’. Participants seeking Engineers Australia membership should ensure that their training provider is accredited by that body to provide Engineering Education Programs at the level of Engineering Associate
UEE62311	Advanced Diploma of Electrical Engineering	This qualification provides competencies to design and validate/evaluate coal mining electrical equipment and

Electrotechnology Industry Qualifications		
AQF Code	Advanced Diploma Qualifications	Descriptions and Scopes
	– Coal Mining	systems, manage risk, estimate and manage projects and provide technical advice/sales. It develops competencies in the ethical and responsible application of mathematics, science, engineering techniques, Standards and Codes of Practice, engineering design practices, supervision and management of physical, human and financial resources in engineering. The core competencies of this qualification meets the prescribed requirements for Engineering Associate membership of Engineers Australia and ERAC requirements for an ‘Electrician’s licence. Participants seeking Engineers Australia membership should ensure that their training provider is accredited by that body to provide Engineering Education Programs at the level of Engineering Associate
UEE62411	Advanced Diploma of Engineering Technology - Air-conditioning and Refrigeration	Prepare to design and validate/evaluate refrigeration and air conditioning equipment and systems and provide technical advice/sales
UEE62511	Advanced Diploma of Air-conditioning and Refrigeration Engineering	Design and validate/evaluate refrigeration and air conditioning equipment and systems, manage risk, estimate and manage projects and provide technical advice/sales. It includes regulatory requirements for purchasing and handling refrigerants. It develops competencies in the ethical and responsible application of mathematics, science, engineering techniques, Standards and Codes of Practice, engineering design practices, supervision and management of physical, human and financial resources in Refrigeration and Air Conditioning engineering. It includes regulatory requirements for purchasing and

Electrotechnology Industry Qualifications

AQF Code

Advanced Diploma Qualifications

Descriptions and Scopes

handling refrigerants.

The core competencies of this qualification meet the prescribed requirements for Engineering Associate membership of Engineers Australia.

Participants seeking Engineers Australia membership should ensure that their training provider is accredited by that body to provide Engineering Education Programs at the level of Engineering Associate.

The structure, composition and range of the qualifications and the requirements necessary for obtaining them, allow employers and employees to select the qualification and units appropriate for their skill and work organisation requirements.

The qualification structures that follow must be read in conjunction with Volume 1 Part 2 Competency Standards, Unit Construction. The structure of the qualifications includes the competency standard units relevant to the outcome of the particular qualification. It does not include pre-requisite competency standard units.

Pre-requisite units

Any pre-requisite competency standard unit not listed in a qualification framework attracts no weighting value, but must be acquired.

For more information see the sections Important Note to Users, Table of Index of Units and Pre-requisite requirements, and Relationship of units to the former Training Package.

1.1.10 Qualification Employability Skills Statements

1.10 Qualification Employability Skills Statements

Employability Skills Summary - All Qualifications at AQF Level 1.

The following table contains a summary of the Employability Skills required by the Electrotechnology Industry for all UEE07 Electrotechnology Training Package qualifications at AQF level 1, namely;

AQF Code	Certificate I Qualifications
UEE10110	Certificate I in ElectroComms Skills

The Employability Skills facets described here are broad industry requirements that may vary depending on qualification packaging rules and options.

Communication
Collect, organise and understand information related to the work task and it's relevant safety procedures
Access, read and comprehend safety instructions and procedures
Share information via speech and in writing
Prepare time sheets
Teamwork
Work with others to generate and review ideas
Work effectively as an individual and as a member of a team
Relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities
Contribute to a positive culture of compliance within an organisation
Develop and maintain networks for the implementation and maintenance of industry knowledge, standards and requirements
Provide feedback
Problem Solving
Apply lateral thinking to generate solutions in response to work problems
Identify, assess and prioritise work risks to maintain efficiency, quality, productivity and workplace safety at all times
Initiative & Enterprise
Identify and comply with all requirements and standards for work in the Electrotechnology industry

Initiate and follow through on the implementation of industry standards in the workplace
Planning & Organising
Plan and organise activities including the maintenance and layout of own worksite and obtain equipment and materials to avoid work flow interruptions or wastage
Plan activities to enable operational skills and knowledge to be gained and maintained
Identify related industry compliance requirements
Maintain relevant industry and work records
Establish clear goals and deliverables
Collect, analyse and organise work task information
Apply time management prioritising techniques
Self Management
Plan own work within given task parameters
Set, monitor and satisfy personal work goals
Accept responsibility for given tasks
Apply systematic and effective time management
Learning
Satisfy the competency requirements for the job
Maintain current knowledge of tools, devices, instruments, materials, work practices and systems
Seek learning opportunities
Take control of and manage own learning
Adopt a open approach to new ideas and techniques
Commit to and promote a culture of continuous learning
Set realistic learning goals for self development
Technology
Use workplace technology related to particular work tasks including tools, devices,

instruments and materials
Attain and maintain IT skills relevant to the Electrotechnology industry
Be willing to gain knowledge and skills relevant to new and emerging technologies

The Employability Skills described above are representative of the Electrotechnology Industry in general and may not reflect enterprise specific requirements or job roles.

Learning and assessment strategies for each qualification should be based on the requirements of the units of competency comprising the qualification and the Assessment Guidelines, Volume 1, Part 3.

Employability Skills Summary for all Qualifications at AQF Level 2.

The following table contains a summary of the Employability Skills required by the Electrotechnology Industry for all UEE07 Electrotechnology Training Package qualifications at AQF level 2, namely;

AQF Code	Certificate II Qualifications
UEE20111	Certificate II in Split Air-conditioning and Heat Pump Systems
UEE20207	Certificate II in Business Equipment Servicing
	<i>Certificate II in Electrotechnology Business Support *</i>
UEE20407	Certificate II in Winding and Assembly
UEE20510	Certificate II in Computer Assembly and Repair
UEE20707	Certificate II in Custom Electronics Assembly and Setup
UEE20707	Certificate II in Data and Voice Communications
UEE20810	Certificate II in Electrical Wholesaling
UEE20907	Certificate II in Electronic Assembly
UEE21007	Certificate II in Fire Alarms Servicing
UEE21107	Certificate II in Gaming Machines Servicing
UEE21207	Certificate II in Antennae Equipment

AQF Code	Certificate II Qualifications
UEE21310	Certificate II in Remote Area Essential Service
UEE21407	Certificate II in Remote Area Power Supply Maintenance
UEE21510	Certificate II in Renewable Energy
UEE21610	Certificate II in Security Assembly and Setup
UEE21707	Certificate II in Technical Support
UEE21910	Certificate II in Electronics
UEE22010	Certificate II in Electrotechnology (Career Start)
UEE22107	Certificate II in Sustainable Energy (Career Start)

** To be developed as part of continuous improvement*

The Employability Skills facets described here are broad industry requirements that may vary depending on qualification packaging rules and options.

Communication
Collect, organise and understand information related to the work task and it's relevant safety procedures
Communicate ideas and information to enable confirmation of work requirement and specifications
Co-operate with other workers/customers and report outcomes and/or any problems
Access, read and comprehend safety instructions and procedures
Share information via speech and in writing
Prepare time sheets
Teamwork
Work with others to generate and review ideas
Work effectively as an individual and as a member of a team
Work with others and in a team to identify work needs and review ideas against those needs

Relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities
Contribute to a positive culture of compliance within an organisation
Develop and maintain networks for the implementation and maintenance of industry knowledge, standards and requirements
Provide feedback
Problem Solving
Apply lateral thinking ideas to generate solutions in response to work problems
Anticipate or clarify problems to avoid interruptions to work flows and processes
Identify, assess and prioritise work risks to maintain efficiency, quality, productivity and work place safety at all times
Initiative & Enterprise
Identify and comply with all requirements and standards for work in the Electrotechnology industry
Apply enterprise best practice and quality systems
Interact effectively with both internal and external industry stakeholders
Initiate and follow through on the implementation of industry standards in the workplace
Planning & Organising
Plan and organise activities including the maintenance and layout of own worksite and obtain equipment and materials to avoid work flow interruptions or wastage
Identify related industry compliance requirements
Maintain relevant industry and work records
Establish clear implementation goals and deliverables
Collect, analyse and organise work task information
Apply time management prioritising techniques
Self Management
Plan own work within given task parameters

Set, monitor and satisfy personal work goals
Accept responsibility for given tasks
Apply systematic and effective time management
Learning
Satisfy the competency requirements for the job
Maintain current knowledge of tools, devices, instruments, materials, work practices and systems
Seek learning opportunities
Take control and manage own learning
Adopt a open approach to new ideas and techniques
Commit to and promote a culture of continuous learning
Set realistic learning goals for self development
Monitor and respond to learning process achievements
Technology
Use workplace technology related to the particular work tasks including tools, devices, instruments and materials
Attain and maintain required technical accreditation/authority under the industry standards
Attain and maintain IT skills relevant to the Electrotechnology industry
Be willing to gain knowledge and skills relevant to new and emerging technologies

The Employability Skills described above are representative of the Electrotechnology Industry in general and may not reflect enterprise specific requirements or job roles.

Learning and assessment strategies for each qualification should be based on the requirements of the units of competency comprising the qualification and the Assessment Guidelines, Volume 1, Part 3.

Employability Skills Summary for all Qualifications at AQF Level 3.

The following table contains a summary of the Employability Skills required by the Electrotechnology Industry for all UEE07 Electrotechnology Training Package qualifications at AQF level 3, namely;

AQF Code	Certificate III Qualifications
UEE30107	Certificate III in Business Equipment
UEE30210	Certificate III in Computer Systems Equipment
UEE30310	Certificate III in Custom Electronics Installations
UEE30407	Certificate III in Data and Voice Communications
UEE30610	Certificate III in Electrical Machine Repair
UEE30707	Certificate III in Switchgear and Control Gear
UEE30807	Certificate III in Electrotechnology Electrician
UEE30907	Certificate III in Electronics and Communications
UEE31007	Certificate III in Fire Protection Control
UEE31107	Certificate III in Gaming Electronics
UEE31210	Certificate III in Instrumentation and Control
UEE31410	Certificate III in Security Equipment
UEE31507	Certificate III in Rail – Communications and Networks
	<i>Certificate III in Wireless Communications *</i>
UEE31710	Certificate III in Hazardous areas – Electrician
UEE31810	Certificate III in Hazardous areas – Instrumentation
UEE31910	Certificate III in Explosion-protected equipment overhaul
UEE32010	Certificate III in Renewable Energy – ELV
UEE32111	Certificate III in Appliance Service
UEE32211	Certificate III in Air-conditioning and Refrigeration

** To be developed as part of continuous improvement*

The Employability Skills facets described here are broad industry requirements that may vary depending on qualification packaging rules and options.

Communication
Collect, organise and understand information related to the work task and it's relevant safety procedures
Communicate ideas and information to enable confirmation of work requirement and specifications
Communicate information using drawing, diagrams, schedules and manuals
Communicate and/or report work outcomes and/or any problems
Communicate ideas, information and advice to co-workers/clients to enable confirmation of product/work requirements and specifications
Communicate effectively in oral and written form
Access, read and comprehend safety instructions and procedures
Collect, organise and understand information related to a work task and it's relevant safety procedures
Undertake negotiations if there are conflicts in work requirements and/or priorities
Share industry information
Document work quotations and tender support schedules
Prepare time sheets
Prepare documentation on particular work tasks including evaluations, reports, timesheets and costing
Prepare and present formal reports to clients and/or co-workers
Teamwork
Work with others to generate ideas and review
Work effectively as an individual and as a member of a team
Work with others and in a team to identify work needs and review ideas against those needs

Work with other and in a team to evaluate and report on work tasks and outcomes
Work with others and in a team to present information to a client and/or co-worker
Relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities
Influence individuals and teams
Develop and maintain networks for implementation and maintenance of industry standards in relation to workplace <i>computer systems</i>
Develop and maintain networks for the implementation and maintenance of industry knowledge, standards and requirements
Coach/mentor others and provide feedback
Problem Solving
Apply lateral thinking ideas to generate solutions in response to work problems
Apply operational research and research management skills
Clarify and identify work issues and apply processes to avoid interruptions to work flow/processes
Clarify problems and enterprise ideas to avoid interruptions to work flow/processes
Use testing techniques to anticipate or clarify problems to avoid interruptions to work flows and process
Generate ideas and alternatives
Analyse information to identify opportunities to develop solutions
Identify, assess and prioritise work risks to maintain efficiency, quality, productivity and work place safety at all times
Initiative & Enterprise
Recognise and respond to circumstances outside instructions or personal competence
Be proactive and apply strategies to overcome work blockages
Adopt proactive relationships with clients and co-workers
Identify and comply with all requirements and standards for work in the Electrotechnology industry

Apply enterprise best practice and quality systems
Generate ideas and translate into workplace actions and outcomes
Interact effectively with both internal and external industry stakeholders
Initiate and follow through on the implementation of the industry standards in the workplace
Translate ideas into action
Planning & Organising
Plan and organise activities including the maintenance and layout of own worksite and obtain equipment and materials to avoid work flow interruptions or wastage
Plan and organise activities to enable choices of maintenance methods of equipment, tools and related work documentation
Plan activities to enable choice of analysis/testing techniques of work outcomes and systems
Develop industry work plans including key performance indicators
Use mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Use computing capabilities that enable the use of mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Identify related industry compliance requirements
Identify, access and allocate required implementation resources
Maintain relevant industry and work records
Maintain relevant industry/work record systems
Maintain industry related records
Understand computer systems, their relationships and applications in the workplace
Establish clear implementation goals and deliverables
Monitor and optimise resource utilisation
Self Management

Plan own work within given task parameters
Set, monitor and satisfy personal work goals
Accept responsibility for given tasks
Clarify and confirm work instructions
Clarify own roles, goals, prerogatives and limitations in relation to the industry
Take responsibility for industry obligations
Evaluate and monitor own performance
Apply systematic and effective time management
Learning
Satisfy the competency requirements for the job
Maintain current knowledge of tools, devices, instruments, materials, work practices and systems
Seek learning opportunities
Provide technical instruction and learning assistance to assigned apprentices, trainees or other less experienced workers
Take control and manage own learning
Adopt a open approach to new ideas and techniques
Commit to and promote a culture of continuous learning
Set realistic learning goals for self development
Monitor and respond to learning process achievements
Technology
Use workplace technology to communicate with the client, document and present information
Use electronic information systems to communicate with co-workers and/or other related personnel
Use workplace technology related to the particular work tasks including tools, devices, instruments and materials
Use work place technology to collate, organise and maintain work documentation

and information
Attain and maintain required technical accreditation/authority under the industry standards
Attain and maintain IT skills relevant to the Electrotechnology industry
Be willing to learn new IT skills
Be willing gain knowledge and skills relevant to new and emerging technologies

The Employability Skills described above are representative of the Electrotechnology Industry in general and may not reflect enterprise specific requirements or job roles.

Learning and assessment strategies for each qualification should be based on the requirements of the units of competency comprising the qualification and the Assessment Guidelines, Volume 1, Part 3.

Employability Skills Summary for all Qualifications at AQF Level 4.

The following table contains a summary of the Employability Skills required by the Electrotechnology Industry for all UEE07 Electrotechnology Training Package qualifications at AQF level 4, namely;

AQF Code	Certificate IV Qualifications
UEE40110	Certificate IV in Computer Systems
UEE40210	Certificate IV in Electrical – Data and Voice Communications
UEE40310	Certificate IV in Electrical Installation Inspection and Audits
UEE40410	Certificate IV in Electrical – Instrumentation
UEE40510	Certificate IV in Electrical – Air-conditioning Systems
UEE40610	Certificate IV in Electrotechnology – Systems Electrician
UEE40710	Certificate IV in Electronics and Communications
UEE40810	Certificate IV in Electrical – Fire Protection Control Systems
UEE40910	Certificate IV in Industrial Electronics and Control
UEE41010	Certificate IV in Energy Management and Control

AQF Code	Certificate IV Qualifications
UEE41110	Certificate IV in Electrical – Lift Systems
UEE41210	Certificate IV in Electrical – Rail Signalling
UEE41510	Certificate IV in Video and Audio Systems
UEE41610	Certificate IV in Renewable Energy
UEE41710	Certificate IV in Rail – Communications and Network Systems
UEE41910	Certificate IV in Electrical – Renewable Energy
UEE42010	Certificate IV in Electrical – Photovoltaic Systems
UEE42110	Certificate IV in Electrotechnology – Electrical Contracting
UEE42210	Certificate IV in Instrumentation and Control
UEE42410	Certificate IV in Hazardous areas – Industrial control
UEE42610	Certificate IV in Hazardous areas – Electrical
UEE42711	Certificate IV in Air-conditioning and Refrigeration Servicing
UEE42811	Certificate IV in Air-conditioning Systems Energy Management and Control
UEE42911	Certificate IV in Refrigeration and Air-conditioning Systems

The Employability Skills facets described here are broad industry requirements that may vary depending on qualification packaging rules and options.

Communication
Collect, organise and understand information related to the work task and it's relevant safety procedures
Communicate ideas and information to enable confirmation of work requirement and specifications
Communicate information using drawing, diagrams, schedules and manuals
Communicate and/or report work outcomes and/or any problems

Communicate effectively in oral and written form
Access, read and comprehend safety instructions and procedures
Undertake negotiations if there are conflicts in work requirements and/or priorities
Share industry information
Share essential business information
Document work quotations and tender support schedules
Process approvals/authorities for industry activities
Prepare time sheets
Prepare documentation on particular work tasks including evaluations, reports, timesheets and costing
Prepare and present formal reports to clients and/or co-workers or other related personnel
Teamwork
Work with others by recognising dependencies and using co-operative approaches to optimise work flow and productivity
Work with others to generate ideas and review
Work effectively as an individual and as a member of a team
Work with others to identify work needs and review ideas against those needs
Work with others to evaluate and report on work tasks and outcomes
Work with others to present information to a client and/or co-worker(s)
Relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities
Influence individuals and teams
Develop and maintain networks for the implementation and maintenance of industry knowledge, standards and requirements
Coach/mentor others and provide feedback
Problem Solving
Use testing and analysis techniques to anticipate and/or clarify problems and plan

around them to avoid interruptions to work flows/processes
Apply lateral thinking to generate solutions in response to work problems
Apply analytical techniques to anticipate design issues and product needs
Apply operational research and research management skills
Clarify and identify work issues and apply processes to avoid interruptions to work flow/processes
Analyse information to identify opportunities to develop solutions
Identify, assess and prioritise work risks to maintain efficiency, quality, productivity and work place safety at all times
Initiative & Enterprise
Recognise and respond to circumstances outside instructions or personal competence
Create new opportunities for the enterprise
Be proactive and apply strategies to overcome work blockages
Adopt a proactive relationship with clients/co-workers
Identify work needs by applying research techniques
Identify and comply with all requirements and standards for work in the Electrotechnology industry
Apply and enterprise best practice and quality systems
Apply and enterprise the best computer systems and applications to ensure quality and efficiency of work tasks and documentation
Generate ideas and translate into workplace actions and outcomes
Interact effectively with both internal and external industry stakeholders
Initiate and follow through on the implementation of industry standards in the workplace
Translate ideas into action
Planning & Organising
Plan and organise activities including the maintenance and layout of own worksite and obtain equipment and materials to avoid work flow interruptions or wastage

Plan and organise activities to enable choices of maintenance methods of equipment, tools and related work documentation
Plan activities to enable choice of analysis/testing techniques of work outcomes and systems
Plan and organise activities to enable the most appropriate testing/analysis procedures to be implemented
Plan activities to enable choice of the best computer systems/programs for application on a particular work task
Develop industry work plans including key performance indicators
Use mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Use computing capabilities that enable the use of mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Identify related industry compliance requirements
Identify, access and allocate required implementation resources
Maintain relevant industry and work records
Maintain relevant industry/work record systems
Maintain industry related records
Understand computer systems, their relationships and applications in the workplace
Establish clear implementation goals and deliverables
Monitor and optimise resource utilisation
Self Management
Plan own work within given task parameters
Maintain current knowledge of computer systems and capabilities
Set, monitor and satisfy personal work goals
Accept responsibility for given tasks
Clarify and confirm work instructions

Clarify own roles, goals, prerogatives and limitations in relation to the industry
Take responsibility for industry obligations
Evaluate and monitor own performance
Apply systematic and effective time management
Learning
Satisfy the competency requirements for the job
Maintain current knowledge of tools, devices, instruments, materials, work practices and systems
Maintain current knowledge of computer systems programs and there relevant applications
Seek learning opportunities
Provide technical instruction and learning assistance to assigned apprentices, trainees or other less experienced workers
Take control and manage own learning
Adopt a open approach to new ideas and techniques
Commit to and promote a culture of continuous learning
Set realistic learning goals for self development
Monitor and respond to learning process achievements
Technology
Use workplace technology to document and present information
Use workplace technology to communicate with clients, co-workers and/or other related personnel
Use workplace technology related to particular work tasks including tools, equipment, devices, instruments and materials
Use workplace technology for data analysis/investigation
Attain and maintain required technical accreditation/authority under the industry standards
Attain and maintain IT skills relevant to the Electrotechnology industry

Be willing to learn new IT skills
Use workplace technology to collate, organise and maintain work documentation and information
Use computer applications as a management tool

The Employability Skills described above are representative of the Electrotechnology Industry in general and may not reflect enterprise specific requirements or job roles.

Learning and assessment strategies for each qualification should be based on the requirements of the units of competency comprising the qualification and the Assessment Guidelines, Volume 1, Part 3.

Employability Skills Summary for all Qualifications at AQF Level 5.

The following table contains a summary of the Employability Skills required by the Electrotechnology Industry for all UEE07 Electrotechnology Training Package qualifications at AQF level 5, namely;

AQF Code	Diploma Qualification
UEE50110	Diploma of Computer Systems Engineering
UEE50210	Diploma of Electrical and Instrumentation
UEE50310	Diploma of Electrical and Refrigeration and Air-conditioning
UEE50410	Diploma of Electrical Engineering
UEE50510	Diploma of Electronics and Communications Engineering
UEE50710	Diploma of Renewable Energy Engineering
UEE50810	Diploma of Research and Development
UEE50910	Diploma of Industrial Electronics and Control Engineering
UEE51010	Diploma of Instrumentation and Control Engineering
UEE51111	Diploma of Engineering Technology - Refrigeration and Air-conditioning

 UEE51211 Diploma of Air-conditioning and Refrigeration Engineering

The Employability Skills facets described here are broad industry requirements that may vary depending on qualification packaging rules and options.

Communication
Collect, organise and understand information related to the work task and it's relevant safety procedures
Communicate ideas and information to enable confirmation of work requirement and specifications
Communicate information using drawing, diagrams, schedules and manuals
Communicate and/or report work outcomes and/or any problems
Communicate effectively in oral and written form
Access, read and comprehend safety instructions and procedures
Undertake negotiations if there are conflicts in work requirements and/or priorities
Share industry information
Share essential business information
Document work quotations and tender support schedules
Process approvals/authorities for industry activities
Prepare time sheets
Prepare documentation on particular work tasks including evaluations, reports, timesheets and costing
Prepare and present formal reports to clients and/or co-workers or other related personnel
Use aesthetic ideas to plan visual presentation material
Teamwork
Work with others by recognising dependencies and using co-operative approaches to optimise work flow and productivity

Work with others to generate ideas and review
Work effectively as an individual and as a member of a team
Work with others to identify work needs and review ideas against those needs
Work with others to evaluate and report on work tasks and outcomes
Work with others to present information to a client and/or co-worker(s)
Relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities
Influence individuals and teams
Develop and maintain networks for the implementation and maintenance of industry knowledge, standards and requirements
Coach/mentor others and provide feedback
Problem Solving
Use testing and analysis techniques to anticipate and/or clarify problems and plan around them to avoid interruptions to work flows/processes
Apply lateral thinking to generate solutions in response to work problems
Apply analytical techniques to anticipate design issues and product needs
Apply operational research and research management skills
Apply contingency management techniques to variable circumstances
Clarify and identify work issues and apply processes to avoid interruptions to work flow/processes
Analyse information to identify opportunities to develop solutions
Identify, assess and prioritise work risks to maintain efficiency, quality, productivity and work place safety at all times
Initiative & Enterprise
Recognise and respond to circumstances outside instructions or personal competence
Create new opportunities for the enterprise
Be proactive and apply strategies to overcome work blockages

Adopt a proactive relationship with clients/co-workers
Identify work needs by applying research techniques
Identify and comply with all requirements and standards for work in the Electrotechnology industry
Apply and enterprise best practice and quality systems
Apply and enterprise the best computer systems and applications to ensure quality and efficiency of work tasks and documentation
Generate ideas and translate into workplace actions and outcomes
Interact effectively with both internal and external industry stakeholders
Initiate and follow through on the implementation of industry standards in the workplace
Translate ideas into action
Planning & Organising
Plan and organise activities including the maintenance and layout of own worksite and obtain equipment and materials to avoid work flow interruptions or wastage
Plan and organise activities to enable choices of maintenance methods of equipment, tools and related work documentation
Plan activities to enable choice of analysis/testing techniques of work outcomes and systems
Plan and organise activities to enable the most appropriate testing/analysis procedures to be implemented
Plan activities to enable choice of the best computer systems/programs for application on a particular work task
Develop industry work plans including key performance indicators
Use mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Use computing capabilities that enable the use of mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Identify related industry compliance requirements

Identify, access and allocate required implementation resources
Maintain relevant industry and work records
Maintain relevant industry/work record systems
Maintain industry related records
Understand computer systems, their relationships and applications in the workplace
Establish clear implementation goals and deliverables
Monitor and optimise resource utilisation
Self Management
Plan own work within given task parameters
Set, monitor and satisfy personal work goals
Accept responsibility for given tasks
Clarify and confirm work instructions
Clarify own roles, goals, prerogatives and limitations in relation to the industry
Take responsibility for industry obligations
Evaluate and monitor own performance
Apply systematic and effective time management
Learning
Satisfy the competency requirements for the job
Maintain current knowledge of tools, devices, instruments, materials, work practices and systems
Maintain current knowledge of computer systems programs and there relevant applications
Seek learning opportunities
Provide technical instruction and learning assistance to assigned apprentices, trainees or other less experienced workers
Take control and manage own learning

Adopt a open approach to new ideas and techniques
Commit to and promote a culture of continuous learning
Set realistic learning goals for self development
Monitor and respond to learning process achievements
Technology
Use workplace technology to document and present information
Use workplace technology to communicate with clients, co-workers and/or other related personnel
Use workplace technology related to particular work tasks including tools, equipment, devices, instruments and materials
Use workplace technology for data analysis/investigation
Attain and maintain required technical accreditation/authority under the industry standards
Attain and maintain IT skills relevant to the Electrotechnology industry
Be willing to learn new IT skills
Use workplace technology to collate, organise and maintain work documentation and information
Use computer applications as a management tool

The Employability Skills described above are representative of the Electrotechnology Industry in general and may not reflect enterprise specific requirements or job roles.

Learning and assessment strategies for each qualification should be based on the requirements of the units of competency comprising the qualification and the Assessment Guidelines, Volume 1, Part 3.

Employability Skills Summary for all Qualifications at AQF Level 6.

The following table contains a summary of the Employability Skills required by the Electrotechnology Industry for all UEE07 Electrotechnology Training Package qualifications at AQF level 6, namely;

AQF Code	Advanced Diploma Qualification
UEE60210	Advanced Diploma of Electronics and Communications Engineering
UEE60410	Advanced Diploma of Computer Systems Engineering
UEE60610	Advanced Diploma of Industrial Electronics and Control Engineering
UEE60910	Advanced Diploma of Renewable Energy Engineering
UEE61110	Advanced Diploma of Automated Systems Maintenance Engineering
UEE61210	Advanced Diploma of Engineering – Explosion protection
UEE61410	Advanced Diploma of Engineering Explosion protection – Industrial Control
UEE61510	Advanced Diploma of Instrumentation and Control Engineering
UEE61710	Advanced Diploma of Engineering Technology - Electronic
UEE61810	Advanced Diploma of Engineering Technology - Computer Systems
UEE62010	Advanced Diploma of Engineering Technology - Renewable Energy
UEE62110	Advanced Diploma of Engineering Technology – Electrical
UEE62211	Advanced Diploma of Electrical – Engineering
UEE62311	Advanced Diploma of Electrical Engineering – Coal Mining
UEE62411	Advanced Diploma of Engineering Technology - Air-conditioning and Refrigeration
UEE62511	Advanced Diploma of Air-conditioning and Refrigeration Engineering

The Employability Skills facets described here are broad industry requirements that may vary depending on qualification packaging rules and options.

Communication

Collect, organise and understand information related to the work task and it's relevant safety procedures
Communicate ideas and information to enable confirmation of work requirement and specifications
Communicate information using drawing, diagrams, schedules and manuals
Communicate and/or report work outcomes and/or any problems
Communicate effectively in oral and written form
Access, read and comprehend safety instructions and procedures
Undertake negotiations if there are conflicts in work requirements and/or priorities
Share industry information
Share essential business information
Share essential IT/Computing information
Document work quotations and tender support schedules
Process approvals/authorities for industry activities
Prepare documentation on particular work tasks including evaluations, reports, timesheets and costing
Prepare and present formal reports to clients and/or co-workers or other related personnel
Use aesthetic ideas to plan visual presentation material
Teamwork
Work with others by recognising dependencies and using co-operative approaches to optimise work flow and productivity
Work with others to generate ideas and review
Work effectively as an individual and as a member of a team
Work with others to identify work needs and review ideas against those needs
Work with others to evaluate and report on work tasks and outcomes
Work with others to present information to a client and/or co-worker(s)
Relate to people from a range of social, cultural and ethnic backgrounds and physical

and mental abilities
Influence individuals and teams
Develop and maintain networks for the implementation and maintenance of industry knowledge, standards and requirements
Coach/mentor others and provide feedback
Problem Solving
Use testing and analysis techniques to anticipate and/or clarify problems and plan around them to avoid interruptions to work flows/processes
Apply lateral thinking to generate solutions in response to work problems
Apply analytical techniques to anticipate design issues and product needs
Apply operational research and research management skills
Apply contingency management techniques to variable circumstances
Clarify and identify work issues and apply processes to avoid interruptions to work flow/processes
Analyse information to identify opportunities to develop solutions
Identify, assess and prioritise work risks to maintain efficiency, quality, productivity and work place safety at all times
Initiative & Enterprise
Recognise and respond to circumstances outside instructions or personal competence
Create new opportunities for the enterprise
Be proactive and apply strategies to overcome work blockages
Adopt a proactive relationship with clients/co-workers
Identify work needs by applying research techniques
Identify and comply with all requirements and standards for work in the Electrotechnology industry
Apply and enterprise best practice and quality systems
Apply and enterprise the best computer systems and applications to ensure quality and efficiency of work tasks and documentation

Generate ideas and translate into workplace actions and outcomes
Interact effectively with both internal and external industry stakeholders
Initiate and follow through on the implementation of industry standards in the workplace
Translate ideas into action
Planning & Organising
Plan and organise activities including the maintenance and layout of own worksite and obtain equipment and materials to avoid work flow interruptions or wastage
Plan and organise activities to enable choices of maintenance methods of equipment, tools and related work documentation
Plan activities to enable choice of analysis/testing techniques of work outcomes and systems
Plan and organise activities to enable the most appropriate testing/analysis procedures to be implemented
Plan activities to enable choice of the best computer systems/programs for application on a particular work task
Develop industry work plans including key performance indicators
Use mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Use computing capabilities that enable the use of mathematical ideas and techniques to correctly complete measurements, calculate quantities, estimate material, labour and overhead requirements and accurately cost the product/service
Identify related industry compliance requirements
Identify, access and allocate required implementation resources
Maintain relevant industry and work records
Maintain relevant industry/work record systems
Maintain industry related records
Understand computer systems, their relationships and applications in the workplace
Understand business systems and their relationships

Establish clear implementation goals and deliverables
Monitor and optimise resource utilisation
Self Management
Plan own work within given task parameters
Set, monitor and satisfy personal work goals
Accept responsibility for given tasks
Clarify and confirm work instructions
Clarify own roles, goals, prerogatives and limitations in relation to the industry
Take responsibility for industry obligations
Evaluate and monitor own performance
Apply systematic and effective time management
Learning
Satisfy the competency requirements for the job
Maintain current knowledge of tools, devices, instruments, materials, work practices and systems
Maintain current knowledge of computer systems programs and there relevant applications
Seek learning opportunities
Provide technical instruction and learning assistance to assigned apprentices, trainees or other less experienced workers
Take control and manage own learning
Adopt a open approach to new ideas and techniques
Commit to and promote a culture of continuous learning
Set realistic learning goals for self development
Monitor and respond to learning process achievements
Technology

Use workplace technology to document and present information
Use workplace technology to communicate with clients, co-workers and/or other related personnel
Use workplace technology related to particular work tasks including tools, equipment, devices, instruments and materials
Use workplace technology for data analysis/investigation
Attain and maintain required technical accreditation/authority under the industry standards
Attain and maintain IT skills relevant to the Electrotechnology industry
Be willing to learn new IT skills
Use workplace technology to collate, organise and maintain work documentation and information
Use computer applications as a management tool

The Employability Skills described above are representative of the Electrotechnology Industry in general and may not reflect enterprise specific requirements or job roles.

Learning and assessment strategies for each qualification should be based on the requirements of the units of competency comprising the qualification and the Assessment Guidelines, Volume 1, Part 3.

1.1.11 Qualifications Structures

1.11 Qualifications Structures

Electrotechnology qualification structures are detailed in the following pages.

1.1.12 Schedule of Electives

Schedule of Electives

The Schedule of Electives forms an integral part of the requisite qualification structure of this Training Package.

Schedule of Electives – 1

Competency standard units have been put into strands to facilitate work outcomes for the qualification, as specified by industry stakeholders. This design feature has been developed to enhance flexibility for enterprise outcomes.

The following dot points provide examples on the use of the Schedule in selecting appropriate competency standard units to complete the Elective requirements of the qualification:

- 1 unit from strand 6, gives a unit strand total of 6
- 2 units from strand 3, gives a unit strand total of 6
- 1 unit from strand 5 PLUS 1 unit from strand 1, gives a unit strand total of 6

Notes:

1. All pre-requisites must be met prior to completing each competency standard unit.
2. Where a competency standard unit is achieved as part of the core of a qualification it shall not be used again for selection as an elective unit.

Strand 8

Schedule 1 – Strand 8 Electives

UEENEEE045B Apply computation when using equipment, materials and concepts in an electrotechnology environment

Strand 7

Schedule 1 – Strand 7 Electives

Nil

Strand 6

Schedule 1 – Strand 6 Electives

UEENEEE043B Produce routine tools/devices for carrying out electrotechnology work activities

UEENEEE046B Identify affects of energy on machinery and materials in an electrotechnology environment

Strand 5

Schedule 1 – Strand 5 Electives

Nil

Strand 4

Schedule 1 – Strand 4 Electives

Nil

Strand 3

Schedule 1 – Strand 3 Electives

One unit from an endorsed TP One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF

Strand 2

Schedule 1 – Strand 2 Electives

- UEENEEB001B Operate and maintain an amateur radio communication station
- UEENEEE002B Dismantle, assemble and fabricate electrotechnology components
- UEENEEE003B Solve problems in extra-low voltage single path circuits
- UEENEEE004B Solve problems in multiple path d.c. circuits

Strand 1

Schedule 1 – Strand 1 Electives

- UEENEEE005B Fix and secure equipment
- UEENEEE020B Provide basic instruction in the use of electrotechnology apparatus
- UEENEEE079A Identify and select components, accessories and materials for electrotechnology work activities

Schedule of Electives – 2

Competency standard units have been put into strands to facilitate work outcomes for the qualification, as specified by industry stakeholders. This design feature has been developed to enhance flexibility for enterprise outcomes.

The following dot points provide examples on the use of the Schedule in selecting appropriate competency standard units to complete the Elective requirements of the qualification:

- 1 unit from strand 6, gives a unit strand total of 6
- 2 units from strand 3, gives a unit strand total of 6
- 1 unit from strand 5 PLUS 1 unit from strand 1, gives a unit strand total of 6

•

Notes:

1. All pre-requisites must be met prior to completing each competency standard unit.
2. Where a competency standard unit is achieved as part of the core of a qualification it shall not be used again for selection as an elective unit.

Strand 8

Schedule 2 – Strand 8 Electives

UEENEEE045B Apply computation when using equipment, materials and concepts in an electrotechnology environment

Strand 7

Schedule 2 – Strand 7 Electives

Nil

Strand 6

Schedule 2 – Strand 6 Electives

UEENEE012B Support computer hardware and software

UEENEEE043B Produce routine tools/devices for carrying out electrotechnology work activities

UEENEEE044B Apply technologies and concepts to electrotechnology work activities

UEENEEE046B Identify affects of energy on machinery and materials in an electrotechnology environment

UEENEEE047B Identify building techniques, methods and materials used in electrotechnology work activities

UEENEEE049B Contribute to the operation of support plant and equipment used in electricity supply

UEENEEE050B Undertake computations in an electrotechnology environment

UEENEEF002B Lay and connect cables for multiple access to telecommunication services

UEENEEG052B Rewind single phase induction machines

UEENEEH003B Carry out routine repairs to business equipment

Schedule 2 – Strand 6 Electives

UEENEEH006B	Assemble and set up fixed audio/video components and systems in buildings and premises
UEENEEK016A	Maintain and repair remote area power generation facilities
UEENEEK017B	Maintain and repair facilities associated with remote area essential services operation
UEENEEK020B	Maintain operation of remote area power plant
UEENEEK047A	Maintain and monitor remote area essential service operations

Strand 5

Schedule 2 – Strand 5 Electives

UEENEEH069B	Solve problems in electronic circuits
UEENEEK013B	Apply sustainable energy practice in daily activities

Strand 4

Schedule 2 – Strand 4 Electives

UEENEEH002B	Assemble, set up and test personal computers
UEENEEE023B	Solve basic problems in electronic and digital equipment
UEENEEE042B	Produce routine products for carrying out electrotechnology work activities
UEENEEH050B	Assemble and set up basic wired and wireless security systems
UEENEEK023B	Carry out basic repairs to renewable energy apparatus by replacement of components

Strand 3

Schedule 2 – Strand 3 Electives

UEENEEE022B	Carry out preparatory electrotechnology work activities
UEENEEE030B	Provide solutions to and report on routine electrotechnology problems
UEENEEE041B	Use of routine equipment/plant/technologies in an electrotechnology

Schedule 2 – Strand 3 Electives

environment

UEENEEE051B	Transport apparatus and materials
UEENEEF015B	Assemble and connect communication frames and cabinets
UEENEEG001B	Solve problems in electromagnetic circuits
UEENEEH008B	Assemble and erect reception antennae and signal distribution equipment
UEENEEH009B	Set up and test gaming/games equipment
UEENEEH028B	Install microwave and antennae and waveguides
UEENEEH062B	Verify compliance and functionality of fire protection installations
One unit from an endorsed TP	One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF
UEENEEJ005B	Position, assemble and start up split air conditioning systems
UEENEEJ072B	Recover, pressure and leak test, evacuate and charge refrigerants – split air conditioning systems
UEENEEK011B	Assemble and connect remote area power supplies
UEENEEM070A	Repair reeling, trailing and flexible cables
UEENEEM071A	Test reeling, trailing and flexible cables
UEENEEM072A	Inspect and fit plugs/couplers for reeling, trailing and flexible cables
NWP261A	Operate and maintain water treatment plant and equipment ²
NWP263A	Monitor and report wastewater treatment plant and Equipment

Strand 2

Schedule 2 – Strand 2 Electives

UEENEEA001B	Assemble electronic apparatus
UEENEEA003B	Set up and check electronic component placement machines
UEENEEA004B	Rework electronic sub assemblies
UEENEEA006B	Apply lead-free soldering techniques

Schedule 2 – Strand 2 Electives

UEENEEB001B	Operate and maintain an amateur radio communication station
UEENEEED004B	Use engineering applications software
UEENEEED043B	Install and configure a computer operating system and software
UEENEEED046B	Set up and configure basic local area network
UEENEEEE002B	Dismantle, assemble and fabricate electrotechnology components
UEENEEEE003B	Solve problems in extra-low voltage single path circuits
UEENEEEE004B	Solve problems in multiple path d.c. circuits
UEENEEEE007B	Use drawings, diagrams, schedules and manuals
UEENEEEE008B	Lay wiring/cabling and terminate accessories for extra-low voltage circuits
UEENEEEE019C	Solve problems in multiple path a.c. circuits
UEENEEEE048C	Carry out routine work activities in an electrotechnology environment
UEENEEEF006B	Solve problems in data and voice communications circuits
UEENEEEF007B	Set up wireless capabilities of communications and data storage devices
UEENEEEG011B	Carry out basic repairs to electrical apparatus
UEENEEEG050B	Wind coils
UEENEEEG051B	Place and connect coils
UEENEEEH001B	Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies
UEENEEEH002B	Carry out basic repairs to electronic apparatus by replacement of components
UEENEEEH004B	Set up and test residential audio/video equipment
UEENEEEH061B	Position and terminate fire detection and warning system apparatus
UEENEEJ002B	Prepare refrigeration tubing and fittings
UEENEEJ003B	Determine the basic operating conditions of vapour compression

Schedule 2 – Strand 2 Electives

systems

UEENEEJ004B	Determine the basic operating conditions of air conditioning systems
UEENEEK003B	Conduct periodic maintenance of remote area power supply (RAPS) battery banks
UEENEEK004B	Conduct periodic maintenance of remote area power supply (RAPS) generator sets
UEENEEK005B	Conduct periodic maintenance of remote area power supply (RAPS) photo voltaic arrays
UEENEEK006B	Conduct periodic maintenance of remote area power supply (RAPS) wind generators
UEENEEK007B	Conduct checks in the demand side use of remote area power supplies
UEENEEK008B	Plan periodic maintenance schedules of remote area power supplies
UEENEEK012B	Provide basic sustainable energy solutions for energy reduction in domestic premises
UEENEEK014B	Promote sustainable energy practice in the community
UEENEEP002B	Attach cords and plugs to electrical equipment for connection to a single phase 250 Volt supply
UEENEEP006B	Attach flexible cables and plugs to electrical equipment connected to a high voltage supply
UEPOPS234A	Perform Routine oxy-acetylene (fuel gas) Welding (OAW)
UEPOPS235A	Perform Routine Manual Arc Welding
UEPOPS236A	Perform Manual Heating, Thermal Cutting and Gouging
NWP209B	Use maps, plans, drawings and specifications
NWP243B	Operate bore fields and groundwater source systems
NWP245B	Maintain tanks and water storage assets
NWP247A	Maintain catchment and surrounding areas
NWP253B	Install and repair water services

Schedule 2 – Strand 2 Electives

NWP255B	Maintain and repair wastewater collection assets
NWP256B	Monitor and report water distribution systems
NWP257B	Maintain and repair wastewater collection systems
NWP259B	Operate, monitor and maintain pump stations
NWP260A	Monitor and report water treatment processes
NWP262A	Monitor and report wastewater treatment processes
NWP268B	Monitor, operate and report chlorine disinfection systems

Strand 1

Schedule 2 – Strand 1 Electives

UEENEEA002B	Select electronic components
UEENEEA005B	Conduct functional and quality tests on assembled electronic apparatus
UEENEE005B	Enter and verify operating instructions in microprocessor equipped devices
UEENEEE001B	Apply OHS practices in the workplace
UEENEEE005B	Fix and secure equipment
UEENEEE032B	Document occupational hazards and risks in computer systems
UEENEEE033B	Document occupational hazards and risks in electrical work
UEENEEE034B	Document occupational hazards and risks in electronics
UEENEEE035B	Document occupational hazards and risks in instrumentation
UEENEEE036B	Document occupational hazards and risks in refrigeration and air-conditioning
UEENEEE037B	Document occupational hazards and risks in electrotechnology
UEENEEE079A	Identify and select components, accessories and materials for electrotechnology work activities
UEENEEF016A	Lay and connect cabling for direct access to telecommunications

Schedule 2 – Strand 1 Electives

services

UEENEEK001B	Maintain safety and tidiness of remote area power supply (RAPS) systems
UEENEEK002B	Work safely with remote area power supply (RAPS) systems
UEENEEK050A	Assemble and set up photovoltaic apparatus in a domestic dwelling
UEENEEM080A	Report on the integrity of explosion-protected equipment in a hazardous area
UEENEEM042A	Conduct visual inspection of hazardous areas installations
UEENEEM003B	Attach cords and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply
UEENEEM008B	Conduct in-service safety testing of electrical cord assemblies and cord connected equipment
NWP218B	Perform and record sampling
NWP226B	Prepare and restore work site
NWP227B	Control vegetation on a site
NWP229B	Repair minor structures
TLID3507C	Operate a boom type elevating work platform
TLILIC508A	Licence to operate a boom-type elevating work platform (boom length 11 meters or more)
RIIOHS202A	Enter and work in confined spaces
RIIOHS204A	Work safely at heights
RIIOHS205A	Control traffic with stop-slow bat
HLTFA301B	Apply first aid

Schedule of Electives – 3

Competency standard units have been put into strands to facilitate work outcomes for the qualification, as specified by industry stakeholders. This design feature has been developed to enhance flexibility for enterprise outcomes.

The following provides examples on the use of the Schedules in selecting appropriate competency standard units to complete the elective requirements of the qualification:

- 1 unit from strand 6, gives a unit strand total of 6
- 2 units from strand 3, gives a unit strand total of 6
- 1 unit from strand 5 PLUS 1 unit from strand 1, gives a unit strand total of 6

Notes:

1. All pre-requisites must be met prior to completing each competency standard unit.
2. Where a competency standard unit is achieved as part of the core of a qualification it shall not be used again for selection as an elective unit.

Strand 6

Schedule 3 – Strand 6 Electives

UENEEA010B	Assemble, mount and connect switchgear and controlgear
UEENED012B	Support computer hardware and software
UEENEEF002B	Lay and connect cables for multiple access to telecommunication services
UEENEEF010B	Select and arrange equipment for local area networks
UEENEEG007B	Select and arrange equipment for general electrical installations
UEENEEG015B	Find and rectify faults in energy supply network equipment
UEENEEG052B	Rewind single phase induction machines
UEENEEG053B	Rewind three phase induction machines rated for low voltage
UEENEEG054B	Rewind direct current machines rated for low voltage
UEENEEH003B	Carry out routine repairs to business equipment
UEENEEH006B	Assemble and set up fixed audio/video components and systems in buildings and premises
UEENEEH010B	Install commercial audio/video system components
UEENEEH017B	Carry out repairs of predictable faults in audio and video replay/recording apparatus
UEENEEH019B	Carry out repairs of predictable faults in television receivers
UEENEEH021B	Find and repair faults in high volume office equipment

Schedule 3 – Strand 6 Electives

UEENEEH071B	Find and repair faults in television receivers
UEENEEH073B	Find and repair faults in professional audio reproduction components
UEENEEH074B	Find and repair faults in audio/video recording equipment
UEENEEI006B	Solve problems in process controllers, transmitters and converters
UEENEEI009B	Set up process measuring and control instruments
UEENEEJ010B	Select refrigerant pipe/tube, accessories and associated controls
UEENEEJ053B	Find and rectify faults in appliance motors and associated controls
UEENEEK017B	Maintain and repair facilities associated with remote area essential services operation
UEENEEK020B	Maintain operation of remote area power plant

Strand 5

Schedule 3 – Strand 5 Electives

UEENEEH051B	Install large wired and wireless security systems
UEENEEH069B	Solve problems in electronic circuits

Strand 4

Schedule 3 – Strand 4 Electives

UEENEE002B	Assemble, set up and test personal computers
UEENEEG016B	Diagnose and rectify faults in lift systems
UEENEEG026B	Install and maintain field power and distribution systems with a LV demand up to 200 A per phase
UEENEEH012B	Troubleshoot digital subsystems
UEENEEH013B	Troubleshoot amplifiers
UEENEEH014B	Troubleshoot frequency dependent circuits

Schedule 3 – Strand 4 Electives

UEENEEH020B	Find and repair faults in gaming and games equipment
UEENEEH050B	Assemble and set up basic wired and wireless security systems
UEENEEH072C	Find and repair faults in communication systems
UEENEEI013B	Select equipment for process control systems
UEENEEK023B	Carry out basic repairs to renewable energy apparatus by replacement of components
UEENEEP001B	Disconnect and reconnect fixed wired electrical equipment connected to a Low Voltage supply

Strand 3

Schedule 3 – Strand 3 Electives

UEENEEA012B	Make up and assemble bus bars
UEENEEA013B	Assemble and wire control panels
UEENEEED007B	Develop, enter and verify programs for programmable logic controllers using ladder instruction set
UEENEEED031B	Develop and validate basic integrated systems
UEENEEF008B	Select and arrange equipment for wireless networks
UEENEEF009B	Install and connect voice and data communications equipment
UEENEEF011B	Test, report and rectify faults in voice and data installations
UEENEEG010B	Find and repair faults in d.c. electrical apparatus and circuits
UEENEEG013B	Install and maintain emergency systems
UEENEEG018B	Maintain operation of electrical mining equipment
UEENEEG019B	Maintain the operation of electrical marine equipment
UEENEEG020B	Select and arrange equipment for special electrical installations
UEENEEG029B	Overhaul and repair switchgear / controlgear
UEENEEG055B	Rewind three phase induction machines rated for high voltage to 3.3 kV

Schedule 3 – Strand 3 Electives

UEENEEG056B	Rewind three phase induction machines rated for high voltage above 3.3 kV
UEENEEG058B	Conduct electrical tests on high voltage electrical machines
UEENEEG064B	Repair mechanical components of electrical machines
UEENEEH008B	Assemble and erect reception antennae and signal distribution equipment
UEENEEH009B	Set up and test gaming/games equipment
UEENEEH015B	Develop software solutions in microcontroller based systems
UEENEEH022B	Find and repair faults in remote control apparatus
UEENEEH027B	Commission commercial radio frequency (RF) transmission and reception systems
UEENEEH028B	Install microwave and antennae and waveguides
UEENEEH054B	Program and commission commercial security alarm systems
UEENEEH055B	Program and commission commercial security access control systems
UEENEEH056B	Program and commission commercial security closed circuit television (CCTV) systems
One unit from endorsed TP	One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF
UEENEEI014B	Find and rectify faults in process control systems
UEENEEJ005B	Position, assemble and start up split air conditioning systems
UEENEEJ072B	Recover, pressure and leak test, evacuate and charge refrigerants – split air conditioning systems
UEENEEM023A	Install explosion-protected equipment and wiring systems — coal mining
UEENEEM024A	Install explosion-protected equipment and wiring systems — gas atmospheres
UEENEEM025A	Install explosion-protected equipment and wiring systems — dust atmospheres

Schedule 3 – Strand 3 Electives

UEENEEM026A	Install explosion-protected equipment and wiring systems — pressurisation
UEENEEM027A	Maintain equipment in hazardous areas — coal mining
UEENEEM028A	Maintain equipment in hazardous areas — gas atmospheres
UEENEEM029A	Maintain equipment in hazardous areas — dust atmospheres
UEENEEM030A	Maintain equipment in hazardous areas — pressurisation
UEENEEM031A	Overhaul and repair of explosion-protected equipment — coal mining
UEENEEM032A	Overhaul and repair of explosion-protected equipment — flameproof enclosures
UEENEEM033A	Overhaul and repair of explosion-protected equipment — gas atmospheres
UEENEEM034A	Overhaul and repair of explosion-protected equipment — dust atmospheres
UEENEEM060A	Carry out overhaul and repair of explosion-protected equipment — coal mining
UEENEEM061A	Carry out overhaul and repair of explosion-protected equipment — flameproof enclosures
UEENEEM062A	Carry out overhaul and repair of explosion-protected equipment — gas atmospheres
UEENEEM063A	Carry out overhaul and repair of explosion-protected equipment — dust atmospheres
UEENEEM070A	Repair reeling, trailing and flexible cables
UEENEEM071A	Test reeling, trailing and flexible cables
UEENEEM072A	Inspect and fit plugs/couplers for reeling, trailing and flexible cables
UEENEEM004B	Disconnect and reconnect explosion-protected electrical equipment connected to Low Voltage supply
UEENEEM005B	Disconnect and reconnect 3.3 kV electric propulsion components of self-propelled earth moving vehicles

Strand 2

Schedule 3 – Strand 2 Electives

UEENEEA001B	Assemble electronic apparatus
UEENEEA003B	Set up and check electronic component placement machines
UEENEEA004B	Rework electronic sub assemblies
UEENEEA006B	Apply lead-free soldering techniques
UEENEEA004B	Use engineering applications software
UEENEEA029B	Develop basic web pages for engineering applications
UEENEEA030B	Select, install, configure and test multimedia devices
UEENEEA043B	Install and configure a computer operating system and software
UEENEEA046B	Set up and configure basic local area network
UEENEEA053B	Set up and test biometric devices
UEENEEA008B	Lay wiring/cabling and terminate accessories for extra-low voltage circuits
UEENEEA019C	Solve problems in multiple path a.c. circuits
UEENEEA021B	Plan an integrated cabling system
UEENEEA003B	Install and maintain cabling for telecommunication services in lifts
UEENEEA004B	Install and modify performance data communication structured cabling
UEENEEA005B	Install and modify performance data communication optical fibre cabling
UEENEEA007B	Set up wireless capabilities of communications and data storage devices
UEENEEA012B	Install aerial communication cables
UEENEEA013B	Install below ground communication cables
UEENEEA014B	Set up and configure basic data communications systems
UEENEEA021B	Verify compliance and functionality of special electrical installations
UEENEEA025B	Plan electrical installations with a LV demand up to 400A per phase

Schedule 3 – Strand 2 Electives

UEENEEG028B	Plan switchboard and control panel layouts
UEENEEG034B	Perform high voltage field switching to a given schedule
UEENEEG057B	Conduct electrical tests on low voltage electrical machines
UEENEEG059B	Conduct mechanical tests of electrical machines
UEENEEG062B	Set up and place electrical apparatus and associated circuits into service
UEENEEG065B	Maintain and service traction lifts
UEENEEG066B	Installation and maintenance of escalators, moving walks and tread ways
UEENEEG067B	Align and install lift equipment
UEENEEH001B	Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies
UEENEEH002B	Carry out basic repairs to electronic apparatus by replacement of components
UEENEEH004B	Set up and test residential audio/video equipment
UEENEEH005B	Verify compliance and functionality of custom electronic installations
UEENEEH007B	Carry out repairs of predictable faults in general electronic apparatus
UEENEEH011B	Troubleshoot d.c. power supplies with single phase input
UEENEEH016B	Find and repair faults in the microwave amplifier sections of electronic apparatus
UEENEEH018B	Find and repair faults in electronic apparatus
UEENEEH023B	Find and repair faults in microwave heating apparatus
UEENEEH024B	Carry out repairs of predictable faults in audio components
UEENEEH038B	Find and repair faults in complex power supplies
UEENEEH039B	Troubleshoot basic amplifiers
UEENEEH042B	Troubleshoot oscillators

Schedule 3 – Strand 2 Electives

UEENEEH046B	Solve fundamental problems in electronic communications systems
UEENEEH052B	Enter instructions and test basic wired and wireless security systems
UEENEEH063B	Enter and verify programs in preparation for commissioning fire protection systems
UEENEEH064B	Commission commercial fire protection systems
UEENEEH065B	Find and repair faults in fire protection systems
UEENEEH066B	Fault find Microcontroller based hardware
UEENEEH070B	Terminate and connect components, conductors, wiring and cables for electronic circuits
UEENEEH087B	Solve problems in musical equipment circuits
UEENEEI001B	Install and set up transducers and sensing devices
UEENEEI002B	Solve problems in pressure measurement systems
UEENEEI003B	Solve problems in density/level measurement systems
UEENEEI004B	Solve problems in flow measurement systems
UEENEEI005B	Solve problems in temperature measurement systems
UEENEEI010B	Set up and adjust process control loops
UEENEEI011B	Find and rectify faults in process control valve and associated equipment
UEENEEI012B	Verify compliance and functionality of process control installations
UEENEEI017B	Calibrate and test measuring instruments
UEENEEJ002B	Prepare refrigeration tubing and fittings
UEENEEJ003B	Determine the basic operating conditions of vapour compression systems
UEENEEJ004B	Determine the basic operating conditions of air conditioning systems
UEENEEJ015B	Solve problems in beverage dispensers
UEENEEJ018B	Solve problems in post mix refrigeration systems

Schedule 3 – Strand 2 Electives

UEENEEJ020B	Solve problems in industrial refrigeration systems
UEENEEK007B	Conduct checks in the demand side use of remote area power supplies
UEENEEK008B	Plan periodic maintenance schedules of remote area power supplies
UEENEEK026B	Install and set up grid connected photovoltaic power systems
UEENEEK048A	Install, configure and commission grid connected photovoltaic power systems
UEENEEM038A	Conduct testing of hazardous area installations — coal mining
UEENEEM039A	Conduct testing of hazardous area installations — gas atmospheres
UEENEEM040A	Conduct testing of hazardous area installations — dust atmospheres
UEENEEM041A	Conduct testing of hazardous area installations — pressurisation
UEENEEM002B	Attach cords and plugs to electrical equipment for connection to a single phase 250 Volt supply
UEPOPS234A	Perform Routine oxy-acetylene (fuel gas) Welding (OAW)
UEPOPS235A	Perform routine manual arc welding
UEPOPS236A	Perform manual heating, thermal cutting and gouging
ICTTEN3056A	Install telecommunications network equipment
UETTDRIS04B	Perform high voltage field switching operation to a given schedule

Strand 1

Schedule 3 – Strand 1 Electives

UEENEEA002B	Select electronic components
UEENEEA005B	Conduct functional and quality tests on assembled electronic apparatus
UEENEED005B	Enter and verify operating instructions in microprocessor equipped devices
UEENEEE005B	Fix and secure equipment

Schedule 3 – Strand 1 Electives

UEENEEF016A	Lay and connect cabling for direct access to telecommunications services
UEENEEI007C	Install process instrumentation and control cabling and tubing
UEENEEI008C	Install process control apparatus and associated equipment
UEENEEJ019B	Solve problems in ice making systems
UEENEEK009B	Attend to breakdowns in remote area power supplies
UEENEEK025C	Solve basic problems in photovoltaic energy apparatus
UEENEEK050A	Assemble and set up photovoltaic apparatus in a domestic dwelling
UEENEEK037B	Install and set up micro-hydro systems
UEENEEK043A	Install small wind energy conversion systems for stand-alone applications
MSACMS200A	Apply competitive manufacturing practices
MSACMT220A	Apply quick changeover procedures
MSACMT221A	Apply Just in Time (JIT) procedures
MSACMT240A	Apply 5S procedures in a manufacturing environment
MSACMT280A	Undertake root cause analysis
MSACMT281A	Contribute to the application of a proactive maintenance strategy
PRMPFES43A	Prevent ozone depleting substance and synthetic greenhouse gas emissions
UEENEEM076A	Use and maintain the integrity of a portable gas detection device
UEENEEM077A	Install and maintain the integrity of fixed gas detection equipment
UEENEEM042A	Conduct visual inspection of hazardous areas installations
UEENEEN002B	Assemble and wire internal electrical signalling equipment
UEENEEN003B	Install and maintain track circuit leads and bonds

Schedule 3 – Strand 1 Electives

UEENEEN004B	Perform cable tests
UEENEEN005B	Install and maintain signalling power supplies
UEENEEN008B	Maintain on-site power operated point-activating devices
UEENEEN009B	Maintain track circuit equipment
UEENEEN011B	Install and maintain power operated signalling equipment
UEENEEN003B	Attach cords and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply
UEENEEN007B	Locate and rectify faults in electrical low voltage equipment following prescribed procedures

Schedule of Electives – 4

Competency standard units have been put into strands to facilitate work outcomes for the qualification, as specified by industry stakeholders. This design feature has been developed to enhance flexibility for enterprise outcomes.

The following dot points provide examples on the use of the Schedule in selecting appropriate competency standard units to complete the Elective requirements of the qualification:

- 1 unit from strand 6, gives a unit strand total of 6
- 2 units from strand 3, gives a unit strand total of 6
- 1 unit from strand 5 PLUS 1 unit from strand 1, gives a unit strand total of 6

Note:

1. Pre-requisite pathways shall be identified and met for all elective units selected.
2. In selecting elective units considerations to career planning advice should be given to units that form part of a pre-requisite pathway for the progression to achieve particular competencies or qualification at a higher level.

Strand 6

Schedule 4 – Strand 6 Electives

UEENEEA010B	Assemble, mount and connect switchgear and controlgear
UEENED012B	Support computer hardware and software

Schedule 4 – Strand 6 Electives

UEENEE017B	Install and configure internetworking systems
UEENEE054B	Analyse and implement biometric techniques and applications
UEENEEF010B	Select and arrange equipment for local area networks
UEENEEG007B	Select and arrange equipment for general electrical installations
UEENEEG015B	Find and rectify faults in energy supply network equipment
UEENEEH017B	Carry out repairs of predictable faults in audio and video replay/recording apparatus
UEENEEH019B	Carry out repairs of predictable faults in television receivers
UEENEEH031B	Diagnose and rectify faults in radar apparatus and systems
UEENEEH034B	Diagnose and rectify faults in electronic medical equipment
UEENEEH035B	Design custom electronic installations
UEENEEH036B	Design commercial audio/video installations
UEENEEH040B	Diagnose and rectify faults in sonar apparatus and systems
UEENEEH053B	Program and test large wired and wireless security systems
UEENEEH071B	Find and repair faults in television receivers
UEENEEH073B	Find and repair faults in professional audio reproduction components
UEENEEH074B	Find and repair faults in audio/video recording equipment
UEENEEI006B	Solve problems in process controllers, transmitters and converters
UEENEEI009B	Set up process measuring and control instruments
UEENEEI015B	Find and rectify faults in medical equipment control systems

Strand 4

Schedule 4 – Strand 4 Electives

UEENEE013B	Install and administer unix based computers
UEENEE015B	Administer user networks

Schedule 4 – Strand 4 Electives

UEENEED024B	Integrate multiple computer operating systems on a client server network
UEENEEG075A	Develop compliance policies and plans to conduct a contracting business
UEENEEG016B	Diagnose and rectify faults in lift systems
UEENEEG026B	Install and maintain field power and distribution systems with a LV demand up to 200A per phase
UEENEEH020B	Find and repair faults in gaming and games equipment
UEENEEH072C	Find and repair faults in communication systems
UEENEEH079B	Diagnose and rectify faults in digital television apparatus
UEENEEH080B	Diagnose and rectify faults in digital transmission systems
UEENEEI013B	Select equipment for process control systems
UEENEEI026B	Provide solutions to pneumatic/hydraulic system operations
UEENEEI027B	Analyse complex electronic circuits controlling fluids
UEENEK023B	Carry out basic repairs to renewable energy apparatus by replacement of components
ICTTC083D	Locate and rectify complex CPE system and equipment faults
ICTTC088D	Locate and rectify network faults on a first in basis
ICTTC089D	Repair and replace telecommunications network hardware

Strand 3

Schedule 4 – Strand 3 Electives

UEENEED007B	Develop, enter and verify programs for programmable logic controllers using ladder instruction set
UEENEED008B	Develop, enter and verify programs in Supervisory Control and Data Acquisition systems
UEENEED009B	Develop, enter and verify programs for industrial control systems using high level instructions
UEENEED031B	Develop and validate basic integrated systems

Schedule 4 – Strand 3 Electives

UEENEED032B	Design integrated systems
UEENEED033B	Design complex integrated systems
UEENEED034B	Configure and maintain industrial control system networks
UEENEEE010B	Develop and implement maintenance programs
UEENEEE018B	Establish, maintain and evaluate OHS systems
UEENEEF008B	Select and arrange equipment for wireless networks
UEENEEF009B	Install and connect voice and data communications equipment
UEENEEF011B	Test, report and rectify faults in voice and data installations
UEENEEG010B	Find and repair faults in d.c. electrical apparatus and circuits
UEENEEG013B	Install and maintain emergency systems
UEENEEG018B	Maintain operation of electrical mining equipment
UEENEEG019B	Maintain operation of electrical marine equipment
UEENEEG020B	Select and arrange equipment for special electrical installations
UEENEEG022B	Conduct compliance inspection of single phase electrical installations
UEENEEG024B	Conduct compliance inspection of special electrical installations
UEENEEG029B	Overhaul and repair switchgear / controlgear
UEENEEG032B	Carry out electrical field testing and report findings
UEENEEG037B	Diagnose and rectify faults in energy supply apparatus
UEENEEG038B	Diagnose and rectify faults in electrical energy distribution systems
UEENEEG039B	Diagnose and rectify faults in distributed generation systems
UEENEEG042B	Diagnose and rectify faults in electrical energy supply transmission systems
UEENEEG055B	Rewind three phase induction machines rated for high voltage to 3.3 kV
UEENEEG056B	Rewind three phase induction machines rated for high voltage above

Schedule 4 – Strand 3 Electives

3.3 kV

UEENEEG058B	Conduct electrical tests on high voltage electrical machines
UEENEEG064B	Repair mechanical components of electrical machines
UEENEEG072C	Investigate and report on electrical incidents
UEENEEH015B	Develop software solutions in microcontroller based systems
UEENEEH022B	Find and repair faults in remote control apparatus
UEENEEH025B	Provide solutions to single phase electronic power control problems
UEENEEH026B	Provide solutions to polyphase electronic power control problems
UEENEEH027B	Commission commercial radio frequency (RF) transmission and reception systems
UEENEEH029B	Diagnose and rectify faults in navigation systems
UEENEEH030B	Diagnose and rectify faults in satellite-based surveillance and observation systems
UEENEEH032B	Diagnose and rectify faults in global positioning systems
UEENEEH033B	Diagnose and rectify faults in telecommunication apparatus and systems
UEENEEH043B	Diagnose and rectify faults in digital subsystems of electronic controls
UEENEEH044B	Diagnose and rectify faults in analogue circuits and components in electronic control systems
UEENEEH054B	Program and commission commercial security alarm systems
UEENEEH055B	Program and commission commercial security access control systems
UEENEEH056B	Program and commission commercial security closed circuit television (CCTV) systems
UEENEEH075B	Find and rectify faults and malfunctions in security system installations
UEENEEH076B	Diagnose and rectify faults in display circuits

Schedule 4 – Strand 3 Electives

UEENEEH077B	Diagnose and rectify faults in recording and replay apparatus
UEENEEH078B	Diagnose and rectify faults in camera circuits
UEENEEI014B	Find and rectify faults in process control systems
UEENEEI019B	Set up field control devices
UEENEEI020B	Provide solutions to problems in basic industrial control systems
UEENEEI025B	Provide solutions to fluid circuit operations
UEENEEK027B	Diagnose faults in renewable energy control systems
UEENEEK028B	Solve problems in stand-alone renewable energy systems
UEENEEK030B	Solve problems in wind energy conversion systems
UEENEEK034B	Install standalone photovoltaic power systems
UEENEEK035C	Design grid connected power supply systems
UEENEEK038B	Design micro-hydro systems
One unit from an endorsed TP	One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF

Strand 2

Schedule 4 – Strand 2 Electives

UEENEEC004B	Prepare specifications for the supply of materials and equipment for electrotechnology projects
UEENEEC005B	Estimate electrotechnology projects
UEENEEED003B	Evaluate and modify programs written in object oriented code
UEENEEED027B	Develop structured programs to control external devices
UEENEEED030B	Select, install, configure and test multimedia devices
UEENEEED053B	Set up and test biometric devices
UEENEEEE014B	Supervise and coordinate work activities
UEENEEEE021B	Plan an integrated cabling system

Schedule 4 – Strand 2 Electives

UEENEEF003B	Install and maintain cabling for telecommunication services in lifts
UEENEEF004B	Install and modify performance data communication structured cabling
UEENEEF005B	Install and modify performance data communication optical fibre cabling
UEENEEF012B	Install aerial communication cables
UEENEEF013B	Install below ground communication cables
UEENEEF014B	Set up and configure basic data communications systems
UEENEEG017B	Install electrical power and control equipment for rail network signalling
UEENEEG021B	Verify compliance and functionality of special electrical installations
UEENEEG023B	Conduct compliance inspection of electrical installations with demand exceeding 100 A per phase
UEENEEG025B	Plan electrical installations with a LV demand up to 400A per phase
UEENEEG027B	Design electrical installations with a LV demand greater than 400 A per phase
UEENEEG028B	Plan switchboard and control panel layouts
UEENEEG034B	Perform high voltage field switching to a given schedule
UEENEEG057B	Conduct electrical tests on low voltage electrical machines
UEENEEG059B	Conduct mechanical tests of electrical machines
UEENEEG060B	Evaluate performance of electrical machines
UEENEEG062B	Set up and place electrical apparatus and associated circuits into service
UEENEEG065B	Maintain and service traction lifts
UEENEEG066B	Installation and maintenance of escalators, moving walks and tread ways
UEENEEG067B	Align and install lift equipment

Schedule 4 – Strand 2 Electives

UEENEEG068B	Diagnose and rectify faults in complex lift systems
UEENEEH007B	Carry out repairs of predictable faults in general electronic apparatus
UEENEEH016B	Find and repair faults in the microwave amplifier sections of electronic apparatus
UEENEEH024B	Carry out repairs of predictable faults in audio components
UEENEEH037B	Program and commission commercial audio/video systems
UEENEEH038B	Find and repair faults in complex power supplies
UEENEEH042B	Troubleshoot oscillators
UEENEEH046B	Solve fundamental problems in electronic communications systems
UEENEEH057B	Develop basic integrated security systems plan
UEENEEH064B	Commission commercial fire protection systems
UEENEEH065B	Find and repair faults in fire protection systems
UEENEEH081B	Design printed circuit boards
UEENEEH086B	Commission microwave and satellite communication systems
UEENEEH087B	Solve problems in musical equipment circuits
UEENEEH090A	Provide solutions to air traffic control system problems
UEENEEI001B	Install and set up transducers and sensing devices
UEENEEI002B	Solve problems in pressure measurement systems
UEENEEI003B	Solve problems in density/level measurement systems
UEENEEI004B	Solve problems in flow measurement systems
UEENEEI005B	Solve problems in temperature measurement systems
UEENEEI010B	Set up and adjust process control loops
UEENEEI011B	Find and rectify faults in process control valve and associated equipment

Schedule 4 – Strand 2 Electives

UEENEEI012B	Verify compliance and functionality of process control installations
UEENEEI017B	Calibrate and test measuring instruments
UEENEEI021B	Find and repair faults in measuring and analysis systems
UEENEEI022B	Assist in commissioning process control systems
UEENEEJ015B	Solve problems in beverage dispensers
UEENEEJ018B	Solve problems in post mix refrigeration systems
UEENEEJ020B	Solve problems in industrial refrigeration systems
UEENEEJ021B	Monitor and adjust energy management systems on refrigeration systems
UEENEEK026B	Install and set up grid connected photovoltaic power systems
UEENEEK048A	Install, configure and commission grid connected photovoltaic power systems
UEENEEM035A	Conduct a conformity assessment of explosion-protected equipment — coal mining
UEENEEM036A	Conduct a conformity assessment of explosion-protected equipment — gas atmospheres
UEENEEM037A	Conduct a conformity assessment of explosion-protected equipment — dust atmospheres
UEENEEM038A	Conduct testing of hazardous area installations — coal mining
UEENEEM039A	Conduct testing of hazardous area installations — gas atmospheres
UEENEEM040A	Conduct testing of hazardous area installations — dust atmospheres
UEENEEM041A	Conduct testing of hazardous area installations — pressurisation
ICTTC085D	Monitor, analyse and action telecommunications network alarms
UETTDRI04B	Perform high voltage field switching operation to a given schedule

Strand 1

Schedule 4 – Strand 1 Electives

Schedule 4 – Strand 1 Electives

UEENEED005B	Enter and verify operating instructions in microprocessor equipped devices
UEENEEE017B	Implement and monitor OHS policies and procedures
UEENEEG071C	Install and set up interval metering
UEENEEK010B	Coordinate maintenance of renewable energy apparatus and systems
UEENEEK025C	Solve basic problems in photovoltaic energy apparatus
UEENEEK032B	Develop strategies to address sustainability issues
UEENEEK037B	Install and set up micro-hydro systems
UEENEEJ019B	Solve problems in ice making systems
UEENEEK042A	Implement & monitor, policies & procedures for environmentally sustainable electrotech work practice
UEENEEI007C	Install process instrumentation and control cabling and tubing
UEENEEI008C	Install process control apparatus and associated equipment
UEENEEM078A	Manage compliance of hazardous areas
UEENEEM042A	Conduct visual inspection of hazardous areas installations
UEENEEM047A	Develop and manage maintenance programs for hazardous areas electrical equipment — coal mining
UEENEEM048A	Develop and manage maintenance programs for hazardous areas electrical equipment — gas atmospheres
UEENEEM049A	Develop and manage maintenance programs for hazardous areas electrical equipment — dust atmospheres
UEENEEM050A	Develop and manage maintenance programs for hazardous areas electrical equipment — pressurisation
UEENEEM054A	Plan electrical installations for hazardous areas — gas atmospheres
UEENEEM055A	Plan electrical installations for hazardous areas — dust atmospheres
UEENEEM056A	Plan electrical installations for hazardous areas — pressurisation

Schedule 4 – Strand 1 Electives

UEENEEN001B	Service mechanical signalling equipment and infrastructure
UEENEEN002B	Assemble and wire internal electrical signalling equipment
UEENEEN003B	Install and maintain track circuit leads and bonds
UEENEEN004B	Perform cable tests
UEENEEN005B	Install and maintain signalling power supplies
UEENEEN006B	Maintain remote control and non-vital interlocking control systems
UEENEEN007B	Maintain power signalling and protected level crossing equipment
UEENEEN008B	Maintain on-site power operated point-activating devices
UEENEEN009B	Maintain track circuit equipment
UEENEEN010B	Maintain electronic signalling and communication equipment
UEENEEN011B	Install and maintain power operated signalling equipment
UEENEEN012B	Maintain power signalling and protective relay interlocking systems
UEENEEN013B	Install and test computer based interlocking equipment
UEENEEN014B	Maintain computer based and solid state interlocking systems
UEENEEN015B	Conduct routine inspecting and testing of new signal cables and lines
UEENEEN016B	Maintain electronic switched and microprocessor-based remote control systems
UEENEEN017B	Install and maintain transmission interface equipment
UEENEEN018B	Find and repair wiring system faults
UEENEEN019B	Test equipment and isolate faults
UEENEEN020B	Install electrical power and control equipment for rail networks
UEENEEN021A	Repair Rail Signalling Cables
UEENEEN025B	Coordinate and manage track protection
UEENEEN026B	Develop rail signalling maintenance programs

Schedule 4 – Strand 1 Electives

UEENEEN027B	Decommission electrical and electro-mechanical signalling from service
UEENEEN028B	Test and commission power signalling equipment
TLIS807B	Decommission electrical and electromechanical signalling infrastructure equipment from service

Schedule of Electives – 5

Competency standard units have been put into strands to facilitate work outcomes for the qualification, as specified by industry stakeholders. This design feature has been developed to enhance flexibility for enterprise outcomes.

The following dot points provide examples on the use of the Schedule in selecting appropriate competency standard units to complete the Elective requirements of the qualification:

- 1 unit from strand 6, gives a unit strand total of 6
- 2 units from strand 3, gives a unit strand total of 6
- 1 unit from strand 5 PLUS 1 unit from strand 1, gives a unit strand total of 6

Notes:

1. All pre-requisites must be met prior to completing each competency standard unit.
2. Where a competency standard unit is achieved as part of the core of a qualification it shall not be used again for selection as an elective unit.

Strand 8

Schedule 5 – Strand 8 Electives

Nil

Strand 7

Schedule 5 – Strand 7 Electives

UEENEED011B Develop object oriented code

Strand 6

Schedule 5 – Strand 6 Electives

UEENEED010B Set up and create content for a web server

Schedule 5 – Strand 6 Electives

UEENEED016B	Develop network services
UEENEED018B	Design and implement internetworking systems
UEENEED054B	Analyse and implement biometric techniques and applications
UEENEED055B	Develop and validate biometric systems installation instructions
UEENEEH031B	Diagnose and rectify faults in radar apparatus and systems
UEENEEH034B	Diagnose and rectify faults in electronic medical equipment
UEENEEH035B	Design custom electronic installations
UEENEEH036B	Design commercial audio/video installations
UEENEEH053B	Program and test large wired and wireless security systems
UEENEEI015B	Find and rectify faults in medical equipment control systems
UEENEEK029B	Design renewable energy heating systems
UEENEEK051A	Develop effective strategies for energy reduction in buildings
UEENEER001B	Contribute to the planning of a research project
UEENEER002B	Contribute to the conduct of a research project
UEENEER003B	Contribute to the development of a product/application/service
UEENEER004B	Contribute to the trial of a product/application/service
UEENEER005B	Contribute to intellectual property management
UEENEER006B	Contribute to the commercialisation of a product/application/service

Strand 5

Schedule 5 – Strand 5 Electives

UEENEED020B	Design and implement Internetworking systems – remote access
UEENEED021B	Design and implement Internetworking systems – multi-layer switching
UEENEED022B	Design and implement Internetworking systems – security

Schedule 5 – Strand 5 Electives

UEENEED023B	Design and implement internetworking systems – wireless LANs/WANs
UEENEEE060B	Provide solutions for uses of materials and thermodynamic effects
UEENEED019B	Design and implement Internetworking systems – advanced routing

Strand 4

Schedule 5 – Strand 4 Electives

UEENEED024B	Integrate multiple computer operating systems on a client server network
UEENEED052B	Design embedded controller systems
UEENEEE061B	Analyse static and dynamic parameters of equipment
UEENEEE062B	Select drive components for equipment design
UEENEEE063B	Analyse materials for suitability in equipment
UEENEEE064B	Design machine drives and production layout plans
UEENEEH045B	Develop solutions to analogue electronic problems
UEENEEI026B	Provide solutions to pneumatic/hydraulic system operations
UEENEEI027B	Analyse complex electronic circuits controlling fluids
UEENEEK033B	Design set up hybrid power systems
UEENEEK046A	Design energy management controls for electrical installations in buildings

Strand 3

Schedule 5 – Strand 3 Electives

UEENEED006B	Prepare tender submissions for electrotechnology projects
UEENEED008B	Develop, enter and verify programs in Supervisory Control and Data Acquisition systems
UEENEED009B	Develop, enter and verify programs for industrial control systems using high level instructions
UEENEED025B	Design and configure human-machine interface networks

Schedule 5 – Strand 3 Electives

UEENEED028B	Develop and test code for microcontroller devices
UEENEED033B	Design complex integrated systems
UEENEED034B	Configure and maintain industrial control system networks
UEENEED050B	Develop control programs for microcomputer equipped devices
UEENEED051B	Provide programming solution for engineering problems
UEENEEE010B	Develop and implement maintenance programs
UEENEEE018B	Establish, maintain and evaluate OHS systems
UEENEEE025B	Solve problems in complex multiple path circuits
UEENEEG030B	Design switchboards rated for high fault levels
UEENEEG032B	Carry out electrical field testing and report findings
UEENEEG035B	Diagnose and rectify faults in a.c. motor drive systems
UEENEEG036B	Diagnose and rectify faults in d.c. motor drive systems
UEENEEG037B	Diagnose and rectify faults in energy supply apparatus
UEENEEG038B	Diagnose and rectify faults in electrical energy distribution systems
UEENEEG039B	Diagnose and rectify faults in distributed generation systems
UEENEEG040B	Develop engineering solutions for energy supply power transformer problems
UEENEEG041B	Diagnose and rectify faults in servo drive systems
UEENEEG042B	Diagnose and rectify faults in electrical energy supply transmission systems
UEENEEG043B	Develop engineering solution for synchronous machine problems
UEENEEG044B	Develop engineering solutions for d.c. machine problems
UEENEEG045B	Develop engineering solutions for induction motor problems
UEENEEG046B	Develop engineering solutions for energy supply system protection problems
UEENEEG047B	Provide computational solutions to power engineering problems

Schedule 5 – Strand 3 Electives

UEENEEG048B	Solve problems in complex multiple path power circuits
UEENEEG049B	Solve problems in complex polyphase power circuits
UEENEEG061B	Design and develop modifications to electrical machines
UEENEEG072C	Investigate and report on electrical incidents
UEENEEH025B	Provide solutions to single phase electronic power control problems
UEENEEH026B	Provide solutions to polyphase electronic power control problems
UEENEEH030B	Diagnose and rectify faults in satellite-based surveillance and observation systems
UEENEEH032B	Diagnose and rectify faults in global positioning systems
UEENEEH033B	Diagnose and rectify faults in telecommunication apparatus and systems
UEENEEH044B	Diagnose and rectify faults in analogue circuits and components in electronic control systems
UEENEEH049B	Develop solutions to audio electronic problems
UEENEEH059B	Design integrated complex security systems
UEENEEI019B	Set up field control devices
UEENEEI020B	Provide solutions to problems in basic industrial control systems
UEENEEI023B	Design electronic control systems
UEENEEI025B	Provide solutions to fluid circuit operations
One unit from an endorsed TP	One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF
UEENEEK027B	Diagnose faults in renewable energy control systems
UEENEEK028B	Solve problems in stand-alone renewable energy systems
UEENEEK030B	Solve problems in wind energy conversion systems
UEENEEK031B	Design wind energy conversion systems rated to 10 kW
UEENEEK035C	Design grid connected power supply systems

Schedule 5 – Strand 3 Electives

UEENEEK038B	Design micro-hydro systems
UEENEEM064A	Conduct audit of hazardous areas installations — coal mining
UEENEEM065A	Conduct audit of hazardous areas installations — gas atmospheres
UEENEEM066A	Conduct audit of hazardous areas installations — dust atmospheres
UEENEEM067A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — coal mining
UEENEEM068A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — gas atmospheres
UEENEEM069A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — dust atmospheres

Strand 2

Schedule 5 – Strand 2 Electives

UEENEE003B	Evaluate and modify programs written in object oriented code
UEENEEE015B	Develop design briefs for electrotechnology projects
UEENEEE016B	Write specifications for electrotechnology projects
UEENEEE026B	Provide computational solutions to basic engineering problems
UEENEEE070B	Write specifications for computer systems engineering projects
UEENEEE071B	Write specifications for electrical engineering projects
UEENEEE072B	Write specifications for electronics and communications engineering projects
UEENEEE073B	Write specifications for refrigeration and air conditioning engineering projects
UEENEEE074B	Write specifications for renewable energy engineering projects
UEENEEE075B	Write specifications for industrial electronics and control projects
UEENEEE077B	Write specifications for automated systems projects
UEENEEG027B	Design electrical installations with a LV demand greater than 400 A per phase

Schedule 5 – Strand 2 Electives

UEENEEG031B	Evaluate performance of electrical apparatus
UEENEEG060B	Evaluate performance of electrical machines
UEENEEG068B	Diagnose and rectify faults in complex lift systems
UEENEEH048B	Design and develop advanced digital systems
UEENEEH057B	Develop basic integrated security systems plan
UEENEEH058B	Design integrated security systems for a single site
UEENEEH081B	Design printed circuit boards
UEENEEH082B	Develop solutions to RF amplifiers problems
UEENEEH083B	Analyse the performance of wireless-based electronic systems
UEENEEH086B	Commission microwave and satellite communication systems
UEENEEH088B	Design and develop electronics/computer systems projects
UEENEEH090A	Provide solutions to air traffic control system problems
UEENEEI022B	Assist in commissioning process control systems
UEENEEK039B	Design stand-alone renewable energy systems
BSBITU306A	Design and produce business documents
BSBSMB405A	Monitor and manage small business operations
PMBQUAL390A	Solve problems using ‘quality tools’

Strand 1

Schedule 5 – Strand 1 Electives

UEENEE044B	Commission computer systems
UEENEE045B	Modify-redesign of computer system
UEENEEE078B	Contribute to risk management in electrotechnology systems
UEENEEH067B	Commission electronics and communications systems
UEENEEH068B	Modify-redesign of electronics and communications system

Schedule 5 – Strand 1 Electives

UEENEEK032B	Develop strategies to address sustainability issues
UEENEEM054A	Plan electrical installations for hazardous areas — gas atmospheres
UEENEEM055A	Plan electrical installations for hazardous areas — dust atmospheres
UEENEEM056A	Plan electrical installations for hazardous areas — pressurisation

Schedule of Electives – 6

Competency standard units have been put into strands to facilitate work outcomes for the qualification, as specified by industry stakeholders. This design feature has been developed to enhance flexibility for enterprise outcomes.

The following dot points provide examples on the use of the Schedule in selecting appropriate competency standard units to complete the Elective requirements of the qualification:

- 1 unit from strand 6, gives a unit strand total of 6
- 2 units from strand 3, gives a unit strand total of 6
- 1 unit from strand 5 PLUS 1 unit from strand 1, gives a unit strand total of 6

Notes:

1. All pre-requisites must be met prior to completing each competency standard unit.
2. Where a competency standard unit is achieved as part of the core of a qualification it shall not be used again for selection as an elective unit.

Strand 8

Schedule 6 – Strand 8 Electives

Nil

Strand 7

Schedule 6 – Strand 7 Electives

Nil

Strand 6

Schedule 6 – Strand 6 Electives

UEENEED016B	Develop network services

Schedule 6 – Strand 6 Electives

UEENEED018B	Design and implement internetworking systems
UEENEED026B	Design a computer based control system
UEENEED055B	Develop and validate biometric systems installation instructions
UEENEED029B	Design renewable energy heating systems
UEENEED051A	Develop effective strategies for energy reduction in buildings
UEENEER001B	Contribute to the planning of a research project
UEENEER002B	Contribute to the conduct of a research project
UEENEER003B	Contribute to the development of a Product/Application/Service
UEENEER004B	Contribute to the trial of a Product/Application/Service
UEENEER005B	Contribute to Intellectual Property Management
UEENEER006B	Contribute to the commercialisation of a product/application/service

Strand 5

Schedule 6 – Strand 5 Electives

UEENEED019B	Design and implement Internetworking systems – advanced routing
UEENEED020B	Design and implement Internetworking systems – remote access
UEENEED021B	Design and implement Internetworking systems – multi-layer switching
UEENEED022B	Design and implement Internetworking systems – security
UEENEED023B	Design and implement internetworking systems – wireless LANs/WANs
UEENEEE011C	Manage risk in electrotechnology activities
UEENEEE060B	Provide solutions for uses of materials and thermodynamic effects

Strand 4

Schedule 6 – Strand 4 Electives

Schedule 6 – Strand 4 Electives

UEENEE014B	Design and manage enterprise networks
UEENEE052B	Design embedded controller systems
UEENEE027B	Use advanced computational processes to provide solutions to engineering problems
UEENEE028B	Develop engineering solutions to photonic problems
UEENEE061B	Analyse static and dynamic parameters of equipment
UEENEE062B	Select drive components for equipment design
UEENEE063B	Analyse materials for suitability in equipment
UEENEE064B	Design machine drives and production layout plans
UEENEE045B	Develop solutions to analogue electronic problems
UEENEE084B	Modify DSP based sub-systems
UEENEE085B	Design a signal-conditioning subsystem
UEENEEI028B	Set up controls on complex fluid systems
UEENEEI029B	Set up electronically controlled mechanically operated complex systems
UEENEEI030B	Set up electronically controlled robotically operated complex systems
UEENEEK033B	Design set up hybrid power systems
UEENEEK046A	Design energy management controls for electrical installations in buildings

Strand 3

Schedule 6 – Strand 3 Electives

UEENEE025B	Design and configure Human-Machine Interface networks
UEENEE028B	Develop and test code for microcontroller devices
UEENEE048B	Plan computer systems projects
UEENEE051B	Provide programming solution for engineering problems
UEENEE050B	Develop control programs for microcomputer equipped devices

Schedule 6 – Strand 3 Electives

UEENEEE013B	Plan electrotechnology projects
UEENEEE025B	Solve problems in complex multiple path circuits
UEENEEE029B	Solve electrotechnical problems
UEENEEG012B	Solve fundamental problems in electrical systems
UEENEEG030B	Design switchboards rated for high fault levels
UEENEEG035B	Diagnose and rectify faults in a.c. motor drive systems
UEENEEG036B	Diagnose and rectify faults in d.c. motor drive systems
UEENEEG040B	Develop engineering solutions for energy supply power transformer problems
UEENEEG041B	Diagnose and rectify faults in servo drive systems
UEENEEG043B	Develop engineering solution for synchronous machine problems
UEENEEG044B	Develop engineering solutions for d.c. machine problems
UEENEEG045B	Develop engineering solutions for induction motor problems
UEENEEG046B	Develop engineering solutions for energy supply system protection problems
UEENEEG047B	Provide computational solutions to power engineering problems
UEENEEG048B	Solve problems in complex multiple path power circuits
UEENEEG049B	Solve problems in complex polyphase power circuits
UEENEEG061B	Design and develop modifications to electrical machines
UEENEEG070B	Plan electrical projects
UEENEEH047B	Assess compliance of electronic apparatus
UEENEEH049B	Develop solutions to audio electronic problems
UEENEEH060B	Plan electronic projects
UEENEEI023B	Design electronic control systems
UEENEEI035B	Plan control projects

Schedule 6 – Strand 3 Electives

UEENEEI037B	Plan automated systems projects
One unit from an endorsed TP	One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF
UEENEEK022B	Plan renewable energy projects
UEENEEK031B	Design wind energy conversion systems rated to 10 kW
UEENEEK040B	Develop engineering solution to renewable energy problems
UEENEEM067A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — coal mining
UEENEEM068A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — gas atmospheres
UEENEEM069A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — dust atmospheres

Strand 2

Schedule 6 – Strand 2 Electives

UEENEEC007B	Manage contract variations
UEENEEE012B	Manage electrotechnology projects
UEENEEE015B	Develop design briefs for electrotechnology projects
UEENEEE026B	Provide computational solutions to basic engineering problems
UEENEEE070B	Write specifications for computer systems engineering projects
UEENEEE071B	Write specifications for electrical engineering projects
UEENEEE072B	Write specifications for electronics and communications engineering projects
UEENEEE073B	Write specifications for refrigeration and air conditioning engineering projects
UEENEEE074B	Write specifications for renewable energy engineering projects
UEENEEE075B	Write specifications for industrial electronics and control projects
UEENEEE077B	Write specifications for automated systems projects

Schedule 6 – Strand 2 Electives

UEENEEG069B	Manage electrical projects
UEENEEH041B	Manage electronics/computer systems projects
UEENEEH048B	Design and develop advanced digital systems
UEENEEH088B	Design and develop electronics/computer systems projects
UEENEEI034B	Manage control projects
UEENEEI036B	Manage automated systems projects
UEENEEK021B	Manage renewable energy projects
UEENEEK039B	Design stand-alone renewable energy systems
UEENEEM052A	Classify hazardous areas — gas atmospheres
UEENEEM053A	Classify hazardous areas — dust atmospheres

Strand 1

Schedule 6 – Strand 1 Electives

UEENEE044B	Commission computer systems
UEENEE045B	Modify-redesign of computer system
UEENEE078B	Contribute to risk management in electrotechnology systems
UEENEEH067B	Commission electronics and communications systems
UEENEEH068B	Modify-redesign of electronics and communications system
UEENEEM057A	Design explosion-protected electrical systems — gas atmospheres
UEENEEM058A	Design explosion-protected electrical systems — dust atmospheres
UEENEEM059A	Design explosion-protected electrical systems — pressurisation
UEENEEM079A	Design of gas detection systems

1.2.01 Competency Standards

Volume 1 Part 2

2.1 Competency Standards

This section explains competency, how competency standards are developed and the industry coverage they can apply to, and the format and construction of individual competency standard units.

What is competency?

A competency comprises the specification of knowledge and skill and the application of that knowledge and skill to the standard of performance required in the workplace. This definition of competency standard includes:

- what is expected of an employee in the workplace rather than on the learning process which embodies the ability to transfer and apply skills and knowledge to new situations and environments
- an emphasis on outcomes and on the application of skills and knowledge, not just specification
- what people are able to do and their ability to do it in a range of contexts, e.g. maintain and use networks of suppliers, government agencies.

The broad concept of industry competency concerns the ability to perform particular tasks and duties to the standard of performance expected in the workplace. Competency requires the application of specified skills and knowledge and attitudes relevant to effective participation in an industry, industry sector or enterprise.

Competency covers all aspects of workplace performance and involves performing individual tasks; managing a range of different tasks; responding to contingencies or breakdowns; and dealing with the responsibilities of the workplace, including working with others. Workplace competency requires the ability to apply relevant skills, knowledge and attitudes consistently over time and in the required workplace situations and environments. In line with this concept of competency, Training Packages focus on what is expected of a competent individual in the workplace as an outcome of learning, rather than focussing on the learning process itself.

Competency standards in Training Packages are determined by industry to meet identified industry skill needs. Competency standards are made up of a number of units of competency each of which describes a key function or role in a particular job function or occupation. Each unit of competency within a Training Package is linked to one or more AQF qualifications.

1.2.02 Contextualisation of Competency Standard Units by RTOs

2.2 Contextualisation of Competency Standard Units by RTOs

Registered Training Organisations (RTOs) may contextualise units of competency to reflect local outcomes provided that no requirements and/or completion rules of the Training Package are infringed. This includes any prevailing regulatory requirements that may apply to the competency standard units. Contextualisation, provided it does not dilute in any way the units of competency, could involve additions or amendments to the unit of competency to suit particular delivery methods, learner profiles, specific enterprise equipment requirements, or to otherwise meet local needs. However, the integrity of the overall intended outcome of the unit of competency must be maintained.

Any contextualisation of units of competency in this endorsed Training Package must be within the bounds of the following advice. In contextualising competency standard units, RTOs:

- must not contravene, diminish or detract from any regulatory/licensing arrangement that may apply to the unit, or its related delivery arrangements
- must not remove or add to the number and content of Elements and Performance Criteria
- may add specific industry terminology to Performance Criteria where this does not distort or narrow the competency outcomes
- may make amendments and additions to the Range Statement as long as such changes do not diminish the breadth of application of the competency or reduce its portability
- may add detail to the Evidence Guide in areas such as the critical aspects of evidence or resources and infrastructure required where these expand the breadth of the competency but do not limit its use.

1.2.03 Components of Units of Competency

2.3 Components of Units of Competency

The components of units of competency are summarised below, in the order in which they appear in each unit of competency:

Unit Title

The unit title is a succinct statement of the outcome of the competency standard unit. Each unit title is unique, both within and across Training Packages.

Unit Descriptor

The scope/descriptor broadly communicates the content and purpose of the competency standard unit and the skill area it addresses. Where units have been contextualised from competency standard units in other endorsed Training Package, summary information is provided.

Employability Skills

This sub-section contains a statement that the unit contains Employability skills.

Prerequisite Competencies and Literacy and Numeracy (optional)

If there are any competency standard units that must be completed before or concurrently, these will be listed. In addition, there may be a sub-section on entry advice related to levels of language and numeracy applicable to the unit.

Application of the Unit

This sub-section fleshes out the scope and purpose of the competency standard, and its operation in different contexts, e.g. showing how it applies in the workplace. It may include a sub-section or second paragraph that describes its relationship with other industry sectors and any licensing application or requirements, such as a licence to practice.

Competency Field (Optional)

The competency field either reflects the way the competency standard units are categorised in the Training Package or denotes the industry sector, specialisation or function. It is an optional component of the competency standard unit.

Sector (optional)

The industry sector is a further categorisation of the competency field and identifies the next classification, for example an elective or supervision field.

Elements of Competency

The elements of competency are the basic building blocks of the competency standard unit. They describe, in terms of outcomes, the significant functions and tasks that make up the competency.

Performance Criteria

The Performance Criteria specify the required performance in relevant tasks, roles, processes, skills and in the applied knowledge that enables competent performance. They are usually written in passive voice. Critical terms or phrases may be written in bold italics and then defined in the Range Statement, in the order of their appearance in the Performance Criteria.

Required Essential Knowledge and Associated Skills

In the competency standard units, essential knowledge and associated skills (EKAS) may be identified separately or combined. Knowledge identifies what a person needs to know to perform the work in an informed and effective manner. Skills describe the application of knowledge to situations where understanding is converted into a workplace outcome and includes the ability to transfer it to new situations and environments.

In this Training Package essential knowledge and associated skills (EKAS) have been separated from the competency standard units to facilitate user-friendliness for interpretation, applicability and future maintenance. Within the EKAS section of each unit clause numbers and titles refer learners to the relevant EKAS details in the separate section in Volume 2. All assessment evidence activities and reporting processes shall include and confirm achievement of the relevant EKAS specification(s).

Range Statement

The Range Statement provides a context for the competency standard unit describing essential operating conditions for training and assessment related to; the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts. The meanings of key terms used in the Performance Criteria are also explained in the Range Statement.

Evidence Guide

The evidence guide is an integral part of the competency standard unit as it provides the assessment information to the RTO assessors about the critical aspects and how the competency may be demonstrated. The evidence guide does this by providing a range of evidence for the assessor to use in making determinations and by providing the assessment context. The evidence guide describes:

- conditions under which competency must be assessed, including variables such as the assessment environment or necessary equipment
- relationships with the assessment of any other competency standard units
- suitable methodologies for conducting assessment, including the potential for workplace simulation
- resource implications, e.g. access to particular equipment, infrastructure or situations
- how consistency in performance can be assessed over time, various contexts and with a range of evidence
- the required critical aspects and underpinning knowledge and skills
- application against relevant legislation, regulation, industrial instruments, codes of practice, guidelines and advisory standards. This also includes anti-discrimination and equal employment opportunity statutes (encompassing application of access, equity and cultural diversity principles associated with under-represented groups).

1.2.04 Employability Skills in Units of Competency

2.4 Employability Skills in Units of Competency

The detail and application of Employability Skills facets will vary according to the job-role requirements of each industry. In developing Training Packages, industry stakeholders are consulted to identify appropriate facets of Employability Skills which are incorporated into the relevant units of competency and qualifications.

Employability Skills are not a discrete requirement contained in units of competency (as was the case with Key Competencies). Employability Skills are specifically expressed in the context of the work outcomes described in units of competency and will appear in elements, performance criteria, range statements and evidence guides. As a result, users of Training Packages are required to review the entire unit of competency in order to accurately determine Employability Skills requirements.

How Employability Skills relate to the Key Competencies

The eight nationally agreed Employability Skills now replace the seven Key Competencies in Training Packages. Trainers and assessors who have used Training Packages prior to the introduction of Employability Skills may find the following comparison useful.

Employability Skills

Mayer Key Competencies

Communication

Communicating ideas and information

Teamwork	Working with others and in teams
Problem solving	Solving problems Using mathematical ideas and techniques
Initiative and enterprise	
Planning and organising	Collecting, analysing and organising information Planning and organising activities
Self-management	
Learning	
Technology	Using technology

When analysing the above table it is important to consider the relationship and natural overlap of Employability Skills. For example, using technology may involve communication skills and combine the understanding of mathematical concepts.

Explicitly embedding Employability Skills in units of competency

This Training Package seeks to ensure that industry-endorsed Employability Skills are explicitly embedded in units of competency. The application of each skill and the level of detail included in each part of the unit will vary according to industry requirements and the nature of the unit of competency.

Employability Skills must be both explicit and embedded within units of competency. This means that Employability Skills will be:

- embedded in units of competency as part of the other performance requirements that make up the competency as a whole
- explicitly described within units of competency to enable Training Packages users to identify accurately the performance requirements of each unit with regards to Employability Skills.

This Training Package also seeks to ensure that Employability Skills are well-defined and written into units of competency so that they are apparent, clear and can be delivered and assessed as an essential component of unit work outcomes.

1.2.05 Competency Standards for the Electrotechnology Industry

2.5 Competency Standards for the Electrotechnology Industry

The first competency standards for the function of Electrotechnology were developed and endorsed in 1992, by the then National Training Board (NTB). These 1992 version competency standard units were updated into Draft Generic Electrotechnology Competency Standards prior to 1998 and provided the basis for developing the Electrotechnology Training Package which was endorsed in 1999 as UTE99. Subsequent minor amendments were made to include an array of qualifications, variations to competency standard units and the inclusion of a range of new technologies and sectors.

The revised units in this Training Package cover the broad range of knowledge and skills applied in the Electrotechnology Industry. The development project satisfied the following characteristics:

- Development, consultation, and validation included appropriate processes with a wide range of industry employer/employee, practitioners, providers, stakeholders/community, and regulatory and government agency representatives.
- The draft standards were distributed throughout the national, State and Territory ITAB network and to industry stakeholders for feedback. Feedback from other industries was also actively encouraged.

During the development process, the ElectroComms and EnergyUtilities Industry Skills Council (formerly the National Utilities and Electrotechnology ITAB), trading as EE-OZ Training Standards and its nationwide focus groups were appropriately representative of the industry, throughout Australia.

1.2.06 Competency Standard Units for the Electrotechnology Industry

2.6 Competency Standard Units for the Electrotechnology Industry

The competency standard units in this Training Package include:

National Electrotechnology Industry (UEE) units

Imported units from other endorsed Training Packages that have been valued by the National Electrotechnology Competency Advisory Council (NECAC) for inclusion in Qualifications in this Training Package.

Competency standard units provide specifications of work performance. The Australian Standard Classifications of Occupation (ASCO) defines a number of occupations served by this Training Package. See 'Preliminary Information' in this Volume. Most vocations in this group have an entry level of skill commensurate with an AQF Certificate III or higher qualification. In some instances relevant experience is required in addition to a formal qualification.

A large body of the skills and knowledge detailed in the competencies within this Training Package generally reside within the family of Electrotechnology vocations classified and grouped as occupations under ASCO (Australian Standards Classification of Occupation Code) by the Australian Bureau of Statistics (ABS). In addition to an array of units used as Possible Skills Sets, each competency standard unit is linked to one or more AQF qualifications.

Unit construction

Within the national training framework, competency standard units are the smallest component of achievement that is nationally recognised, i.e. the unit as a whole is recognised not individual elements or Performance Criteria within the unit.

The competency standard units in this Training Package have been developed in accordance with the DEEWR standardised format.

Each unit has a unique title, relates to an industry context, and conforms to national coding requirements. Issues considered in constructing competency standard units in this Training Package include breadth, size, transferability and the interrelationships between units. The relationship with any prevailing regulatory requirements and regimes is included in the unit where appropriate.

Competency standard units provide the basis for:

- recognition of skills within and across industries
- work organisation reviews and options
- development of training
- assessment
- certification
- credit transfer and articulation.

Some competency standard units have been constructed to allow reporting of additional information, generally in relation to a specific context and would be in the form of an *endorsement*.

An *Endorsement* is a statement recognising the high degree of commonality (in process or function) in Elements and Performance Criteria of the unit when applied across the industry irrespective of the required technical knowledge. *Endorsements* are a way of including information in the Evidence Guide of the unit that relates to a particular application and/or vocational outcome. This type of unit might be seen as several units in one, that is a unit with five *Endorsements* has five specific outcomes. Additional information is contained in the relevant units.

In units that include *endorsements*, all aspects of a selected *endorsement* must be completed to attain formal recognition of a specific outcome.

In cases where units contain *endorsements* they should be interpreted in the context of the qualification which requires the nomination of an *endorsement* as detailed in Volume 1 Part 1 – Qualifications Framework,.

Employability Skills

A new feature included in the competency standard units of this Training Package is the inclusion of Employability Skills, i.e. that enable employees to develop and use ‘real life’ skills and experiences in work, e.g. for self-learning, for reflecting on performance, for interpreting the workplace, in planning and organising work, and in responding to new situations that are non-routine.

Employability Skills apply to work in general as enabling skills, rather than to particular occupations or industries. They focus on the enabling qualities of knowledge and skills as they are applied in an integrated way in workplace situations.

Contextualisation

In some competency standard units ‘notes’ have been attached to specific content to add value and clarity. The notes augment one or more of the following; Scope, Performance Criteria, Range Statement, Essential Knowledge and Associated Skills or other related sections. The insertion of these ‘notes’ is primarily to provide users and support material developers with additional guidance as to the range and depth so as to achieve acceptable consistency between deliverers and assessors.

As the type, form, process, technique, technology or equipment may change over time it is the RTOs responsibility to remain current in their delivery and assessment arrangements and reference to the notes will assist in this regard.

In these instances RTOs should aim to accommodate the change by varying the context of the examples given in the ‘Notes’. However, the variation must not alter the intended outcome of the competency standard units in any way.

Where contextualisation of the notes varies the outcome of the competency standard units and its related content, RTOs should consult with EE-Oz Training Standards to explore options for incorporating and/or covering the new arrangements, so that currency of the Training Package is maintained.

It should be noted that any need to alter the competency standard units from the intended outcomes requires a new or varied competency standard unit. Such changes are to be undertaken through the continuous improvement processes required of Training Packages, which in relation to this Training Package is managed by EE-Oz Training Standards.

Also refer to Volume 1 Part 1 – Qualifications Framework, of this Electrotechnology Training Package that describes vocational standards for the Industry.

Prerequisites

It is important to note that training delivery of prerequisite competency standard units may be concurrent with the delivery of the unit calling up the prerequisite. However, the final assessment event and the deeming of competence are to follow the prerequisite sequence.

Assessment guidelines

The Electrotechnology Industry has developed guidelines for the assessment of these competency standards. Assessment guidelines are included at Volume 1 Part 3 of this Training Package. Within a competency standard unit there may be advice as to additional reporting that is preferred by Industry. Where appropriate, RTOs should recognise and support this preference.

Qualifications

The Electrotechnology Industry has clearly identified qualifications which are linked to and use the competency standards. These are listed and detailed in Volume 1 Part 1 – Qualifications Framework of this Training Package. Included are details of the content and composition of the qualifications, the Industry Qualifications Framework, completion requirements, the rules for structuring, flexibility arrangements and the qualifications structure for each qualification. Further, there is a full description provided for each qualification which explains its application and gives added meaning to the group of units making up the qualification.

Exporting CSUs from this Training Package

No competency standard unit from this Training Package is to be used in isolation or exported without including all relevant interrelated components such as definitions, glossary, essential knowledge and skills, work performance requirements, matters related to language, literacy and numeracy, access, equity, cultural diversity or any regulatory arrangements that apply.

1.2.07 Maintenance of Competency Standards

2.7 Maintenance of Competency Standards

The Electrotechnology Industry competency standards were developed and are owned by the industry. However, it is acknowledged that copyright ownership with respect to this material rests with the Commonwealth.

The competency standards must be maintained so that they reflect the ongoing needs of the Electrotechnology Industry and respond in a timely manner to changed technologies and circumstances.

The parties (identified in the Preliminary Information of this Training Package) who constitute the Electrotechnology Industry of the ElectroComms and EnergyUtilities Industry Skills Council share responsibility for the maintenance of the competency standards.

- The maintenance of competency standards will be coordinated and managed by ElectroComms and EnergyUtilities Industry Skills Council Ltd trading as EE-Oz Training Standards or its successor.
- Suggestions and proposals for changes from all parties are welcomed. These should be documented and submitted to EE-Oz Training Standards in accordance with its policies and procedures.

1.2.08 Index of Competency Standard Units

2.8 Index of Competency Standard Units

The units in this Training Package have been placed in Discipline groups that would typically relate to a particular or special area of industry need and for ease in recognition of related unit groupings.

Table 1 – Index of Units and Scopes/Descriptors

Discipline A – Assembly

Unit Code	Unit Title	Scope/Descriptor
UEENEEA001B	Assemble electronic apparatus	This unit covers fitting and interconnecting of electronic sub assemblies. It encompasses the safe use of hand tools power tools, identifying components, high reliability soldering, following set procedures and work instructions and keeping work records
UEENEEA002B	Select electronic components	This unit covers the identifying and selecting of electronic components for assembly from job specifications. It encompasses working safely, interpreting job specifications, identifying components by colour code and markings and following quality procedures and work instructions
UEENEEA003B	Set up and check electronic component placement machines	This unit covers the setting up of electronic circuit board assembly machines. It encompasses working safely, interpreting job specifications, identifying components by colour code and markings, following machine set-up routines and following quality procedures and work instructions
UEENEEA004B	Rework electronic sub assemblies	This unit covers correcting and/or modifying electronic sub assemblies. It encompasses working safely, high reliability de-soldering/soldering, checking components against job specifications, testing and following quality procedures.
UEENEEA005B	Conduct functional and quality tests on assembled electronic apparatus	This unit covers setting up testing equipment, testing functionality and inspecting quality of electronic apparatus. It encompasses working safely with electricity, testing device set-up, following testing and inspection procedures, interpreting and reporting testing and inspection results and making recommendations for dealing with defects.

Unit Code	Unit Title	Scope/Descriptor
UEENEEA006B	Apply lead-free soldering techniques	This unit covers connecting/de-connecting electronic components using lead-free soldering. It encompasses working safely, high reliability soldering/de-soldering, checking components against job specifications, testing and following quality procedures.
UEENEEA007A to UEENEEA009A	RESERVED	
UEENEEA010B	Assemble, mount and connect switchgear and controlgear	This unit covers the assembling and mounting of switchgear and controlgear including the interconnections within a switchboard enclosure intended to operate at voltages up to 1000 V a.c. or 1500 V d.c. It encompasses working safely, following standards, specifications and component manufacturers requirements, matching equipment with that specified, terminating cables and connecting wiring and completing necessary documentation.
UEENEEA011A	RESERVED	
UEENEEA012B	Make up and assemble bus bars	This unit covers fabricating and assembling copper and aluminium bus bar for interconnections in switchboards and for specific plant that has high current demand. It encompasses working safely and to standards and specifications, measuring, cutting, shaping and fixing bus bar and completing necessary documentation
UEENEEA013B	Assemble and wire control panels	This unit covers mounting control devices, wiring support in control panel enclosures and installing the interconnecting wiring. It encompasses working safely, following layout and circuit diagrams, mounting equipment, installing and terminating wiring, functional testing and completing necessary documentation.

Discipline B – Broadcast

Unit Code	Unit Title	Scope/Descriptor
UEENEED001B	Operate and	This unit deals with operation and maintenance of an

Unit Code	Unit Title	Scope/Descriptor
	maintain an amateur radio communication station	amateur radio communication station suitable to HF, VHF and SHF communication using multiple modes of operation. It encompasses correct operating procedures, safe working practices, following written and oral instruction and procedures, basic testing techniques, dismantling and assembling apparatus, disconnecting and reconnecting components, and operating to the Standard Licence Level as prescribed by the Australian Communication Media Authority.

Discipline C – Commercial

Unit Code	Unit Title	Scope/Descriptor
UEENEEC001B	Maintain documentation	This unit covers the maintenance of the variety of documentation required to record work activities, purchases and expenses and compliance obligations. It encompasses documentation typically required in an electrotechnology enterprise, work instructions and procedures and time management
UEENEEC002B	Source and purchase material/parts for installation or service jobs	This unit covers sourcing and purchasing / ordering materials/parts for installation or service jobs. It encompasses following job specification, using manufacture's catalogues, making telephone, Internet or email enquiries, selecting compliance materials and completing the necessary purchasing documentation. <i>Note: In the unit the value of materials for installation jobs is limited to \$20k.</i>
UEENEEC003B	Provide quotations for installation or service jobs	This unit covers providing quotations for installation and service work not exceeding \$20k. It encompasses following job specification, using manufacturer catalogues, making telephone, Internet or email enquiries, selecting compliance materials, pricing materials and labour costs, completing the necessary quotation documentation and applying the necessary customer relations protocols

Unit Code	Unit Title	Scope/Descriptor
UEENEEC004B	Prepare specifications for the supply of materials and equipment for electrotechnology projects	This unit covers writing technical specifications for the supply of materials and equipment for electrotechnology projects. It encompasses establishing the performance requirements, comparing requirements with available materials and equipment, specifying material and equipment performance requirements and documenting the specification
UEENEEC005B	Estimate electrotechnology projects	This unit covers estimate material and labour costs for competitive quotation/tenders for work exceeding \$20k. It encompasses reading and understanding job specifications, material take-offs, determining labour and site requirements, costing and documenting
UEENEEC006B	Prepare tender submissions for electrotechnology projects	This unit covers the preparation of tender documents. It encompasses reading and understanding tender requirements and project specifications, verifying estimates and capacity to meet timelines, complying with legal requirements and documenting submissions
UEENEEC007B	Manage contract variations	This unit covers estimating and negotiating variations to contracted work. It encompasses understanding the specification on which the contracted price is based, identifying contract variations, negotiating and using methods for submitting variations, documenting and applying customer relations protocols
UEENEEC008B	Receive and store materials and equipment for electrotechnology work	This unit covers the receiving and storing of materials and equipment for a construction site or workshop store. It encompasses receiving materials and equipment, checking consignment notes, storing materials and equipment and completing the necessary documentation
UEENEEC009B	Provide quotations for inspection and compliance audit services	This unit covers providing quotations for compliance inspections and technical safety audits. It encompasses reading and understanding job specification, pricing labour and site costs, completing the necessary quotation documentation and applying the

Unit Code	Unit Title	Scope/Descriptor
		necessary customer relations protocols
UEENEEC010B	Deliver a service to customers	This unit covers the interacting with customers to identify and meet their service needs. It encompasses following community and enterprise policies and standards, identifying customer needs identifying and resolving problems/issues and maintaining product/service quality.
UEENEEC011A	RESERVED	
UEENEEC012B	Direct technical and non-technical enquiries to appropriate personnel	This unit covers clarifying the nature of technical and non-technical enquiries of customers and co workers and directing such enquiries to appropriate personnel. It encompasses working safely, applying appropriate knowledge to questioning enquirers, clarifying the point of an enquiry, directing enquiries appropriately and documenting actions.
UEENEEC013B	Participate in business equipment work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC014B	Participate in computer equipment work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations

Unit Code	Unit Title	Scope/Descriptor
		for periodic reporting of competency development activities.
UEENEEC015B	Participate in custom electronic installations work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC016B	Participate in voice and data communications work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC017B	Participate in appliance servicing work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC018B	Participate in electrical machine repair work and	This unit covers the application of industry/enterprise policies in actively

Unit Code	Unit Title	Scope/Descriptor
	competency development activities	participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC019B	Participate in switchgear and controlgear work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC020B	Participate in electrical work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC021B	Participate in electronics and communications work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted,

Unit Code	Unit Title	Scope/Descriptor
		understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC022B	Participate in fire protection control work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC023B	Participate in gaming electronic work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC024B	Participate in instrumentation and control work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency

Unit Code	Unit Title	Scope/Descriptor
		development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC025B	Participate in refrigeration and air conditioning work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC026B	Participate in security equipment work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC027B	Participate in rail communications and networks work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.

Unit Code	Unit Title	Scope/Descriptor
UEENEEC028B	Participate in hazardous areas work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEC029B	Participate in explosion-protected equipment overhaul work and competency development activities	This unit covers the application of industry/enterprise policies in actively participating in work activities and in one's own competency development. It complies with established industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.

Discipline D – Computerised Systems

Unit Code	Unit Title	Scope/Descriptor
UEENEEC001B	Use basic computer applications relevant to a workplace	This unit covers the basic use of personal computers application relevant to a work function. It encompasses switching the computer on, applying user preferences, selecting basic applications, entering and retrieving information and printing files.
UEENEEC002B	Assemble, set up and test personal computers	This unit covers assembly, setting up and testing personal computers as directed in computer service manuals. It encompasses safe working practices, checking computer components, assembling components to form a basic personal

Unit Code	Unit Title	Scope/Descriptor
		computer, installing and testing basic operating system, drivers and application software, following written and oral instruction and applying customer relations procedures.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED003B	Evaluate and modify programs written in object oriented code	This unit covers evaluating and modifying programs based on object-oriented code. It encompasses safe working practices, following written and oral instruction and procedures, applying knowledge of object-oriented code scripting and testing and documenting outcomes.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED004B	Use engineering applications software	This unit covers the use of computers application relevant to engineering support work functions. It encompasses installing software, applying user preferences, using application menus and tools, entering and retrieves information, working with groups and transferring and printing files.
		Note: <i>Examples of engineering application software are Visio, Electronic Work Bench, LabView.</i>
UEENEED005B	Enter and verify operating instructions in microprocessor equipped devices	This unit covers entering instructions in microprocessor-equipped devices (embedded system) with simple built-in programming function and verifying that the device operates as intended. It encompasses safe working practices, checking device installation, following written and oral instruction and procedures and completing necessary documentation.
		Note: <i>Examples of devices are simple programmable relays, timers, temperature controllers, switches and basic detection devices</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>for security and fire the like.</i>
UEENEED006A	RESERVED	
UEENEED007B	Develop, enter and verify programs for programmable logic controllers using ladder instruction set	This unit covers development, installation and testing of programs for programmable logic controllers (PLC) for a system requiring extended control functions. It encompasses working safely, applying knowledge of control systems, control system development methods, ladder logic control functions, using ladder instruction set, following written instructions and documenting program development and testing activities.
UEENEED008B	Develop, enter and verify programs in Supervisory Control and Data Acquisition systems	This unit covers development, installation and testing of programs in for supervisory control and data acquisition. It encompasses working safely, process analysis, developing database of process conditions, developing Human-Machine Interface (HMI), using dedicated SCADA software package and documenting programming activities.
UEENEED009B	Develop, enter and verify programs for industrial control systems using high level instructions	This unit covers development, installation and testing of programs for an industrial system requiring advance control functions. It encompasses working safely, using structure logic, acceptable design techniques, applying knowledge of high level instructions, and documenting development and programming activities
UEENEED010B	Set up and create content for a web server	This unit covers installation, set up, implementation and provision of ongoing support of web services. It encompasses working safely, installing and administering server software and databases, server side scripting, configuring access and security and documenting work activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED011B	Develop object oriented code	This competency standard unit covers developing, implementing and testing object oriented programming solutions using object orientated programming language. It encompasses following

Unit Code	Unit Title	Scope/Descriptor
		development brief, using appropriate development software, writing code that features classes, inheritance, arrays, and advanced library components and documenting development activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED012B	Support computer hardware and software	This unit covers upgrading and maintaining computers, computer devices and peripherals and installing, maintaining and configuring software. It encompasses safe working practices, installing and testing the upgrading components, locating faults in hardware components, replacing faulty subsystems, installing and testing the operating system and application software, testing functionality, rectifying malfunctions, following written and oral instruction and procedures and applying appropriate customer relations.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED013B	Install and administer Unix based computers	This unit covers the installation and administration of UNIX based and networked computers. It encompasses safe working practices, performing basic UNIX, Linux or Mac OSX operating system installation, administration functions of logging in and out, setting up GUI applications, manipulating text files, creating and searching files and directories, changing permissions, using text editors, identifying and modifying initialisation files, streamlining command, execution using shell features, using basic network commands and documenting all administration activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>endorsed IT Training Package.</i>
UEENEED014B	Design and manage enterprise networks	This unit covers designing, managing, monitoring and diagnose enterprise servers. It encompasses safe working practices, designing and managing Domain Name Server (DNS), Email servers, Dynamic Host Configuration Protocol (DHCP), Remote access servers, Network Address Translation (NAT), Directory services, Authentication Servers and documenting all designing and managing activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED015B	Administer user networks	This unit covers the administration of network servers. It encompasses safe working practices, establishing and maintaining user and group permissions, network security and shared resource management, monitoring and optimising network systems performance and reliability, maintaining currency of the network and documenting all administration activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED016B	Develop network services	This unit covers develop services for network clients for emails, Internet access, shared resources. It encompasses safe working practices, installing and configuring Domain Name Server (DNS), email servers, Dynamic Host Configuration Protocol (DHCP), remote access servers, Network Address Translation (NAT), directory services, Authentication Servers and documenting development activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>endorsed IT Training Package.</i>
UEENEED017B	Install and configure Internetworking systems	This unit covers the interconnection of networks using Open Systems Interconnection model (OSI) layer 2 and 3 devices. It encompasses safe working practice, basic installation and configuration of switches and routers and documenting installation and configuration activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED018B	Design and implement Internetworking systems	This unit covers the design, implementation and performance monitoring of Internetworking systems. It encompasses safe working practice, evaluating customer requirements, applying sound design principles, using Wide Area Network (WAN) technologies, complying with regulation and standards, and documentation of design and performance monitoring.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED019B	Design and implement Internetworking systems – advanced routing	This unit covers the design, implementation and performance monitoring of Internetworking systems. It encompasses safe working practice, evaluating customer requirements, applying sound design principles, complying with regulation and standards, incorporation and advance configuration of remote access and documentation of design and performance monitoring
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED020B	Design and implement	This unit covers the design, implementation and performance monitoring of Internetworking

Unit Code	Unit Title	Scope/Descriptor
	Internetworking systems – remote access	systems. It encompasses safe working practice, evaluating customer requirements, applying sound design principles, complying with regulation and standards, incorporation and advance configuration of remote access and documentation of design and performance monitoring. Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED021B	Design and implement Internetworking systems – multi-layer switching	This unit covers the design, implementation and performance monitoring of Internetworking systems. It encompasses safe working practice, evaluating customer requirements, applying sound design principles, complying with regulation and standards, incorporation and advance multi-layer switching technologies and documentation of design and performance monitoring. Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED022B	Design and implement Internetworking systems – security	This unit covers the design, implementation and performance monitoring of Internetworking systems. It encompasses safe working practice, evaluating customer requirements, applying sound design principles, complying with regulation and standards, incorporation of advance security technologies and documentation of design and performance monitoring. Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED023B	Design and implement Internetworking systems – wireless	This unit covers the design, implementation and performance monitoring of Internetworking systems. It encompasses safe working practice, evaluating customer requirements, applying sound

Unit Code	Unit Title	Scope/Descriptor
	LANs/WANs	design principles, complying with regulation and standards, incorporation and advance wireless LANs technologies and documentation of design and performance monitoring.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED024B	Integrate multiple computer operating systems on a client server network	This unit covers interconnecting computers to form a local area network (LAN). It encompasses applying different computer and network operating system on a single LAN, using network standards and protocols, selecting network topology and physical media, disaster planning recovery, performance management and documentation of work activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED025B	Design and configure Human-Machine Interface networks	This unit covers monitoring and maintaining the operation of distributive and central control system networks. It encompasses safe working practices, installing and configuring controllers and devices, monitoring system operations, diagnosing malfunctions and faults and documenting development activities.
UEENEED026B	Design a computer based control system	This unit covers the design of computer application for control processes. It encompasses apply knowledge of control devices, control systems, programmable logic controllers, supervisory control and data acquisition systems and control programming methods, developing alternative design schemes based on design brief, customer relations and documenting designs
UEENEED027B	Develop structured programs to control external devices	This competency standard unit covers programming of microprocessor/microcontroller devices to access external devices. The unit encompasses working safely, applying knowledge

Unit Code	Unit Title	Scope/Descriptor
		of control applications, and analogue and digital input/output signals, programming fundamentals, writing and testing program and documenting programming activities.
UEENEED028B	Develop and test code for microcontroller devices	This competency standard unit covers structured programming instructions for micro devices at a fundamental level. The unit encompasses working safely, applying knowledge device architecture and programming fundamentals, writing and testing specified instructions and documenting development activities.
		Note <i>In this unit the term ‘micro’ refers to micro-controllers however competency in the unit can be achieved using microprocessors.</i>
UEENEED029B	Develop basic web pages for engineering applications	This unit covers the development of web pages for engineering applications. It encompasses working safely, developing web pages using authoring tools, client-side scripting, and fundamental server-side scripting and documenting development activities.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED030B	Select, install, configure and test multimedia devices	This unit covers assembly, setting up and testing multimedia computer systems as directed in computer service manuals and device/driver documentation. It encompasses safe working practices, and selecting, installing, configuring and testing multimedia computer system components, applications, and driver software, following written and oral instruction and applying customer relations’ procedures.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED031B	Develop and validate	This unit covers planning installations, developing

Unit Code	Unit Title	Scope/Descriptor
	basic integrated systems	instructions and validating integrated systems with up to three independent subsystems. It encompasses working safely, understanding operating parameters and capabilities, following instructions and documenting
UEENEED032B	Design integrated systems	This unit covers designing systems for the control and management of services such as lighting, air conditioning, water use entertainment facilities, communications for buildings and premises. It encompasses developing control scenarios based on a design brief, negotiating with architect/designer, builder and client, applying knowledge of integrated systems and protocols, developing design drawings and obtaining approval for final design.
		Note <i>This Unit is limited to systems with up to three inter working subsystems</i>
UEENEED033B	Design complex integrated systems	This unit covers designing large and networked systems for the control services and energy management in buildings and premises. It encompasses developing control scenarios based on a design specifications and/or brief, negotiating with architect/designer, builder and client, applying knowledge of integrated systems, networks and protocols, developing design drawings and obtaining approval for final design.
UEENEED034B	Configure and maintain industrial control system networks	This unit covers installing, configuring and maintaining communication service on a control network. It encompasses safe working practices; applying knowledge of industrial control network topology and protocols, configuring data links, bus monitoring and system management and access, network testing and documenting system settings.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED035A to	RESERVED	

Unit Code	Unit Title	Scope/Descriptor
UEENEED042A		
UEENEED043B	Install and configure a computer operating system and software	This unit covers installing and configuring an operating system and software on a personal computer. It encompasses safe working practices, installing and testing the operating system and application software, testing functionality, rectifying operating anomalies, following written and oral instruction and procedures and applying appropriate customer relations.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED044B	Commission computer systems	This competency standard unit covers undertaking commissioning procedures of computer systems to comply with predetermined parameters and delivery to client. It encompasses safe working practices, system parameter testing, analysis and adjusting to assure optimum performance, following procedures, and documenting final operating parameters and settings.
UEENEED045B	Modify-redesign of computer system	This competency standard unit covers the modification and redesign of computer systems to augment existing systems for clients. It encompasses safe working practices, system parameter reconfiguration, analysis to assure optimum performance, following procedures, and documenting final modifications and settings.
UEENEED046B	Set up and configure basic local area network	This unit covers setting up, configuring and maintaining operation of a basic local area network (LAN) of up to 20 connected devices. It encompasses safe working practices, installing network hardware, installing and configuring network software, establish user accounts, configure shared Internet connection and documenting set up parameters and LAN topology.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED047A	RESERVED	
UEENEED048B	Plan computer systems projects	This unit covers development and documentation of computer systems project proposals, milestones and completions. The unit encompasses, establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines
UEENEED049A	RESERVED	
UEENEED050B	Develop control programs for microcomputer equipped devices	This unit covers development of hardware and programs to control external devices using microcomputers as apply to engineering product development work. It encompasses working safely, following design brief, applying knowledge of microcomputer architecture, constructing prototype devices, and programming using assembler or 'C' programming language, testing device operation and documenting development work.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED051B	Provide programming solution for engineering problems	This unit covers developing, implementing and testing programming solutions, using a structured programming language. It encompasses following design brief using appropriate development software, writing code and documenting development activities.
		Note 1: Typical engineering problems are those encountered in meeting requirements in a design brief, meeting performance requirements and compliance standards, revising a systems operating parameters and dealing with system malfunctions. Note 2: This unit applies to all aspects of

Unit Code	Unit Title	Scope/Descriptor
		Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.
UEENEED052B	Design embedded controller systems	This unit covers designing control systems using microcontrollers, or PCs or embedded signal processors (DSPs). It encompasses working safely, following design briefs and applying knowledge of embedded system devices, interpreting device specifications, constructing prototypes, using appropriate development software, applying programming techniques, testing developed system prototype operation, verifying compliance of the design against the final brief and documenting design and development work. Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEED053B	Set up and test biometric devices	This unit covers setting up and testing various biometric devices as implemented in the field of biometric measurements. This is achieved through the installing, setting up, configuring and testing biometric devices in accordance with requirements. It encompasses safe working practices, following written and oral instructions and procedures, applying knowledge of biometric devices then installing and testing their performance while documenting outcomes.
UEENEED054B	Analyse and implement biometric techniques and applications	This unit covers analysing and implementing the various established biometric techniques and applications as implemented in the field of biometric measurements. This is achieved through evaluation of the major biometric system from enrolment phase, interaction with the operator and subject, to decision making. It encompasses safe working practices, following written and oral instructions and procedures, applying knowledge of biometric systems then implementing, testing and evaluating their performance while documenting outcomes.

Unit Code	Unit Title	Scope/Descriptor
UEENEED055B	Develop and validate biometric systems installation instructions	This unit covers the development of biometric system installation, instructions and validating requirements of biometric systems. It encompasses working safely, understanding operating parameters and capabilities, following instructions and while documenting outcomes.

Discipline E – Cross-Discipline

Unit Code	Unit Title	Scope/Descriptor
UEENEEE001B	Apply OHS practices in the workplace	This unit specifies the mandatory requirements of occupational health and safety and how they apply to the various electrotechnology work functions. It encompasses responsibilities for health and safety, risk management processes at all operative levels and adherence to safety practices as part of the normal way of doing work.
		Note: <i>Components of this unit are included in the critical aspects of evidence of each applicable unit to ensure that OHS practices are demonstrated as they apply to specific work functions and situation</i>
UEENEEE002B	Dismantle, assemble and fabricate electrotechnology components	This unit covers basic fitting and fabrication techniques as they apply in the various electrotechnology work functions. It encompasses the safe use of hand, fixed and portable power tools; cutting, shaping joining and fixing using metallic and non-metallic materials; dismantling and assembling equipment; basic mechanical measurement and marking-out and reading diagrams.
UEENEEE003B	Solve problems in extra-low voltage single path circuits	This unit covers providing known solutions to predictable problems in single path circuits operated at extra-low voltage as they apply to various electrotechnology work functions. It

Unit Code	Unit Title	Scope/Descriptor
		encompasses working safely, problem solving procedures, including the use of basic voltage, current and resistance measuring devices, providing known solutions to predictable circuit problems.
UEENEEE004B	Solve problems in multiple path d.c. circuits	This unit covers determining correct operation of single source d.c. parallel and series-parallel circuits and providing solutions as they apply to various electrotechnology work functions. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in multiple path circuit.
UEENEEE005B	Fix and secure equipment	This unit covers fixing, securing and mounting techniques as apply in the various electrotechnology work functions. It encompasses the safe use of hand and portable power tools, safe lifting techniques, safe use of ladders and elevated platforms and the selection and safe application of fixing devices and supporting accessories/equipment.
UEENEEE006B	Apply methods to maintain currency of industry developments	This unit covers methods for keeping up-to-date with developments in electrotechnology-adopted technologies, standards and safety that affect the currency of competencies held. It encompasses accessing relevant information and skills and using formal and informal ways of acquiring this information and skills.
UEENEEE007B	Use drawings, diagrams, schedules and manuals	This unit covers the use of drawings, diagrams, equipment and cable schedules and manuals as they apply to the various electrotechnology work functions. It encompasses the rudiments for communicating with schematic, wiring and mechanical diagrams and equipment and cable/connection schedules, manuals,

Unit Code	Unit Title	Scope/Descriptor
		site and architectural drawings and plans showing the location of services, apparatus, plant and machinery.
UEENEEE008B	Lay wiring/cabling and terminate accessories for extra-low voltage circuits	This unit covers the laying of wiring/cabling, connection of accessories and continuity and insulation resistance testing of circuits intended to operate at extra-low voltage. Typically this includes circuits and accessories for ELV powered devices, security, controls, integrated systems and audio/video systems. It encompasses the principles of single source, single load power circuits, control and communications circuits, safe working practices and following work processes that satisfy electrical principles for safety and functionality.
UEENEEE009B	Comply with scheduled and preventative maintenance program processes	This unit covers the quality assurance and risk management compliance processes for maintaining the electrotechnology aspects of plant and equipment. It encompasses working safely and to technical, quality and risk management standards, work specifications and maintenance schedules, sample inspections, evaluating components and completing the necessary maintenance documentation.
UEENEEE010B	Develop and implement maintenance programs	This unit covers the development of maintenance programs to ensure safe and continued operation of plant and equipment. It encompasses evaluating risks associated with equipment failure, development of failsafe strategies incorporating maintenance frequency, repair/overhaul/replacement policies, and development of record and reporting system.
UEENEEE011C	Manage risk in electrotechnology activities	This unit covers managing risk related to OHS, environment, resources and financial viability. It encompasses identifying risk events, the likelihood and consequences of such events, evaluating

Unit Code	Unit Title	Scope/Descriptor
		risk, risk management planning and mitigation of risk.
UEENEEE012B	Manage electrotechnology projects	This unit covers the management of electrotechnology projects involving design, modifications, installation and or maintenance of systems and equipment. It encompasses management of safety, budget, variations, personnel, resources and critical path timelines and necessary progress and completion documentation.
UEENEEE013B	Plan electrotechnology projects	This unit covers development and documentation of project proposals, milestones and completions. It encompasses establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines.
UEENEEE014B	Supervise and coordinate work activities	This unit covers supervising and coordinating work activities in an electrotechnology discipline. It encompasses working safety, implementing safety procedures and processes, sequencing work activities, providing guidance and work instructions to others, ensuring job requirements are met and maintain necessary work documentation.
UEENEEE015B	Develop design briefs for electrotechnology projects	This unit covers developing requirement to be incorporated into the design of electrotechnology projects. It encompasses determining the safety requirements to be met, establishing client's expectations, ensuring cost effective solutions are pursued and documenting design requirements.
UEENEEE016B	Write specifications for electrotechnology projects	This unit covers developing requirement to be incorporated into the writing of specifications for electrotechnology projects. It encompasses determining the safety requirements to be met, establishing client's expectations,

Unit Code	Unit Title	Scope/Descriptor
		ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE017B	Implement and monitor OHS policies and procedures	This unit covers the mandatory requirements of persons in a supervisory role to implement and monitor an organisation's occupational health and safety policies, procedures and programs. It encompasses understanding an organisation's OHS obligations, providing safety information to staff, implementing and monitoring participative arrangements, safety procedures and training and maintaining safety records.
UEENEEE018B	Establish, maintain and evaluate OHS systems	This unit covers the mandatory responsibility of an organisation's executive officers to establish, maintain and evaluate an OHS system. It encompasses understanding an organisation's OHS obligations, establishing and maintaining participative arrangements, procedures for hazard identification, risk assessment and control measures, procedures for dealing with hazardous incidents, safety training, and safety records, and evaluating the safety system.
UEENEEE019C	Solve problems in multiple path a.c. circuits	This unit covers determining correct operation of single source a.c. parallel and series-parallel circuits and providing solutions as they apply to various electrotechnology work functions. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in multiple path circuits.
UEENEEE020B	Provide basic instruction in the use of electrotechnology	This unit covers instructing customers/users in the use of electrotechnology apparatus. It

Unit Code	Unit Title	Scope/Descriptor
	apparatus	encompasses appropriate customer relations, the use of apparatus manufacturer's instruction material, basic instruction methods and evaluation and completing documentation.
UEENEEE021B	Plan an integrated cabling system	This unit covers the planning of cable routes for power, lighting, communications, entertainment, distributed video and audio and energy management and control. This unit encompasses determining immediate and future cabling needs of an installation and their origins and termination points, planning cable routes, specifying cable types, sizes, fixing/support methods and cable identification systems and documenting cabling plans based on calculated and/or deemed-to-comply solutions as well as the planning of the wiring hub if required.
UEENEEE022B	Carry out preparatory electrotechnology work activities	This unit covers the carrying out of preparatory work related to any electrotechnology discipline. It encompasses working safely, following basic instructions under direct supervision. It will include electrotechnology support activities including the use of basic hand tools, the safe use of ladders and elevated work platforms and the fixing and securing of equipment under direction following routine work practices.
UEENEEE023B	Solve basic problems in electronic and digital equipment	This unit covers determining correct operation of basic electronic and digital equipment and providing solutions as they apply to various electronic and computer work functions. It encompasses working safely, problem solving procedures, including the use of basic measuring devices, providing solutions derived from equipment behaviour and measurements to predictable problems.

Unit Code	Unit Title	Scope/Descriptor
UEENEEE024C	Compile and produce an electrotechnology report	This unit covers complying and producing an electrotechnology report. It encompasses confirming that the safety requirements are met and all regulatory responsibilities are adhered to. The person competent in this unit must demonstrate an ability to identify information sources and collect and analyse and format information applicable to the electrotechnology industry and produce a report as required.
UEENEEE025B	Solve problems in complex multiple path circuits	This unit covers determining correct operation of complex series-parallel circuits and providing solutions as they apply to various electrotechnology work functions. It encompasses working safely, problem solving procedures, including using electrical measuring devices, applying appropriate circuit theorems and providing solutions derived from measurements and calculations and justification for such solutions.
UEENEEE026B	Provide computational solutions to basic engineering problems	This unit covers the application of computational processes to solving engineering problems. It encompasses working safely, applying problem solving techniques, using a range of mathematical processes, providing solutions to electrical/electronics engineering problems and justifying such solutions. Note: <i>Typical engineering problems are those encountered in meeting requirements in a design brief, meeting performance requirements and compliance standards, revising systems operating parameters and dealing with system malfunctions.</i>
UEENEEE027B	Use advanced computational processes to provide solutions to engineering problems	This unit covers the application of advanced computational processes to solve engineering problems. It encompasses working safely, applying

Unit Code	Unit Title	Scope/Descriptor
		problem solving techniques, using a range of advanced mathematical processes, providing solutions to electrical/electronics engineering problems and justifying such solutions. Note: <i>Typical engineering problems are those encountered in meeting requirements in a design brief, meeting performance requirements and compliance standards, revising systems operating parameters and dealing with system malfunctions.</i>
UEENEEE028B	Develop engineering solutions to photonic problems	This unit covers developing engineering solutions to resolve problems with photonic systems. It encompasses working safely, apply extensive knowledge of photonic technologies and their application, gathering and analysing data, and applying problem solving techniques, developing and documenting solutions and alternatives.
UEENEEE029B	Solve electrotechnical problems	This unit covers the application of calculations required to solve electrotechnical problems. It encompasses working safely, applying problem solving techniques, using a range of mathematical processes and techniques to providing solutions to electrotechnical problems, and justifying such solutions. Note: <i>Typical electrotechnical problems are those encountered in meeting requirements in meeting performance requirements and compliance standards, revising systems operating parameters and dealing with system malfunctions</i>
UEENEEE030B	Provide solutions to and report on routine electrotechnology problems	This unit covers the application of fundamental numerical calculations required to solve routine electrotechnology problems and reporting the outcomes to requirements. It encompasses working safely, applying

Unit Code	Unit Title	Scope/Descriptor
		routine problem solving techniques, using a range of fundamental mathematical processes and techniques to identifying solutions to electrotechnology problems, and reporting the solutions. Note: <i>Typical electrotechnical problems are those encountered in meeting requirements in meeting performance requirements and compliance standards, revising systems operating parameters and dealing with system malfunctions. Typical reports are those based on routine structures and formats, and require the application of routine communication fundamentals.</i>
UEENEEE031A	RESERVED	
UEENEEE032B	Document occupational hazards and risks in computer systems	This unit covers i) occupational work hazard identification, ii) identifying health and safety risks to workers, iii) classification of risks, iv) documenting control measures intended to eliminate or reduce the risk that could potentially arise during the conduct of work activities and v) consultation processes with those involved with computer systems work. This unit primarily deals with the process involved in completing documentation and/or making appropriate modifications to pre-prepared documents.
UEENEEE033B	Document occupational hazards and risks in electrical work	This unit covers i) occupational work hazard identification, ii) identifying health and safety risks to workers, iii) classification of risks, iv) documenting control measures intended to eliminate or reduce the risk that could potentially arise during the conduct of work activities and v) consultation processes with those involved with electrical work. This unit deals primarily with the process involved in completing documentation and/or making appropriate modifications to pre-prepared documents.

Unit Code	Unit Title	Scope/Descriptor
UEENEEE034B	Document occupational hazards and risks in electronics	This unit deals primarily with the process involved in completing documentation and/or making appropriate modifications to pre-prepared documents. It covers i) occupational work hazard identification; ii) identifying health and safety risks to workers; iii) classifying risks; iv) documenting control measures intended to eliminate or reduce the risk that could potentially arise during the conduct of work activities; and v) consultation processes with those involved with computer systems work.
UEENEEE035B	Document occupational hazards and risks in instrumentation	This unit primarily deals with the process involved in completing documentation and/or making appropriate modifications to pre-prepared documents. It covers i) occupational work hazard identification; ii) identifying health and safety risks to workers; iii) classification of risks; iv) documenting control measures intended to eliminate or reduce the risk that could potentially arise during the conduct of work activities; and v) consultation processes with those involved with computer systems work.
UEENEEE036B	Document occupational hazards and risks in refrigeration and air-conditioning	This unit deals primarily with the process involved in completing documentation and/or making appropriate modifications to pre-prepared documents. It covers i) occupational work hazard identification; ii) identifying health and safety risks to workers; iii) classification of risks; iv) documenting control measures intended to eliminate or reduce the risk that could potentially arise during the conduct of work activities; and v) consultation processes with those involved with refrigeration and Air-conditioning work.
UEENEEE037B	Document occupational hazards and risks in electrotechnology	This unit deals primarily with the process involved in completing documentation and/or making appropriate modifications to pre-prepared documents. It covers i)

Unit Code	Unit Title	Scope/Descriptor
		occupational work hazard identification; ii) identifying health and safety risks to workers; iii) classification of risks; iv) documenting control measures intended to eliminate or reduce the risk that could potentially arise during the conduct of work activities; and v) consultation processes with those involved with electrotechnology work.
UEENEEE038B	Participate in development and follow a personal competency development plan	This unit covers the application of skills and knowledge in taking responsibility for one's own competency development. It encompasses understanding the structure of a competency development plan, participating in the development of a personal competency development plan, understanding responsibilities and obligation under competency development plan, following activities for developing competency, self-monitoring competency development and meeting trainee obligations for periodic reporting of competency development activities.
UEENEEE039A	RESERVED	
UEENEEE041B	Use of routine equipment/plant/technologies in an electrotechnology environment	This unit covers routine tools, equipment and personnel protective equipment required to do work in the electrotechnology environment, is used in accordance with the schedule of work to ensure work is completed in an agreed time, to a quality standard and with a minimum waste.
UEENEEE042B	Produce routine products for carrying out electrotechnology work activities	This unit covers routine products required to do work in the electrotechnology environment are produced in accordance with the schedule of work ensuring work is completed in an agreed time, to a quality standard and with a minimum waste.
UEENEEE043B	Produce routine tools/devices for carrying out	This unit covers routine tools/devices required to do work in the

Unit Code	Unit Title	Scope/Descriptor
	electrotechnology work activities	electrotechnology environment are produced in accordance with the schedule of work ensuring work is completed in an agreed time, to a quality standard and with a minimum waste.
UEENEEE044B	Apply technologies and concepts to electrotechnology work activities	This unit covers undertake electrotechnology work activities using a range of technologies such as computers , and apply analytical concepts to achieve the desired outcome ensuring work is completed in an agreed time, to a quality standard and with a minimum of waste.
UEENEEE045B	Apply computation when using equipment, materials and concepts in an electrotechnology environment	This unit covers undertaking computations to produce appropriate results using a range of equipment, materials and concepts in carrying out electrotechnology work activities, whilst ensuring work is completed in an agreed time, to a quality standard and with a minimum of waste.
UEENEEE046B	Identify affects of energy on machinery and materials in an electrotechnology environment	This unit covers affects of energy on machinery and/or materials used in an electrotechnology environment are identified and completed in an agreed time, to a quality standard and using appropriate technology mediums, where required. It encompasses working safely, applying knowledge of identifying the effects of energy on machinery and materials in an electrotechnology environment.
UEENEEE047B	Identify building techniques, methods and materials used in electrotechnology work activities	This unit covers identifying a range of techniques, methods and materials used in electrotechnology work activities, including types of fixing devices, segregation requirements, fixing structures, walls and floor structures, lifting techniques and other related building materials. It encompasses working safely, applying knowledge of identifying building techniques, methods and materials used

Unit Code	Unit Title	Scope/Descriptor
		in electrotechnology work activities.
UEENEEE048C	Carry out routine work activities in an electrotechnology environment	This unit covers undertaking scheduled routine work activities in the electrotechnology industry in an agreed time, to a quality standard and with a minimum of waste. It encompasses working safely, applying knowledge of carrying out routine work activities in electrotechnology environments.
UEENEEE049B	Contribute to the operation of support plant and equipment used in electricity supply	This unit covers contributing to the operation of support plant and equipment used in the Electricity Supply Industry for scheduled work in an agreed time, to a quality standard and with a minimum of waste. It encompasses working safely, applying knowledge of contributing to the operation of support plant and equipment used in electricity supply.
UEENEEE050B	Undertake computations in an electrotechnology environment	This unit covers computational and mathematical procedures to solve problems or to enhance given data. It encompasses working safely, applying knowledge of undertaking computations in electrotechnology environment.
UEENEEE051B	Transport apparatus and materials	This unit covers the transportation of apparatus, plant accessories and materials. It encompasses safe working practices and following work processes that satisfy electrical principles for transporting apparatus/materials.
UEENEEE052A to UEENEEE059A	RESERVED	
UEENEEE060B	Provide solutions for uses of materials and thermodynamic effects	This unit covers the solution for the appropriate selection and use of materials and thermodynamic effects relative to an engineering problem. It encompasses working safely, problem solving procedures, including using measuring instruments, applying appropriate

Unit Code	Unit Title	Scope/Descriptor
		theorems and providing solutions derived from measurements and calculations and justification for such solutions.
UEENEEE061B	Analyse static and dynamic parameters of equipment	This unit covers the analysis of static and dynamic parameters of equipment associated with plant and machinery. It encompasses working safely, applying extensive knowledge of equipment operation and construction and its application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical machine problems are those encountered in meeting performance requirements and compliance standards, revising machine operating parameters and dealing with machine malfunctions.</i>
UEENEEE062B	Select drive components for equipment design	This unit covers the selection of drive components based on design concepts for the operation of plant and equipment. It encompasses working safely; apply extensive knowledge of drive component operation and characteristics, their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical drive components are those encountered in meeting performance requirements and compliance standards, revising machine operating parameters and dealing with machine malfunctions.</i>
UEENEEE063B	Analyse materials for suitability in equipment	This unit covers the analysis of materials for their suitable use in the construction of equipment. It encompasses working safely; apply extensive knowledge of materials and their properties as they relate to equipment construction and operation, gathering and analysing data,

Unit Code	Unit Title	Scope/Descriptor
		applying problem solving techniques, developing and documenting findings, solutions and providing alternatives.
		Note: <i>Typical drive components are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions.</i>
UEENEEE064B	Design machine drives and production layout plans	This unit covers the design of machine drives and the layout of machinery for the efficient production of goods produced by automated equipment. It encompasses working safely, applying extensive knowledge of machine drives and equipment layout arrangements, their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives. Note: <i>Typical machine drives and production layout plans are those encountered in meeting performance requirements and compliance standards, production requirements and efficient use of materials and human resources.</i>
UEENEEE065A to UEENEEE069A	RESERVED	
UEENEEE070B	Write specifications for computer systems engineering projects	This unit covers developing requirements to be incorporated into the writing of specifications for computer systems engineering projects. It encompasses determining the safety requirements to be met, establishing client expectations, ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE071B	Write specifications for electrical engineering projects	This unit covers developing requirements to be incorporated into the writing of

Unit Code	Unit Title	Scope/Descriptor
		specifications for electrical engineering projects. It encompasses determining the safety requirements to be met, establishing client expectations, ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE072B	Write specifications for electronics and communications engineering projects	This unit covers developing requirements to be incorporated into the writing of specifications for electronics and communications engineering projects. It encompasses determining the safety requirements to be met, establishing client expectations, ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE073B	Write specifications for refrigeration and air conditioning engineering projects	This unit covers developing requirements to be incorporated into the writing of specifications for refrigeration and air conditioning engineering projects. It encompasses determining the safety requirements to be met, establishing client expectations, ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE074B	Write specifications for renewable energy engineering projects	This unit covers developing requirements to be incorporated into the writing of specifications for renewable energy engineering projects. It encompasses determining the safety requirements to be met, establishing client expectations, ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE075B	Write specifications for industrial electronics and control projects	This unit covers developing requirements to be incorporated into the writing of specifications for industrial electronics and control projects. It encompasses determining the safety requirements to be met, establishing client expectations, ensuring cost effective solutions are

Unit Code	Unit Title	Scope/Descriptor
		pursued and documenting design and technical requirements.
UEENEEE076A	RESERVED	
UEENEEE077B	Write specifications for automated systems projects	This unit covers developing requirements to be incorporated into the writing of specifications for automated systems projects. It encompasses determining the safety requirements to be met, establishing client expectations, ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE078B	Contribute to risk management in electrotechnology systems	This unit covers contributing to the management of risk in electrotechnology systems related to OHS, environment, resources and financial viability. It encompasses contributing to the identification of electrotechnology systems risks; and risk events, the likelihood and consequences of such events, evaluating risk, risk management planning and mitigation of risk.
UEENEEE079A	Identify and select components, accessories and materials for electrotechnology work activities	This unit covers undertaking a schedule of work for selecting appropriately identified components, accessories or materials in an agreed time, to a quality standard and with a minimum of waste, using appropriate technology mediums where required.
UEENEEE080A	Apply industry and community standards to engineering activities	This unit covers the industry and community standards expected of engineers. It encompasses knowledge and application of ethical and community standards, seeking advice regarding broader implications of engineering works, adopting appropriate technologies and engaging in current engineering issues.
UEENEEE081A	Apply material science to solving electrotechnology	This unit covers the application of materials for a specific purpose in electrotechnology. It encompasses

Unit Code	Unit Title	Scope/Descriptor
	engineering problems	working safely, knowledge of materials science including classifications, characteristics and any impact a material may have on health and the environment, the processes of corrosion and degradation, how particular materials are used, solving electrotechnology problems involving of materials for a particular application and documenting justification for such solutions.
UEENEEE082A	Apply physics to solving electrotechnology engineering problems	This unit covers the law of physics and how they apply to solving electrotechnology related problems. It encompasses working safely, knowledge of measurements of physical phenomena, linear and angular motion, harmonic motion, wave theory, optics, acoustics and heat capacity and transfer, use of measurement techniques, solving physics related problems and documenting justification for such solutions.
UEENEEE083A	Establish and follow a competency development plan in an electrotechnology engineering discipline	This unit covers establishing and following a plan for one's own competency development. It encompasses establishing a plan in consultation with the enrolling registered training organisation (RTO), following industry/enterprise procedures regarding how work is conducted, understanding responsibilities and obligations under competency development plan, following activities for developing competency, pursuing opportunities to develop competencies, to self-monitoring competency development and meeting obligations for periodic reporting of competency development activities.
UEENEEE084A	Write specifications for electrotechnology engineering projects	This unit covers developing requirement to be incorporated into the writing of specifications for electrotechnology engineering projects. It encompasses determining the safety requirements to be met, establishing client expectations,

Unit Code	Unit Title	Scope/Descriptor
		ensuring cost effective solutions are pursued and documenting design and technical requirements.
UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace	This unit specifies the mandatory requirements of occupational health and safety and how they apply to the various electrotechnology work functions. It encompasses responsibilities for health and safety, risk management processes at all operative levels and adherence to safety practices as part of the normal way of doing work.
UEENEEE102A	Fabricate, assemble and dismantle utilities industry components	This unit covers basic fitting and fabrication techniques as they apply in the various electrotechnology work functions. It encompasses the safe use of hand, fixed and portable power tools; cutting, shaping joining and fixing using metallic and non-metallic materials; dismantling and assembling equipment; basic mechanical measurement and marking-out and reading drawings/diagrams
UEENEEE104A	Solve problems in d.c. circuits	This unit covers determining correct operation of single source d.c. series, parallel and series-parallel circuits and providing solutions as they apply to various electrotechnology work functions. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in single and multiple path circuits.
UEENEEE105A	Fix and secure electrotechnology equipment	This unit covers fixing, securing and mounting techniques as apply in the various electrotechnology work functions. It encompasses the safe use of hand and portable power tools, safe lifting techniques, safe use of ladders and elevated platforms and the selection and safe application of fixing devices and

Unit Code	Unit Title	Scope/Descriptor
		supporting accessories/equipment.
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications	This unit covers the use of drawings, diagrams, cable schedules, standards, codes and specifications as they apply to the various electrotechnology work functions. It encompasses the rudiments for communicating with schematic, wiring and mechanical diagrams and equipment and cable/connection schedules, manuals, site and architectural drawings and plans showing the location of services, apparatus, plant and machinery and understanding the use and format of compliance standards and job specifications.
UEENEEE125A	Provide engineering solutions for problems in complex multiple path circuits	This unit covers determining correct operation of complex multiple path circuits and providing engineering solutions as they apply to various branches of electrotechnology work functions. It encompasses working safely, problem solving procedures, including using electrical measuring devices, applying appropriate circuit theorems and providing solutions derived from measurements and calculations and justification for such solutions.
UEENEEE126A	Provide solutions to basic engineering computational problems	This unit covers the application of computational processes to solve engineering problems. It encompasses working safely, applying problem solving techniques, using a range of mathematical processes, providing solutions to electrical/electronics engineering problems and justifying such solutions. Note; Typical engineering problems are those encountered in meeting requirements in a design brief, meeting performance requirements and compliance standards, revising systems operating parameters

Unit Code	Unit Title	Scope/Descriptor
		and dealing with system malfunctions
UEENEEE137A	Document and apply measures to control OHS risks associated with electrotechnology work	This unit covers identifying occupational health and safety hazard and risks and documenting control measures. It encompasses identifying workplace hazards, assigning levels of risk, developing control measures to eliminate and/or mitigate risks, reviewing risk control measures and maintaining documentation of hazards, risk control measures and their application in accordance with compliance procedures.

Discipline F – Data and Voice

Unit Code	Unit Title	Scope/Descriptor
UEENEEF002B	Lay and connect cables for multiple access to telecommunication services	This unit covers the laying and termination of telecommunications cabling in buildings and premises. It encompasses working safely and to Australian Communications and Media Authority's 'Open' Cabling Provider Rule, installing multiple telephone line, multi-pair cables, backbone cabling, terminating in socket outlets, termination modules and distributors, testing and compliance checks and completing cabling documentation.
UEENEEF003B	Install and maintain cabling for telecommunication services in lifts	This unit covers the installation and termination of telecommunications cabling in buildings and premises. It encompasses working safely and to Australian Communications and Media Authority's 'Lift' Cabling Provider Rule, installing multiple telephone lines, multi-pair cables, backbone cabling, terminating in socket outlets, termination modules and distributors, testing and compliance checks and completing cabling documentation.
UEENEEF004B	Install and modify performance data communication structured cabling	This unit covers the installation and termination of high performance data cabling in buildings and premises, intended for connection to a telecommunications network. It encompasses working safely and to standards, installing

Unit Code	Unit Title	Scope/Descriptor
		multiple data lines and backbones using structured twisted pair cabling, terminating at distributors, termination modules and in socket outlets, testing and compliance checks and completing cabling documentation.
UEENEEF005B	Install and modify performance data communication optical fibre cabling	This unit covers the installation and termination of high performance data cabling in buildings and premises and intended for connection to a telecommunications network. It encompasses working safely and to standards, installing multiple data lines and backbones using optical fibre cabling, terminating at distributors, splices and on socket outlets, testing and compliance checks and completing cabling documentation.
UEENEEF006B	Solve problems in data and voice communications circuits	This unit covers providing known solutions to predictable problems in single and multiple path circuits operated at extra-low voltage as they apply to various data and voice communications work functions. It encompasses working safely, problem solving procedures, including the use of basic voltage, current and resistance measuring devices, providing known solutions to predictable communication circuit problems.
UEENEEF007B	Set up the wireless capabilities of communications and data storage devices	This unit covers entering instructions in wireless devices with simple built-in programming function and verifying that the device operates as intended. It encompasses safe working practices, checking device software installation, following written and oral instruction and procedures and completing necessary documentation.
		Note: Examples of wireless devices are personal digital assistants(PDAs), mobile phones, personal computers (PCs) remote controls etc
UEENEEF008B	Select and arrange equipment for wireless networks	This unit covers selecting and arranging wireless access devices, routers and switches for local area and wide area networks intended for connection to a telecommunications network. It encompasses selecting compliant equipment, developing LAN/WAN arrangements that comply with regulation, based on calculated and deemed-to-comply solutions and completing

Unit Code	Unit Title	Scope/Descriptor
		network documentation.
UEENEEF009B	Install and connect voice and data communications equipment	This unit covers the installation, termination and setting up of voice and data equipment for high performance LANs in buildings and premises and intended for connection to a telecommunications network. It encompasses working safely and to standards, installing hubs, routers, switches, decoders, PABXs connected by structured, coaxial and optical fibre cabling, and completing network documentation.
UEENEEF010B	Select and arrange equipment for local area networks	This unit covers selecting and arranging voice and data communication cabling routes, socket outlets, termination modules, switches, routers and distributors in LANs intended for connection to a telecommunications network. It encompasses selecting compliant equipment, developing LAN arrangements that comply with regulation, based on calculated and deemed-to-comply solutions and completing network documentation.
UEENEEF011B	Test, report and rectify faults in voice and data installations	This unit covers testing for certification finding and repairing faults in telecommunication installations and local area networks. It encompasses working safely, reading cabling diagrams, performance testing, applying logical fault finding procedures, testing functionality of the network, conducting repairs and completing the necessary documentation.
UEENEEF012B	Install aerial communication cables	This unit covers installation of catenary and aerial communication cables on existing post and poles. It encompasses working safely and to standard and specifications, installing catenary cable, fixing communication cables and completing necessary documentation
UEENEEF013B	Install below ground communication cables	This unit covers installation of below-ground conduits and ducts and drawing-in communication cables. It encompasses working safely and to standards/specifications, preparing and filling trenches, placing conduits and ducts, drawing cables. It also includes completing necessary documentation.

Unit Code	Unit Title	Scope/Descriptor
UEENEEF014B	Set up and configure basic data communications systems	This unit covers setting up, configuring and maintaining operation of personal computer-based data communications systems. It encompasses safe working practices, installing data communications hardware, installing and configuring data communications software and documenting set-up parameters.
		Note: <i>This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.</i>
UEENEEF015B	Assemble and connect communication frames and cabinets	This unit covers assembly and connection of communication frames and cabinets. It encompasses working safely, following standards, specifications and component/manufacture requirements, matching equipment with that specified, terminating and connecting communication wiring and completing necessary documentation.
UEENEEF016A	Lay and connect cabling for direct access to telecommunications services	This unit covers the installation and termination of telecommunications cabling in buildings and premises. It encompasses working safely and to Australian Communications and Media Authority's 'Restricted' Cabling Provider Rule, installing telephone line, two-pair (quad) cables, terminating on socket outlets, testing and compliance checks and completing cabling documentation.

Discipline G – Electrical

Unit Code	Unit Title	Scope/Descriptor
UEENEEG001B	Solve problems in electromagnetic circuits	This unit covers determining correct operation of electromagnetic circuits and providing solutions as they apply to electrical installations and equipment. It encompasses working safely, power circuit problems-solving processes, including the use of voltage, current and resistance measuring devices, providing solutions derived from

Unit Code	Unit Title	Scope/Descriptor
		measurements and calculations to predictable problems in multiple path circuit.
UEENEEG002B	Solve problems in single and three phase low voltage circuits	This unit covers ascertaining correct operation of single and three phase circuits and solving circuit problems as they apply to servicing, fault finding installation and compliance work functions. It encompasses safe working practices, multi-phase circuit arrangements, issues related to, protection, power factor and MEN systems and solutions to circuit problems derived from calculated and measured parameters.
UEENEEG003B	Install wiring and accessories for low voltage circuits	This unit covers the installation. In building and premises, of wiring enclosures, cable support systems, cables and accessories – intended to operate at voltages up to 1000 V a.c. or 1500 V d.c. It encompasses working safely and to installation standards, routing cables to specified locations, terminating cables and connecting wiring at accessories and completing the necessary installation documentation. Note: This unit includes the skills and knowledge covered by Unit UEENEEE008B Lay cable and accessories for extra-low voltage circuits.
UEENEEG004B	Install low voltage electrical apparatus and associated equipment	This unit covers the installation of protection devices, switchgear and controlgear, appliances and luminaries and intended to operate at voltages up to 1000 V a.c. or 1500 V d.c. It encompasses working safely and to installation standards, matching equipment with that specified for a given location, placing and securing equipment accurately, making required circuit connections and completing the necessary installation documentation.
UEENEEG005B	Verify compliance and functionality of general electrical installations	This unit covers inspection and testing to verify whether an electrical installation is safe and complies with all requirements. It encompasses working safely, visual inspections and mandatory, optional and functional test procedures, identifying non-compliance defects and mandatory reporting requirements.

Unit Code	Unit Title	Scope/Descriptor
UEENEEG006A	Solve problems in single and three phase low voltage machines	This unit covers ascertaining correct operation of single and three phase machines and solving machine problems as they apply to servicing, fault finding, installation and compliance work functions. It encompasses safe working practices, machine connections circuit arrangements, issues related to machine operation, characteristics and protection and solutions to machine problems derived from calculated and measured parameters.
UEENEEG007B	Select and arrange equipment for general electrical installations	This unit covers selecting equipment for electrical installations operating at voltages up to 1,000V a.c. or 1500 V d.c. to meet performance standards. These encompass schemes for protection of persons and property, correct functioning, compatibility with the supply, arrangement of circuits and selection of switchgear, controlgear, protection devices and wiring based on calculated and deemed-to-comply solutions
UEENEEG008B	Find and repair faults in electrical apparatus and circuits	This unit covers finding and repairing faults in electrical apparatus and interconnecting circuits and equipment operating at voltages up to 1,000 V a.c. or 1500 V d.c. It encompasses working safely, reading circuit diagrams, sketching diagrams from traced wiring, logically applying fault finding procedures, conducting repairs and completing the necessary service documentation
UEENEEG009B	Develop and connect control circuits	This unit covers developing, connecting and functionally testing electrical power and control circuits that perform specific control functions. It encompasses working safely; developing schematic/ladder diagrams and converting them to wiring diagrams; selecting and connecting contactors and control devices to perform a specific function
UEENEEG010B	Find and repair faults in d.c. electrical apparatus and circuits	This unit covers finding and repairing faults in electrical apparatus and interconnecting circuits and equipment operating at voltages up to 1500 V d.c. It encompasses working safely, reading circuit diagrams, sketching diagrams from traced wiring, applying logical fault finding procedures, conducting repairs and completing the necessary service documentation

Unit Code	Unit Title	Scope/Descriptor
UEENEEG011B	Carry out basic repairs to electrical apparatus	This unit deals with the repair or replacement of mechanical and electrical components of electrical apparatus. It encompasses safe working practices, following written and oral instruction and procedures, basic testing and techniques for dismantling and assembling apparatus and disconnecting and reconnecting components
UEENEEG012B	Solve fundamental problems in electrical systems	This unit covers ascertaining correct operation of electrical systems in building and premises and solving fundamental system problems as applies to engineering support work functions. It encompasses working safely, problem solving techniques, interpreting electrical measurements, providing solutions derived from measurements to predictable problems in electrical systems and providing justification for such solutions
UEENEEG013B	Install and maintain emergency systems	This unit covers the installation and maintenance of fire and smoke control, emergency lighting and early warning systems in buildings and premises. It encompasses working safely and to installation and maintenance standards, complying with maintenance schedules and completing the necessary documentation
UEENEEG015B	Find and rectify faults in energy supply network equipment	This unit covers finding and rectifying faults in energy supply network electrical equipment. It encompasses working safely, reading circuit and reticulation diagrams, applying logical fault finding procedures, following fault rectification procedures and completing the necessary documentation
UEENEEG016B	Diagnose and rectify faults in lift systems	This unit covers diagnosing and rectifying faults in traction lift systems and equipment. It encompasses working safely, replacing and/or adjustment of lift circuit and associated components, diagnosing and repairing of faults in lift circuits and associated components (including governors, brakes, safety gear, safety devices, lift machines, door components and controllers) and releasing passengers from lifts which have become immobilised
UEENEEG018B	Maintain operation of	This unit covers servicing of electrical systems and

Unit Code	Unit Title	Scope/Descriptor
	electrical mining equipment	equipment in underground and open-cut mines. It encompasses working safely, applying knowledge of mining electrical systems and equipment, reading circuit and reticulation diagrams, applying logical fault diagnosis procedures, following fault rectification procedures and maintaining the necessary documentation
UEENEEG019B	Maintain operation of electrical marine equipment	This unit covers the servicing of electrical systems and equipment on vessels and ships. It encompasses working safely, applying knowledge of marine electrical systems and equipment, reading circuit and reticulation diagrams, applying logical fault diagnosis procedures, following fault rectification procedures and maintaining the necessary operational documentation.
UEENEEG020B	Select and arrange equipment for special electrical installations	This unit covers selecting and arranging electrical equipment into distribution circuits for installations in caravan parks, construction and demolition sites, marinas, medical treatment areas and moveable premises operating at voltages up to 1000V a.c. or 1500 V d.c. It encompasses schemes for protection of persons and property, correct functioning, compatibility with the supply, arrangement of circuits and selection of switchgear, controlgear, protection devices and wiring based on calculated and deemed-to-comply solutions.
UEENEEG021B	Verify compliance and functionality of special electrical installations	This unit covers testing and visual inspection for verifying that an electrical installation in caravan parks, construction and demolition sites, marinas, medical treatment areas, moveable premises and HV installation in consumer's premises are safe and comply with requirements. It encompasses procedures for safely conducting mandatory and optional tests, conducting visual inspections, identifying non-compliance defects and mandatory reporting requirements.
UEENEEG022B	Conduct compliance inspection of single phase electrical installations	This unit covers inspection of single-phase domestic installations with a demand not exceeding 100 A for verifying compliance with electrical safety regulations. It encompasses

Unit Code	Unit Title	Scope/Descriptor
		working safely, conducting tests and inspections, documenting non-compliance defects, taking/recommending actions resulting from non-compliance defects, applying regulatory requirements and completing inspection reports.
UEENEEG023B	Conduct compliance inspection of electrical installations with demand exceeding 100 A per phase	This unit covers inspection of general electrical installations for verifying compliance with electrical safety regulations. It encompasses working safely, conducting tests and inspections, documenting non-compliance defects, taking/recommending actions resulting from non-compliance defects, applying regulatory requirements and completing inspection reports
UEENEEG024B	Conduct compliance inspection of special electrical installations	This unit covers inspection of electrical installation in marinas, moveable premises and caravan parks, medical treatment centres, construction and demolition sites and HV installation in consumer's premises for verifying compliance with electrical safety regulations. It encompasses working safely, conducting tests and inspections, documenting non-compliance defects, taking/recommending actions resulting from non-compliance defects, applying regulatory requirements and completing inspection reports.
UEENEEG025B	Plan electrical installations with a LV demand up to 400 A per phase	This unit covers the planning of circuit and equipment for electrical installations where standardised arrangements for service and CT metering equipment are used, not exceeding 400 A per phase. This encompasses schemes for protection of persons and property, correct functioning, compatibility with the supply, arrangement of circuits, metering and control, cable route planning, specifying type and rating of switchgear, controlgear, protection devices and wiring based on calculated and deemed-to-comply solutions and planning documentation.
UEENEEG026B	Install and maintain field power and distribution systems with a LV demand up to 200 A per phase	This unit covers the installation of electrical power intended to operate at voltages to 1000 V a.c. or 1500 V d.c. It encompasses working safely and to standards, positioning site generator sets, routing cables to specified locations, matching equipment

Unit Code	Unit Title	Scope/Descriptor
		with that specified for a given location terminating cables and connecting accessories and completing the necessary installation documentation.
UEENEEG027B	Design electrical installations with a LV demand greater than 400 A per phase	This unit covers the design of supply and distribution arrangements, control, protection and selection of equipment for electrical installations with low voltage demand greater than 400 amperes per phase. This encompasses designing schemes for protection of persons and property and correct functioning, compatibility with the supply, and arrangement of circuits, determination of fault levels, effective switchgear, control gear, and protection against over current and over and under voltage and wiring based on calculations to meet required safety and performance standards and functional requirements.
UEENEEG028B	Plan switchboard and control panel layouts	This unit covers selecting and arranging equipment in electrical switchboards and control panels operating at voltages up to 1,000V a.c. or 1500 V d.c. and fault levels not exceeding 20 kA. It encompasses arrangements for protection of persons and property, correct functioning, compatibility with the supply, and intended arrangement of circuits and selection of switchgear, controlgear and protection devices based on calculated and deemed-to-comply solutions and planning documentation.
UEENEEG029B	Overhaul and repair major switchgear / controlgear	This unit covers the overhauling and repairing switchgear/controlgear rated in excess of 20 kA. It requires the ability to establish and document the level of work required, arranging for the overhaul/repair to be carried out, verify compliance of overhauled/repared switchgear/controlgear and complete the necessary documentation.
UEENEEG030B	Design switchboards rated for high fault levels	This unit covers the design of supply and distribution arrangements, control, protection and selection of equipment for switchboards with low voltage demand greater than 400 amperes per phase. This encompasses designing schemes for protection of persons and property and correct functioning, compatibility with the supply, and arrangement of circuits, determination of fault

Unit Code	Unit Title	Scope/Descriptor
		levels, effective switchgear, control gear, and protection against over current over and under voltage and wiring based on calculations to meet required safety and performance standards and functional requirements.
UEENEEG031B	Evaluate performance of electrical apparatus	This unit covers testing of electrical apparatus for compliance with a standard and regulation for the purpose of certification, approval and/or product quality maintenance. It encompasses safe working practices, determining performance requirements, inspecting, and setting up performance tests, evaluating inspection and test results and documenting test outcomes.
UEENEEG032B	Carry out electrical field testing and report findings	This unit covers field testing of electrical systems, circuits and apparatus to determine the cause of faults, malfunctions or compliance. It encompasses working safely and to standards, applying knowledge of electrical measurement and testing, following appropriate test procedures, documenting, evaluating and reporting test results.
UEENEEG033A	Solve problems in single and three phase low voltage electrical apparatus and circuits	This unit covers ascertaining correct operation of single and three phase low voltage electrical apparatus and circuits and solving circuit problems as they apply to servicing, fault finding, installation and compliance work functions. It encompasses safe working practices, apparatus circuit arrangements, issues related to operation, characteristics and protection and solutions to apparatus/circuit problems derived from calculated and measured parameters.
UEENEEG034B	Perform high voltage field switching to a given schedule	This unit covers the carrying out of high voltage switching operations involving the operation of circuit breaking and isolation devices from a given switching schedule and according to enterprise procedures. It also encompasses the process of; communicating with the Switching Control Officer or Electrical Control Officer, isolating the electrical equipment and the line or work site, as well as proving that the area is de-energised and earthed, issuing/accepting electrical permits and the returning of the affected circuits to service.

Unit Code	Unit Title	Scope/Descriptor
UEENEEG035B	Diagnose and rectify faults in a.c. motor drive systems	This unit covers diagnosing and rectifying faults in systems controlling starting, speed, torque, power output, efficient running and braking of a.c. motors. It encompasses safe working practices, interpreting technical data, applying knowledge of a.c. motors operating parameters to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEG036B	Diagnose and rectify faults in d.c. motor drive systems	This unit covers diagnosing and rectifying faults in systems controlling starting, speed, torque, power output, efficient running and braking of d.c. motors. It encompasses safe working practices, interpreting technical data, applying knowledge of d.c. motors operating parameters to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEG037B	Diagnose and rectify faults in energy supply apparatus	This unit covers diagnosing and rectifying faults in apparatus in energy supply and distribution systems. It encompasses safe working practices, interpreting diagrams and technical data, applying knowledge of energy supply apparatus to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEG038B	Diagnose and rectify faults in electrical energy distribution systems	This unit covers diagnosing and rectifying faults in networks supplying electrical energy to consumers. It encompasses safe working practices, interpreting diagrams and technical data, applying knowledge of energy supply and reticulation systems to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEG039B	Diagnose and rectify faults in distributed generation systems	This unit covers diagnosing and rectifying faults in distributed generation systems. It encompasses safe working practices, interpreting diagrams and technical data, applying knowledge of energy supply and reticulation systems to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work

Unit Code	Unit Title	Scope/Descriptor
		activities and outcomes.
UEENEEG040B	Develop engineering solutions for energy supply power transformer problems	This unit covers developing engineering solutions to resolve problems with energy supply system protection. It encompasses working safely, apply extensive knowledge of energy supply power transformer operation and their application, gathering and analysing data, and applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical transformer problems are those encountered in meeting performance requirements and compliance standards, revising a transformer operating parameters and dealing with transformer malfunctions.</i>
UEENEEG041B	Diagnose and rectify faults in servo drive systems	This unit covers diagnosing and rectifying faults in systems controlling servo and drives. It encompasses safe working practices, interpreting technical data, applying knowledge of servo/stepper drives operating parameters to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEG042B	Diagnose and rectify faults in electrical energy supply transmission systems	This unit covers diagnosing and rectifying faults in electrical energy transmission systems. It encompasses safe working practices, interpreting diagrams and technical data, applying knowledge of energy supply and transmission systems to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes
UEENEEG043B	Develop engineering solution for synchronous machine problems	This unit covers developing engineering solutions to resolve problems with synchronous machines. It encompasses working safely, apply extensive knowledge of synchronous machine operation, construction and their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical machine problems are those encountered in meeting performance requirements and compliance standards, revising a machine</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>operating parameters and dealing with machine malfunctions.</i>
UEENEEG044B	Develop engineering solutions for d.c. machine problems	This unit covers developing engineering solutions to resolve problems with d.c. machines. It encompasses working safely, apply extensive knowledge of d.c machine operation and construction and their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical machine problems are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions.</i>
UEENEEG045B	Develop engineering solutions for induction motor problems	This unit covers developing engineering solutions to resolve problems with induction motors. It encompasses working safely, apply extensive knowledge of induction motor operation and construction and their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical motor problems are those encountered in meeting performance requirements and compliance standards, revising a motor operating parameters and dealing with motor malfunctions.</i>
UEENEEG046B	Develop engineering solutions for energy supply system protection problems	This unit covers developing engineering solutions to resolve problems with energy supply system protection. It encompasses working safely, apply extensive knowledge of energy supply system protection operation, protection devices and their application, gathering and analysing data, and applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical protection problems are those encountered in meeting performance requirements and compliance standards, revising a protection operating parameters and dealing with protection</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>malfunctions.</i>
UEENEEG047B	Provide computational solutions to power engineering problems	This unit covers the application of computational processes to solving problems encountered in power engineering. It encompasses working safely, applying problem solving techniques, using a range of mathematical processes, providing solutions to power engineering problems and justifying such solutions. Note: <i>Typical engineering problems are those encountered in meeting requirements in a design brief, meeting performance requirements and compliance standards, revising systems operating parameters and dealing with system malfunctions.</i>
UEENEEG048B	Solve problems in complex multiple path power circuits	This unit covers the determining correct operation of complex series-parallel power circuits and providing solutions as they apply to electrical power engineering work functions. It encompasses working safely, problem solving procedures, including electrical measuring devices, applying appropriate circuit theorems and providing solutions derive from measurements and calculations and providing justification for such solutions. Note: <i>Typical engineering problems are those encountered in meeting requirements in a design brief, meeting performance requirements and compliance standards, revising systems operating parameters and dealing with system malfunctions.</i>
UEENEEG049B	Solve problems in complex polyphase power circuits	This unit covers determining correct operation of complex polyphase power circuits and providing solutions as they apply to electrical power engineering work functions. It encompasses working safely, problem solving procedures, including using electrical measuring devices, applying appropriate circuit theorems and providing solutions derived from measurements and calculations and justification for such solutions.
UEENEEG050B	Wind coils	This unit covers setting up coil former and winding machines and winding coils for static and rotating machines. It encompasses working safely,

Unit Code	Unit Title	Scope/Descriptor
		using hand and powered tools, measuring, applying basic knowledge of electrical circuits, following technical instructions and set procedures and recording work activities
UEENEEG051B	Place and connect coils	This unit covers insulating, placing and connecting coils, in small armatures/stators, transformers and solenoid equipped devices. It encompasses working safely, using hand and powered tools, measuring, applying basic knowledge of electrical circuits, connecting conductors following technical instructions and set procedures and recording work activities
UEENEEG052B	Rewind single phase induction machines	This unit covers dismantling and winding stators for single-phase induction machines. It encompasses working safely, using hand and powered tools, measuring, applying basic knowledge of electrical circuits and winding data, following technical instructions, and set procedures and recording work activities
UEENEEG053B	Rewind three phase induction machines rated for low voltage	This unit covers preparing, placing and connecting coils and insulating three phase stators and rotors. It encompasses working safely, using hand and powered tools, measuring, applying knowledge of electrical circuits and stator windings, using testing devices, applying technical and quality standards and keeping winding records
UEENEEG054B	Rewind direct current machines rated for low voltage	This unit covers preparing, placing and connecting coils and insulating direct current motor armatures and poles. It encompasses working safely, using hand and powered tools, measuring, applying knowledge of electrical circuits and stator windings, using testing devices, applying technical and quality standards and keeping winding records.
UEENEEG055B	Rewind three phase induction machines rated for high voltage to 3.3 kV	This unit covers preparing, placing and connecting coils and insulating three phase stators and rotors rated for high voltage to 3.3 kV. It encompasses working safely, using hand and powered tools, measuring, applying knowledge of electrical circuits and HV stator windings, applying technical and quality standards and keeping

Unit Code	Unit Title	Scope/Descriptor
		winding records.
UEENEEG056B	Rewind three phase induction machines rated for high voltage above 3.3 kV	This unit covers preparing, placing and connecting coils and insulating three phase stators and rotors rated for high voltage above 3.3 kV. It encompasses working safely, using hand and powered tools, measuring, applying knowledge of electrical circuits and HV stator windings, applying technical and quality standards and keeping winding records
UEENEEG057B	Conduct electrical tests on low voltage electrical machines	This unit covers electrical safety and functional testing of electrical machines designed to operate at low voltage. It encompasses working safely, setting up and conducting continuity, insulation and short circuit and inspection and testing of iron circuit, interpreting and documenting test results and any resulting corrective actions
UEENEEG058B	Conduct electrical tests on high voltage electrical machines	This unit covers electrical safety and functional testing of electrical machines designed to operate at high voltage. It encompasses working safely, setting up and conducting continuity, insulation and short circuit and inspection and testing of iron circuit, interpreting and documenting test results and any resulting corrective actions.
UEENEEG059B	Conduct mechanical tests on electrical machines	This unit covers mechanical safety and functional testing of electrical machines and their mechanical components. It encompasses working safely, setting up and conducting tests, taking measurements, interpreting and documenting test results and any resulting corrective actions
UEENEEG060B	Evaluate performance of electrical machines	This unit covers electrical and mechanical safety and performance evaluation of electrical machines across their load range. It encompasses working safely, setting up and conducting evaluation measurements, evaluating performance from measured parameters and documenting results and recommending any resulting corrective actions.
UEENEEG061B	Design and develop modifications to electrical machines	This unit covers the performance and efficiency aspects of electrical machine design as applied to the modification of existing machines. It encompasses designing to given parameters, including those related to safety and efficiency,

Unit Code	Unit Title	Scope/Descriptor
		adhering to compliance standards and compliance assessments and documentation.
UEENEEG062B	Set up and place electrical apparatus and associated circuits into service	This unit covers adjusting and setting up electrical apparatus before placing and checking that they operate as intended. It encompasses working safely and to standards, following specified set up procedures, ensuring safety devices are correctly set, evaluating apparatus and circuit operation against specified parameters and completing necessary documentation
UEENEEG063A	Arrange circuits, control and protection for general electrical installations	This unit covers the arrangement and termination of circuits, control and protection devices and systems for electrical installations operating at voltages up to 1,000 V a.c. or 1,500 V d.c. It encompass knowledge and application of schemes for protection of persons and property, correct functioning, ensuring compatibility with the supply, arranging installation into circuits and selecting and arranging switchgear/controlgear and protective devices to meet compliance requirements and documenting arrangement decisions.
UEENEEG064B	Repair mechanical components of electrical machines	This unit covers the repair of mechanical components of electrical machines, including basic machining. It encompasses working safely and to standards, following written instructions and drawing, selecting and setting up machine tools, basic machining, and measuring and documenting work activities.
UEENEEG065B	Maintain and service traction lifts	This unit covers maintenance and servicing of traction lift systems and equipment. It encompasses working safely, conducting site cleaning, lubricating and painting lift equipment, inspecting of suspension, governors, compensators, floor selector and tappet switch ropes, and carrying out periodic testing on lift safety gear.
UEENEEG066B	Installation and maintenance of escalators, moving walks and tread ways	This unit covers installation and maintenance of escalators, moving walks and tread ways, including repair or replacement of escalator handrails, cleaning, lubricating, replacement and adjustment of mechanical components. It

Unit Code	Unit Title	Scope/Descriptor
		encompasses working safely.
UEENEEG067B	Align and install lift equipment	This unit covers alignment and installation of lift mechanical and electrical equipment. It encompasses working safely, alignment of lift structures such as measuring, marking out and aligning of lift installations including machine room equipment, lift well equipment, the lift car and associated equipment and landing door frames and doors, setting out of multiple lift wells in varying configurations and the installation of well and pit equipment, lift car equipment, superstructure and counterweights, machine room equipment, landing, door frames and door, landing buttons and indicator boxes.
UEENEEG068B	Diagnose and rectify faults in complex lift systems	This unit covers diagnosing and rectifying faults in complex traction lift systems and equipment. It encompasses working safely, replacing and/or adjustment of solid state/electrical circuitry and components, diagnosing and repairing of complex faults in lift circuits and associated components (including governors, brakes, safety gear, safety devices, lift machines, door components and controllers).
UEENEEG069B	Manage electrical projects	This unit covers the management of electrical projects involving design, modifications, installation and/or maintenance of systems and equipment. It encompasses management of safety, budget variation, personnel, resources, critical path timelines and completion documentation.
UEENEEG070B	Plan electrical projects	This unit covers development and documentation of electrical project proposals, milestones and completions. It encompasses, establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines
UEENEEG071C	Install and set up interval metering	This unit covers the installation and set up of interval metering for measurement of energy use by consumers under choice of supplier arrangement. It encompasses working safely and to installation and set-up standards, evaluating the integrity of metering wiring and earthing systems, fixing metering, making power and

Unit Code	Unit Title	Scope/Descriptor
		communication connections, setting meter parameters and completing the necessary documentation.
UEENEEG072C	Investigate and report on electrical incidents	This unit covers investigating and reporting possible electrical cause(s) of incidents resulting electric shock, injury, fatality or property damage. It encompasses working safely, gathering information from an incident site and from witnesses, conducting site tests, gathering and arranging for analysis of forensic evidence, documenting findings and presenting evidence in court.
UEENEEG073A	RESERVED	
UEENEEG074A	RESERVED	
UEENEEG075A	Develop compliance policies and plans to conduct a contracting business	This unit covers the development of plans and policies to ensure regulatory requirements are met in conducting a contracting business, technical, occupational and workplace relation requirements associated with functions and responsibilities of a contracting business. It encompasses applying knowledge of technical regulations and standards, legislated obligations in relation to safety, the environment, heritage sites and employment and human resources. Note: <i>This unit should be undertaken in conjunction with UEENEEE018B Establish, maintain and evaluate OHS systems</i>
UEENEEG076A	Install and replace low voltage current transformer metering	This unit covers the installation and/or replacement of low voltage CT metering for measurement of energy use by consumers under choice of supplier arrangement. It encompasses working safely and to installation and set up standards, evaluating the integrity of metering wiring and earthing systems, fixing metering, making power and communication connections, setting meter parameters and completing the necessary documentation.
UEENEEG101A	Solve problems in electromagnetic devices and related	This unit covers determining correct operation of electromagnetic devices and related circuits and providing solutions as they apply to electrical

Unit Code	Unit Title	Scope/Descriptor
	circuits	installations and equipment. It encompasses working safely, power circuit problems solving processes, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in electromagnetic devices and related circuits.
UEENEEG102A	Solve problems in low voltage a.c. circuits	This unit covers ascertaining correct operation of single and three phase a.c. circuits and solving circuit problems as they apply to servicing, fault finding, installation and compliance work functions. It encompasses safe working practices, multiphase circuit arrangements, issues related to protection, power factor and MEN systems and solutions to circuit problems derived from calculated and measured parameters.
UEENEEG103A	Install low voltage wiring and accessories	This unit covers the installation in building and premises of wiring enclosures, cable support systems, cables and accessories and designed to operate at voltages up to 1,000 V a.c. or 1,500 V d.c. It encompasses working safely and to installation standards, routing cables to specified locations, terminating cables and connecting wiring at accessories and completing the necessary installation documentation.
UEENEEG104A	Install appliances, switchgear and associated accessories for low voltage electrical installations	This unit covers the installation of appliances protection devices, switchgear, controlgear, switchboards, and accessories designed to operate at voltages up to 1,000 V a.c. or 1,500 V d.c. It encompasses working safely and to installation standards, matching appliances and accessories with that specified, making required circuit connections and completing the necessary installation documentation.
UEENEEG105A	Verify compliance and functionality of low voltage general electrical installations	This unit covers inspection and testing to verify whether an electrical installation is safe and complies with all requirements. It encompasses working safely, visual inspections and mandatory, optional and functional testing following verification procedures, identifying non-compliance defects and mandatory reporting requirements.

Unit Code	Unit Title	Scope/Descriptor
UEENEEG106A	Terminate cables, cords and accessories for low voltage circuits	This unit covers the termination of cables and cords and their conductors at accessories and current-using devices designed to operate at voltages up to 1,000 V a.c. or 1,500 V d.c. It encompasses working safely and to standards, understanding wiring system and cable types and applications, selecting appropriate termination accessories, preparing and terminating cables and cords, terminating cables/cord conductors and ensuring completed termination complies with requirements.
UEENEEG107A	Select wiring systems and cables for low voltage general electrical installations	This unit covers selecting wiring systems and cables for electrical installations operating at voltages up to 1,000V a.c. or 1,500 V d.c. It encompass knowledge and application of wiring systems and cable types, selecting wiring system compatible with the installation conditions, selecting cables that comply with required current-carrying capacity and voltage drop and earth fault-loop impedance limitations, coordination between protective devices and conductors and documenting selection decisions
UEENEEG108A	Trouble-shoot and repair faults in low voltage electrical apparatus and circuits	This unit covers trouble-shooting and repairing faults in electrical apparatus and interconnecting circuits and equipment operating at voltages up to 1,000 V a.c. or 1,500 V d.c. It encompasses working safely, reading circuit diagrams, sketching diagrams from traced wiring, logically applying fault finding procedures, conducting repairs and completing the necessary service documentation.
UEENEEG109A	Develop and connect electrical control circuits	This unit covers developing, connecting and functionally testing electrical power and control circuits that perform specific control functions. It encompasses working safely; developing schematic/ladder diagrams and converting them to wiring diagrams; selecting and connecting contactors and control devices to perform a specific function.
UEENEEG149A	Provide engineering solutions to problems in complex polyphase	This unit covers determining correct operation of complex polyphase power circuits and providing solutions as they apply to electrical power

Unit Code	Unit Title	Scope/Descriptor
	power circuits	engineering work functions. It encompasses working safely, problem solving procedures, including using electrical measuring devices, applying appropriate circuit theorems and providing solutions derived from measurements and calculations and justification for such solutions.
UEENEEG171A	Install, set up and commission interval metering	This unit covers the installation, set up and commission of interval metering for measurement of energy use by consumers under choice of supplier arrangement. It encompasses working safely and to installation and set up standards, evaluating the integrity of metering wiring and earthing systems, fixing metering, making power and communication connections, setting meter parameters and completing the necessary documentation.

Discipline H – Electronic

Unit Code	Unit Title	Scope/Descriptor
UEENEEH001B	Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies	This unit deals with the repair of computer equipment by replacement of slot/plug connected modules/sub-assemblies. It encompasses safe working practices, following written and oral instruction and procedures, basic testing techniques, dismantling and assembling apparatus and disconnecting and reconnecting components.
UEENEEH002B	Carry out basic repairs to electronic apparatus by replacement of components	This unit deals the replacement of electronic components, cabling and sub systems of electronic apparatus. It encompasses safe working practices, following written and oral instruction and procedures, basic testing and techniques, dismantling and assembling apparatus and disconnecting and reconnecting components.
UEENEEH003B	Carry out routine repairs to business equipment	This unit covers the confirmation of predictable faults and repair of such faults, including replacement of mechanical components and of discrete and integrated

Unit Code	Unit Title	Scope/Descriptor
		components of business electronic equipment. It encompasses safe working practices, following written and oral instruction and routine testing and repair procedures, verifying equipment operation and reporting.
UEENEEH004B	Set up and test residential audio/video equipment	This unit covers setting up of non-fixed audio and video equipment as directed in user manuals in a residential or business environment. It encompasses safe working practices, connection and secure and optimum placement of system components, following written and oral instruction and procedures and customer relations.
UEENEEH005B	Verify compliance and functionality of custom electronic installations	This unit covers testing and visual inspection for verifying that a custom electronic system and components are safe and comply with requirements and functions as intended. It encompasses working safely, conducting compliance tests, conducting visual inspections, identifying non-compliance defects and mandatory reporting requirements.
UEENEEH006B	Assemble and set up fixed audio/video components and systems in buildings and premises	This unit covers installing of fixed audio/video components and systems in a residential or business environment. It encompasses safe working practices; secure placement and connection of system components, following written and oral instruction and procedures and customer relations.
UEENEEH007B	Carry out repairs of predictable faults in general electronic apparatus	This unit covers identifying predictable faults and repairing by replacement of subassemblies in electronic apparatus. It encompasses safe working practices, interpreting circuit diagrams and service manuals, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation
UEENEEH008B	Assemble and erect reception antennae and	This unit covers the installation, positioning and securing of terrestrial and satellite arrays

Unit Code	Unit Title	Scope/Descriptor
	signal distribution equipment	and dishes and associated amplifiers and the reticulation of cables and connection of multiple access outlets and associated equipment. It encompasses safe working practices, selection of antennae and distribution components, installation techniques, use of testing devices and following written and oral instruction and procedures.
UEENEEH009B	Set up and test gaming/games equipment	This unit covers the setting up of electronic gaming and games equipment to manufacturer instructions in compliance with regulations. It encompasses safe working practices, connection and secure placement of gaming/games equipment, following written and oral instruction and procedures and customer relations
UEENEEH010B	Install commercial audio/video system components	This unit covers installation of components for audio/video facilities in buildings and premises. It encompasses working safely and to specifications and standards, matching equipment with that specified for a given location, terminating and interconnecting cables/conductors and completing the necessary installation documentation.
UEENEEH011B	Troubleshoot d.c. power supplies with single phase input	This unit covers determining correct operation of independent power supplies and power supply sections of electronic apparatus. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in d.c. power supplies with single phased input
UEENEEH012B	Troubleshoot digital subsystems	This unit covers determining correct operation of digital systems. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in digital

Unit Code	Unit Title	Scope/Descriptor
		components circuits.
UEENEEH013B	Troubleshoot amplifiers	This unit covers determining correct operation of amplifiers. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in amplifier sections/circuits.
UEENEEH014B	Troubleshoot frequency dependent circuits	This unit covers determining correct operation of resonance circuits used in electronic apparatus. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in resonance circuits.
UEENEEH015B	Develop software solutions in microcontroller based systems	This unit covers determining correct operation of microcontroller based systems software. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in microprocessor hardware and firmware.
UEENEEH016B	Find and repair faults in the microwave amplifier sections in electronic apparatus	This unit covers fault finding and repair of microwave amplifier sections in electronic apparatus. It encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH017B	Carry out repairs of predictable faults in audio and video replay/recording apparatus	This unit covers identifying predictable faults and repairing by replacement of subassemblies in CD, DVD and tape replay/recording apparatus. It encompasses safe working practices, interpreting circuit diagrams and service manuals, applying logical fault finding procedures, conducting

Unit Code	Unit Title	Scope/Descriptor
		repairs, safety and functional testing and completing the necessary service documentation
UEENEEH018B	Find and repair faults in electronic apparatus	This unit covers fault finding and repairing of general electronic apparatus. It encompasses safe working practices, consulting apparatus service manuals, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH019B	Carry out repairs of predictable faults in television receivers	This unit covers identifying predictable faults and their repair by replacement of subassemblies in televisions. It encompasses safe working practices, interpreting circuit diagrams and service manuals, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH020B	Find and repair faults in gaming and games equipment	This unit covers fault finding and repair of gaming equipment. It encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH021B	Find and repair faults in high volume office equipment	This unit covers fault finding and repair in high volume photo copiers (40 to 80 ppm), fax machines etc. It encompasses safe working practices, interpreting electrical and mechanical diagrams, applying knowledge of office equipment to logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation
UEENEEH022B	Find and repair faults in remote control apparatus	This unit covers fault finding and repair in remote control apparatus and devices. It encompasses safe working practices, interpreting circuit diagrams, applying knowledge of remote control to logical fault finding procedures, conducting repairs,

Unit Code	Unit Title	Scope/Descriptor
		safety and functional testing and completing the necessary service documentation.
UEENEEH023B	Find and repair faults in microwave heating apparatus	This unit covers fault finding and repair in microwave ovens. It encompasses safe working practices, interpreting circuit diagrams, applying knowledge of microwave heating to logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH024B	Carry out repairs of predictable faults in audio components	This unit covers identifying predictable faults and repairing by replacement of subassemblies in audio components. It encompasses safe working practices, interpreting circuit diagrams and service manuals, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation
UEENEEH025B	Provide solutions to single phase electronic power control problems	This unit covers solving problems with electronic aspects of single phase power control devices and circuits. It encompasses safe working practices, interpreting diagrams, applying knowledge of electronic power control devices and their application, using effective problem solving techniques, safety and functional testing and reporting work activities and outcomes.
		Note: <i>Typical single phase electronic power control problems are those encountered in meeting performance requirements and compliance standards, revising control operating parameters and dealing with control malfunctions.</i>
UEENEEH026B	Provide solutions to polyphase electronic power control problems	This unit covers solving problems with electronic aspects of polyphase power control devices and circuits. It encompasses safe working practices, interpreting diagrams, applying knowledge of electronic power control devices and their application, using effective problem solving techniques, safety and functional testing and reporting work

Unit Code	Unit Title	Scope/Descriptor
		activities and outcomes.
		Note: <i>Typical polyphase electronic power control problems are those encountered in meeting performance requirements and compliance standards, revising control operating parameters and dealing with control malfunctions.</i>
UEENEEH027B	Commission commercial radio frequency (RF) transmission and reception systems	This unit covers the setting up and adjusting of RF transmission and reception systems for optimum performance. It encompasses safe working practices, signal testing and analysis, adjusting equipment, following procedures and documenting.
UEENEEH028B	Install microwave and antennae and waveguides	This unit covers the installation and testing of waveguides and antennae for microwave communications systems. It encompasses working safely and to installation standards, matching hardware and accessories with that specified for a given location, installation techniques, pre commission adjustment of antennas and waveguides and following instruction and procedures.
UEENEEH029B	Diagnose and rectify faults in navigation systems	This unit covers fault finding and repair of faults in navigation systems. It encompasses safe working practices, interpreting circuit diagrams, applying logical diagnostic methods and knowledge of navigation system components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH030B	Diagnose and rectify faults in satellite-based surveillance and observation systems	This unit covers fault finding and repair of faults in surveillance and observation systems. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of surveillance system components, rectify faults, safety and functional testing and completing the necessary service documentation.
UEENEEH031B	Diagnose and rectify faults in radar apparatus and	This unit covers fault finding and repair of faults in radar apparatus and systems. It

Unit Code	Unit Title	Scope/Descriptor
	systems	encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of radar system components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH032B	Diagnose and rectify faults in global positioning systems	This unit covers fault diagnosis and rectification in global positioning systems. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of GPS system components, rectify faults, safety and functional testing and completing the necessary service documentation.
UEENEEH033B	Diagnose and rectify faults in telecommunication apparatus and systems	This unit covers fault diagnosis and rectification in telecommunication apparatus and systems. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of telecommunication system components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH034B	Diagnose and rectify faults in electronic medical equipment	This unit covers diagnosing and rectifying faults in the electronic aspects of electronic medical equipment. It encompasses safe working practices, interpreting process and circuit diagrams, applying knowledge of medical process controls to logical diagnosis procedures, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH035B	Design custom electronic installations	This unit covers the design of home entertainment aspects of custom electronic installations and energy control systems. It encompasses developing control scenarios based on a design brief, negotiating with architect/designer, builder and client, applying knowledge of electronic audio/video components, home theatre acoustics and relevant electrical installation regulations, developing design drawings and

Unit Code	Unit Title	Scope/Descriptor
		obtaining approval for final design.
UEENEEH036B	Design commercial audio/video installations	This unit covers the design of audio/video facilities in meeting rooms, classrooms, studios, theatres and halls etc. It encompasses applying knowledge of electronic audio/video components, acoustics and visual displays, analogue and digital communication, multimedia storage and reproduction, negotiating with clients and others and documenting design.
UEENEEH037B	Program and commission commercial audio/video systems	This unit covers testing, adjusting and balancing of audio/video facilities in meeting rooms, classrooms, studios, theatres and halls etc. It encompasses working safely and to specifications, measuring and adjusting necessary parameters to meet specified performance, working with clients and documenting and certifying set performance parameters.
UEENEEH038B	Find and repair faults in complex power supplies	This unit covers fault finding and repair of regulated and switch mode power supplies. It encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH039B	Troubleshoot basic amplifiers	This unit covers determining correct operation of basic amplifier circuits. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in basic amplifier circuits.
UEENEEH040B	Diagnose and rectify faults in sonar apparatus and systems	This unit covers fault finding and repair of faults in sonar apparatus and systems. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of sonar system components, rectify faults, safety and functional testing and completing the

Unit Code	Unit Title	Scope/Descriptor
		necessary service documentation.
UEENEEH041B	Manage electronics/computer systems projects	This unit covers the management and implementation of electronic/computer systems projects involving design, modifications, installation, and/or maintenance of systems and equipment. The unit encompasses management of safety, budget variation, personnel, resources, and critical path timelines and completion documentation.
UEENEEH042B	Troubleshoot oscillators	This unit covers determining correct operation of discrete component and modularised oscillators. It encompasses working safely, problem solving procedures, including the use of; voltage, current, resistance and phase measuring devices, providing solutions derived from measurements and calculations to predictable problems in oscillators.
UEENEEH043B	Diagnose and rectify faults in digital subsystems of electronic controls	This unit covers diagnosing and rectifying faults in digital components of electronic control systems. It encompasses safe working practices, interpreting diagrams and technical data, applying knowledge of digital subsystems to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEH044B	Diagnose and rectify faults in analogue circuits and components in electronic control systems	This unit covers diagnosing and rectifying faults in analogue applications in electronic control systems. It encompasses safe working practices, interpreting diagrams and technical data, applying knowledge of analogue circuits and components to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
		Note: Examples of analogue applications are power and differential amplifiers, integrators, comparators function generators precision rectifiers, active filters.

Unit Code	Unit Title	Scope/Descriptor
UEENEEH045B	Develop solutions to analogue electronic problems	This unit covers developing engineering solutions to resolve problems with analogue electronics. It encompasses working safely, apply extensive knowledge of analogue electronics circuit and device operation and their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical analogue electronic problems are those encountered in meeting performance requirements and compliance standards, revising an analogue electronic operating parameters and dealing with analogue electronic malfunctions.</i>
UEENEEH046B	Solve fundamental problems in electronic communications systems	This unit covers ascertaining correct operation of communications systems and solving fundamental system problems as met in engineering support work functions. It encompasses working safely, problem solving techniques, and the use of a range of measuring devices, providing solutions derived from measurements to predictable problems in electronic communication systems.
UEENEEH047B	Assess compliance of electronic apparatus	This unit covers assessing electronic apparatus for compliance with a standard and/or regulation for the purpose of certification or approval. It encompasses safe working practices, determining specified requirements, inspecting, and setting up performance tests, evaluating inspection and test results and documenting evaluation outcomes.
UEENEEH048B	Design and develop advanced digital systems	This unit covers the design and development of advanced digital systems. It encompasses working safely, following design brief, applying knowledge of digital components/devices, interpreting device/component specifications, constructing prototype devices, applying programming techniques to programmable

Unit Code	Unit Title	Scope/Descriptor
		devices, testing developed system prototype operation, verifying compliance of the design against the final brief, and documenting design and development work.
UEENEEH049B	Develop solutions to audio electronic problems	This unit covers developing engineering solutions to resolve problems with audio electronics. It encompasses working safely, applying extensive knowledge of audio electronics circuits and device operation and application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical audio electronic problems are those encountered in meeting performance requirements and compliance standards, revising audio electronic operating parameters and dealing with audio electronic malfunctions.</i>
UEENEEH050B	Assemble and set up basic wired and wireless security systems	This unit covers installing electronic security systems with up to 50 connected devices typically used in single domestic and small commercial premises. It encompasses, working safely and to standards, following oral and written instructions and procedures, securely placing and connecting security system components, and applying customer relation protocols.
UEENEEH051B	Install large wired and wireless security systems	This unit covers installing, entering instructions and testing of electronic security systems with in excess of 50 connected devices in building, premises and precincts. It encompasses working safely and to standards, following and job specifications, securely placing and connecting security system components, and applying customer relation protocols.
UEENEEH052B	Enter instructions and test basic wired and wireless security systems	This unit covers entering instructions and testing electronic security systems with up to 50 connected devices typically used in single domestic and small commercial premises. It encompasses safe working practices, basic

Unit Code	Unit Title	Scope/Descriptor
		programming as directed in user manuals, adjusting security devices, system testing and following written and oral instruction and procedures and customer relations.
UEENEEH053B	Program and test large wired and wireless security systems	This unit covers programming functions and testing electronic security systems with in excess of 50 connected devices in buildings, premises and precincts. It encompasses safe working practices, programming, adjusting security devices, system testing and following written and oral instruction and procedures and customer relations.
UEENEEH054B	Program and commission commercial security alarm systems	This unit covers installation and testing of security alarm system typically used in commercial buildings and premises. It encompasses working safely, following specifications and security access scenarios, programming security alarm functions, using circuit diagrams and schedules, and providing as-programmed document.
UEENEEH055B	Program and commission commercial security access control systems	This unit covers installation and testing of security access control system typically used in commercial buildings and premises. It encompasses working safely, following specifications and security access scenarios, programming security functions, using circuit diagrams and schedules, and providing as-programmed document.
UEENEEH056B	Program and commission commercial security closed circuit television (CCTV) systems	This unit covers installation and testing of security CCTV systems typically used in commercial buildings and premises. It encompasses working safely, following specifications and security observation scenarios, programming security functions, using circuit diagrams and schedules, and providing as-programmed document
UEENEEH057B	Develop basic integrated security systems plan	This unit covers integrating security components to form a complete security system with up to 100 connected intrusion and access devices and based on common security scenarios. It encompasses applying knowledge of common security scenarios and

Unit Code	Unit Title	Scope/Descriptor
		security network standards and protocols, selecting network topology and physical media, disaster recovery planning, performance management and documentation of work activities
UEENEEH058B	Design integrated security systems for a single site	This unit covers integrating security components to form a security system with multiple and interrelated subsystems. It encompasses applying knowledge of security scenarios and security network standards and protocols, selecting network topology and physical media, disaster recovery planning, performance management and negotiating with clients and others and documenting design.
UEENEEH059B	Design integrated complex security systems	This unit covers integrating security components to form a complex security system across multiple sites with multiple and related subsystems and remote monitoring and control. It encompasses applying knowledge of security scenarios and security network standards and protocols, selecting network topology and physical media, disaster recovery planning, performance management and negotiating with clients and others and documenting design.
UEENEEH060B	Plan electronic projects	This unit covers the development and documentation of electronics project proposals, milestones and completions. It encompasses, establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines.
UEENEEH061B	Position and terminate fire detection and warning system apparatus	This unit covers installing electronic fire detection and warning systems in buildings and premises. It encompasses, working safely and to standards, following oral and written instructions and procedures, securely placing and connecting fire detection system and warning components and applying customer relation protocols.

Unit Code	Unit Title	Scope/Descriptor
UEENEEH062B	Verify compliance and functionality of fire protection installations	This unit covers testing and visual inspection to verify that a fire protection system and components are safe and comply with requirements and functions as intended. It encompasses working safely, conducting compliance tests, conducting visual inspections, identifying non-compliance defects and mandatory reporting requirements.
UEENEEH063B	Enter and verify programs in preparation for commissioning fire protection systems	This unit covers programming fire protection systems that include multiple connected detection, warning and fire control devices and remote monitoring. It encompasses working safely, applying knowledge of fire protection scenarios, using fire protection standards and protocols, entering system instructions, testing functionality of fire protection components and system operation, and documentation of commissioning activities.
UEENEEH064B	Commission commercial fire protection systems	This unit covers commissioning fire protection systems that include multiple connected detection, warning and fire control devices and remote monitoring. It encompasses working safely, applying knowledge of fire protection scenarios, using fire protection standards and protocols, entering system instructions, testing functionality of fire protection components and system operation, and documentation of commissioning activities.
UEENEEH065B	Find and repair faults in fire protection systems	This unit covers fault finding and repair of fire protection systems that include multiple connected detection, warning and fire control devices and remote monitoring to the sub-assembly level. It encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH066B	Fault find Microcontroller	This unit covers determining correct

Unit Code	Unit Title	Scope/Descriptor
	based hardware	operation of microcontroller systems. It encompasses working safely, problem solving procedures, providing solutions derived from measurements and calculations to predictable faults in microcontroller hardware.
UEENEEH067B	Commission electronics and communications systems	This competency standard unit covers undertaking commissioning procedures of electronics and communications systems to comply with predetermined parameters and delivery to client. It encompasses safe working practices, system parameter testing, analysis and adjusting to assure optimum performance, following procedures, and documenting final operating parameters and settings.
UEENEEH068B	Modify-redesign of electronics and communications system	This competency standard unit covers the modification and redesign of electronics and communications systems to augment existing systems for clients. It encompasses safe working practices, system parameter reconfiguration, analysis to assure optimum performance, following procedures, and documenting final modifications and settings.
UEENEEH069B	Solve problems in electronic circuits	This competency standard unit covers determining correct operation of single source parallel and series-parallel circuits and providing solutions as they apply to various electronic work functions. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in multiple path circuit.
UEENEEH070B	Terminate and connect components, conductors, wiring and cables for electronic circuits	This unit covers the implementation, performance and evaluation of component connections and terminations of conductors, wiring, cables, and other recognised mediums. It encompasses implementing reliable termination and connection processes, working to specifications, safe use of connection and termination tools, safe use

Unit Code	Unit Title	Scope/Descriptor
		of termination and/or soldering devices, selection and placement of components, termination and connection preparation, termination and connection techniques, and evaluating termination and connection work.
UEENEEH071B	Find and repair faults in television receivers	This unit covers fault finding and repair of faults in signal processing and scanning and deflection sections of television receivers. It encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH072C	Find and repair faults in communication systems	This unit covers fault finding and repair of radio frequency sections in electronic apparatus. The unit encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH073B	Find and repair faults in professional audio reproduction components	This unit covers fault finding and repair of professional and high-end audio amplifiers, pre-amplifiers, receivers, graphic equalisers, speakers. It encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH074B	Find and repair faults in audio/video recording equipment	This unit covers fault finding and repair of ACR, CD, VCR and DVD players/recorders. It encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEH075B	Find and rectify faults and malfunctions in security	This unit covers fault finding and repair of security system installations. It encompasses safe working practices, interpreting circuit

Unit Code	Unit Title	Scope/Descriptor
	system installations	diagrams, applying knowledge of security systems to logical fault finding procedures, rectifying faults/malfunctions, and safety and functional testing and completing the necessary service documentation.
UEENEEH076B	Diagnose and rectify faults in display circuits	This unit covers fault finding and repair of faults in cathode ray tubes, liquid crystal and plasma display circuits. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of display circuit components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH077B	Diagnose and rectify faults in recording and replay apparatus	This unit covers fault finding and repair of faults in SACD, DVD and DVDA recording and replay apparatus. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of recording and replay apparatus components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH078B	Diagnose and rectify faults in camera circuits	This unit covers fault finding and repair of faults in camera circuits. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of camera circuit components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH079B	Diagnose and rectify faults in digital television apparatus	This unit covers fault finding and repair of faults in digital television apparatus. It encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of digital television apparatus circuit components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH080B	Diagnose and rectify faults in digital transmission	This unit covers fault finding and repair of faults in digital transmission systems. It

Unit Code	Unit Title	Scope/Descriptor
	systems	encompasses safe working practices, interpreting diagrams, applying logical diagnostic methods and knowledge of digital transmission systems circuit components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH081B	Design printed circuit boards	This unit covers the design of printed circuit boards. The unit encompasses application of knowledge of electronic circuits, components, component assemblies, developing alternative design schemes based on design brief, customer relations and documenting designs.
UEENEEH082B	Develop solutions to RF amplifier problems	This unit covers developing engineering solutions to resolve problems with RF amplifiers. It encompasses working safely, applying extensive knowledge of RF amplifier circuits and device operation and their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives. Note: <i>Typical RF amplifiers electronic problems are those encountered in meeting performance requirements and compliance standards, revising an RF amplifier electronic operating parameters and dealing with RF amplifiers electronic malfunctions.</i>
UEENEEH083B	Analyse the performance of wireless-based electronic systems	This unit covers the analysis of wireless based electronic systems to provide solutions to mobile communications performance. It encompasses working safely, applying extensive knowledge of mobile communications parameters, gathering and analysing data, applying problem solving techniques, developing and documenting results and solutions for use in design work.
UEENEEH084B	Modify DSP based sub-systems	This unit covers modifying electronic DSP based sub-systems. It encompasses working safely, following design brief, apply knowledge of digital and analogue devices,

Unit Code	Unit Title	Scope/Descriptor
		interpreting device specifications, constructing prototypes, testing developed system prototype operation and documenting design and development work.
UEENEEH085B	Design a signal-conditioning subsystem	This unit covers designing electronic data acquisition systems incorporating sensors and transducers and digital and analogue elements. It encompasses working safely, following design brief, apply knowledge of digital and analogue devices, interpreting device specifications, constructing prototypes, testing developed system prototype operation and documenting design and development work
UEENEEH086B	Commission microwave and satellite communication systems	This unit covers the setting-up and adjusting of satellite communication systems for optimum performance. It encompasses safe working practices, signal testing and analysis, adjusting equipment, following procedures and documenting.
UEENEEH087B	Solve problems in musical equipment circuits	This competency standard unit covers determining correct operation of valve instrument amplifiers and associated musical instrument circuits. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in musical equipment circuits and troubleshooting.
UEENEEH088B	Design and develop electronics/computer systems project	This unit covers the design and development of electronics/computer systems projects. It encompasses working safely, designing, constructing, and recording, evaluating and reporting of an electronics/computer systems design project.
UEENEEH089A	RESERVED	
UEENEEH090A	Provide solutions to air traffic control system	This unit covers providing solutions to resolve problems in air traffic control systems. The unit encompasses safe working

Unit Code	Unit Title	Scope/Descriptor
	problems	practices, interpreting diagrams, applying knowledge of air traffic control systems and their application, using effective problem solving techniques, safety and reporting work activities and outcomes. Note. Typical systems could be Air Traffic Management (ATM), Voice Switching and Control (VSCS), Data and Communications Networks, Aeronautical Fixed Telecommunications Network (AFTN), Control Maintenance Monitoring (CMM), Operational Display Suite (ODS), Air Situation Display (ASD), Tower Situational Awareness Display (TSAD), Aeronautical Reference Data Display and Distribution System (ARDDDS), back up to the above systems, Buildings & Services and Navigational Aids.
UEENEEH091A	Diagnose and rectify faults in air navigation systems	This unit covers fault finding, repairing of faults and commissioning of air navigation systems. The unit encompasses safe working practices, interpreting circuit diagrams, applying logical diagnostic methods and knowledge of navigation system components, rectifying faults, safety and functional testing and completing the necessary service documentation.
UEENEEH092A	Develop engineering solutions for air surveillance apparatus and systems	This unit covers development of engineering solutions for air surveillance apparatus and systems. The unit encompasses safe working practices, interpreting diagrams, applying logical engineering solution methods and knowledge of air surveillance apparatus and systems, safety and functional testing, and completing the necessary service documentation.

Discipline I – Instrument

Unit Code	Unit Title	Scope/Descriptor

Unit Code	Unit Title	Scope/Descriptor
UEENEEI001B	Install and set up transducers and sensing devices	This unit covers the installation and setting up of transducers and sensors. It encompasses working safely and to installation standards, matching equipment with that specified for a given location, placing and securing equipment accurately, making required pneumatic, hydraulic and electrical circuit connections, adjusting and setting up devices to specifications and manufacturer instructions and completing the necessary installation documentation.
UEENEEI002B	Solve problems in pressure measurement systems	This unit covers setting up pressure measuring systems and providing solutions to pressure measurement problems as they apply to various process and control work functions. It encompasses working safely, setting up and calibrating pressure measuring systems, problem solving techniques, the use of a range of measuring devices, providing solutions derived from measurements and calculations to predictable problems in pressure measurement systems.
UEENEEI003B	Solve problems in density/level measurement systems	This unit covers setting up density/level measuring systems and providing solutions to density/level measurement problems as they apply to various process and control work functions. It encompasses working safely, setting up and calibrating density/level measuring systems, problem solving techniques, the use of a range of measuring devices, providing solutions derived from measurements and calculations to predictable problems in density/level measurement systems
UEENEEI004B	Solve problems in flow measurement systems	This unit covers setting up flow measuring systems and providing solutions to flow measurement problems as they apply to various process and control work functions. It encompasses working safely, setting up and calibrating flow measuring systems, problem solving techniques, the use of a range of measuring devices, providing solutions derived from measurements and calculations

Unit Code	Unit Title	Scope/Descriptor
		to predictable problems in flow measurement systems.
UEENEEI005B	Solve problems in temperature measurement systems	This unit covers setting up temperature measuring systems and providing solutions to temperature measurement problems as they apply to various process and control work functions. It encompasses working safely, setting up and calibrating temperature measuring systems, problem solving techniques, the use of a range of measuring devices, providing solutions derived from measurements and calculations to predictable problems in temperature measurement systems.
UEENEEI006B	Solve problems in process controllers, transmitters and converters	This unit covers providing solutions to predictable problems in process controllers, transmitters and converters. It encompasses working safely, applying logical problem solving procedures, evaluating performance, the use of measuring devices, providing solutions to predictable control problems, and documenting solutions.
UEENEEI007C	Install process instrumentation and control cabling and tubing	This unit covers the installation and termination of instrument and control cabling and tubing for chemical, industrial or food processing systems or equipment used in medical procedures. It encompasses working safely and to standards, routing cables and tubing to specified locations, terminating cables and tubing and connecting wiring at accessories and at instruments and control apparatus and completing the necessary installation documentation.
UEENEEI008C	Install process control apparatus and associated equipment	This unit covers the installation of measurement, monitoring and control apparatus and associated equipment. It encompasses working safely and to installation standards, matching equipment with that specified for a given location, placing and securing equipment accurately, making required pneumatic, hydraulic and electrical circuit connections and completing

Unit Code	Unit Title	Scope/Descriptor
		the necessary installation documentation.
UEENEEI009B	Set up process measuring and control instruments	This unit covers the calibration of instruments for measuring chemical and physical characteristics as it applies to the control of processes. It encompasses working safely and to standards, following set-up and calibration procedures, testing and reporting.
UEENEEI010B	Set up and adjust process control loops	This unit covers basic setting up and adjustment of controllers and control elements to specified output. It encompasses working safely and to standards, following set-up and adjustment procedures, applying knowledge of process requirements, testing and reporting
UEENEEI011B	Find and rectify faults in process control valve and associated equipment	This unit covers finding and repairing faults in control valves, actuators and positioners. It encompasses working safely, interpreting valve specifications, applying knowledge of control valve operating parameters, conducting tests and repairs and completing the necessary service documentation.
UEENEEI012B	Verify compliance and functionality of process control installations	This unit covers pre-commissioning testing and visual inspection for verifying that installed process control apparatus in non-hazardous areas is safe and complies with requirements. It encompasses procedures for safely conducting safety tests, conducting visual inspections, identifying non-compliance defects and reporting requirements.
UEENEEI013B	Select equipment for process control systems	This unit covers selecting equipment for process control systems to meet performance standards. It encompasses the adoption of process control schemes that meet safety and process requirements, selection of control equipment and interconnecting cabling and tubing/piping based on calculated and deemed-to-comply arrangements.
UEENEEI014B	Find and rectify faults in process control systems	This unit covers finding and rectifying faults in process control apparatus and systems. It encompasses safe working practices, interpreting process and circuit diagrams,

Unit Code	Unit Title	Scope/Descriptor
		applying knowledge of process controls to logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.
UEENEEI015B	Find and rectify faults in medical equipment control systems	This unit covers finding and rectifying faults in medical equipment systems. It encompasses safe working practices, interpreting process and circuit diagrams, applying knowledge of medical process controls to logical fault finding procedures, effective repairs, safety and functional testing and completing the necessary service documentation.
UEENEEI016A	RESERVED	
UEENEEI017B	Calibrate and test measuring instruments	This unit covers calibration, adjustment and testing of measuring instruments. It encompasses working safely and to standards, following calibration and adjustment procedures, applying knowledge of parameters to be measured, testing and reporting.
UEENEEI018A	RESERVED	
UEENEEI019B	Set up field control devices	This unit covers setting up field control devices such as transducers, sensors, and actuators. It encompasses working safely, following design brief, applying knowledge of device operating principles, interpreting device specifications, following manufacturer's set up specifications, testing device operation and documenting set up parameters.
UEENEEI020B	Provide solutions to problems in basic industrial control systems	This unit covers solving problems in basic industrial control systems. It encompasses safe working practices, interpreting process and circuit diagrams, applying knowledge of industry controls to problem solving techniques, safety and functional testing and completing the necessary documentation. Note: <i>Typical basic industrial control</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>system problems are those encountered in meeting performance requirements and compliance standards, revising control operating parameters and dealing with control malfunctions.</i>
UEENEEI021B	Find and repair faults in measuring and analysis systems	This unit covers finding and repairing faults in measuring and analysis systems. It encompasses working safely, reading circuit diagrams and device specifications, applying logical fault finding procedures, conducting repairs and completing the necessary service documentation.
UEENEEI022B	Assist in commissioning process control systems	This unit covers commissioning of process control systems. It encompasses working safely and with others, complying with requirements, applying knowledge of process and control components, pre-commissioning tests, following start up procedures, checking and adjusting components and controls to ensure efficient and safe operation and completing commissioning documentation
UEENEEI023B	Design electronic control systems	This unit covers designing electronic control systems incorporating closed loop and digital and analogue elements. It encompasses working safely, following design brief, applying knowledge of digital and analogue devices, interpreting device specifications, constructing prototypes, using appropriate development software, applying programming techniques, testing developed system prototype operation and documenting design and development work.
UEENEEI024A	RESERVED	
UEENEEI025B	Provide solutions to fluid circuit operations	This unit covers the solution to problems associated with the operation of fluid controlled circuits. It encompasses working safely, problem solving procedures, including using measuring instruments, applying appropriate circuit theorems and providing solutions derived from measurements and calculations and justification for such

Unit Code	Unit Title	Scope/Descriptor
		solutions.
UEENEEI026B	Provide solutions to pneumatic/hydraulic system operations	This unit covers the set up and maintenance of pneumatic and hydraulic systems. It encompasses working safely, problem solving procedures, including using measuring instruments, applying appropriate circuit theorems and providing solutions derived from measurements and calculations and justification for such solutions.
UEENEEI027B	Analyse complex electronic circuits controlling fluids	This unit covers the analysis of complex electronic control circuits that integrate with the operation of fluid control systems on machinery. It encompasses working safely, applying extensive knowledge of equipment and electronic and fluid control circuit operations, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical problems are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions.</i>
UEENEEI028B	Set up controls on complex fluid systems	This unit covers the setting up, adjustment, maintenance and modification of electronically controlled complex systems that are integrated with hydraulic devices. It encompasses working safely, applying extensive knowledge of complex circuits designed to operate fluid systems and the integration to hydraulics, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical problems are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions.</i>

Unit Code	Unit Title	Scope/Descriptor
UEENEEI029B	Set up electronically controlled mechanically operated complex systems	This unit covers the setting up, adjustment, maintenance and modification of electronically controlled mechanically operated complex systems. It encompasses working safely, applying extensive knowledge of electronic circuits and the integration to mechanically operated equipment and systems, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical problems are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions.</i>
UEENEEI030B	Set up electronically controlled robotically operated complex systems	This unit covers the setting up, adjustment, maintenance and modification of electronically controlled robotically operated complex systems. It encompasses working safely, applying extensive knowledge of electronic circuits and the integration to robotically operated equipment and systems, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.
		Note: <i>Typical circuits are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions.</i>
UEENEEI031A to UEENEEI033A	RESERVED	
UEENEEI034B	Manage control projects	This unit covers the management of control projects involving design, modifications, installation, and/or maintenance of systems and equipment. It encompasses the management of safety, budget variation, personnel, resources, critical path timelines and completion of documentation.

Unit Code	Unit Title	Scope/Descriptor
UEENEEI035B	Plan control projects	This unit covers the development and documentation of control project proposals, milestones and completions. It encompasses, establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines.
UEENEEI036B	Manage automated systems projects	This unit covers the management of automated systems projects involving design, modifications, installation, and/or maintenance of systems and equipment. It encompasses management of safety, budget variation, personnel, resources, critical path timelines and completion of documentation.
UEENEEI037B	Plan automated systems projects	This unit covers development and documentation of automated systems project proposals, milestones and completions. It encompasses, establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines.
UEENEEI038A	Provide solutions to ELV electro-pneumatic control systems and drives	This unit covers developing and implementing control solutions for systems using electro-pneumatic elements operating at extra-low voltage and variable speed drives. It encompasses safe working practices, establishing required control functions, checking device installation, entering instruction into programmable devices, following written and oral instruction and procedures and completing necessary documentation. Note: Electrical connections referred to in this unit are confined to pre-assembled plug and socket sets. This unit does not cover competencies for installation and connection of electrical wiring.
UEENEEI040A	Plan the installation of integrated systems	This unit covers the planning and practices in installing an integrated systems. It encompasses working safely, applying

Unit Code	Unit Title	Scope/Descriptor
		knowledge bus system parameters, topology and installation requirements, bus system cables and terminations, control and dimming methods and planning and documenting integrated installation plans.
UEENEEI041A	Develop integrated systems	This unit covers the development of integrated systems. It encompasses working safely, scrutinising and adapting project specifications, applying knowledge of the application for integrated systems, system topologies and devices applications and capabilities, system programming methods, using diagnostic tools and documenting the developed systems.
UEENEEI042B	Develop an integrated system interface for access through a touch screen	This unit covers the development of integrated systems touch screen interface. It encompasses working safely, applying knowledge of the application integrated system, working with customers to determine required control parameters, application of touch screen software components and embellishments, network connectivity, using diagnostic tools and documenting the developed systems.
UEENEEI043A	Develop access control of integrated systems using logic-based programming tools	This unit covers programming functions and parameters of touch screens and other access controls in an integrated system. It encompasses working safely and to manufacturer's instructions and regulatory requirements, applying knowledge of the application integrated system, using proprietary touch screen programming tools, and documenting as-programmed access functions.
UEENEEI044A	Develop interfaces for multiple access methods to monitor, schedule and control an integrated system	This unit covers programming for multiple access to integrated systems for a single dwelling. Such access includes mobile phones, computer networks, remote controls, touch screens and the like. It encompasses working safely and to manufacturer's instructions and regulatory requirements, installing and setting up gateway equipment, applying knowledge of the application of

Unit Code	Unit Title	Scope/Descriptor
		integrated system including remote reprogramming and monitoring, using proprietary programming tools, and documenting as-programmed assess functions.

Discipline J – Refrigeration and Air Conditioning

Unit Code	Unit Title	Scope/Descriptor
UEENEEJ002B	Prepare refrigerant tubing and fittings	This unit covers the basic connection of refrigeration and air conditioning piping/tubing and fittings. It encompasses the safe use of hand, fixed and portable power tools for cutting, flaring, bending, swaging, silver brazing copper tube to copper tube, Bundy tube and brass and steel fittings, measurement and reading drawings and diagrams.
UEENEEJ003B	Determine the basic operating conditions of vapour compression systems	This unit covers the determination of the operating conditions of vapour compression systems. It encompasses working safely, determining refrigerant pressures and temperatures and relevant air and water temperatures using measurement and basic calculation methods.
UEENEEJ004B	Determine the basic operating conditions of air conditioning systems	This unit covers the determination of the basic operating conditions of air conditioning systems. It encompasses working safely, determining air temperature, air flow rates and relative humidity using measurement and basic calculation methods.
UEENEEJ005B	Position, assemble and start up split air conditioning systems	This unit covers the assembly, installation, starting up and decommissioning of single head split air conditioning systems up to a maximum of 18kW _r refrigeration capacity. It encompasses working safely and to standards, following routine procedures to install equipment, connecting pipe work, pressure testing, evacuating, perform functional checks and complete installation / regulatory documentation.

Unit Code	Unit Title	Scope/Descriptor
		Note: <i>The Ozone Protection and Synthetic Greenhouse Gas Legislation Amendment Bill 2003 may apply to this unit. Prior to planning the delivery of any training and/or assessment activities all legislative and regulatory requirements shall be identified and included.</i>
UEENEEJ006B	Install pipework for refrigeration and air conditioning systems	This unit covers the installation, in buildings and premises, of refrigerant piping/tubing, fittings, flow controls, pressure sensing controls, and accessories for refrigeration and air conditioning systems. It encompasses working safely and to installation standards, routing pipe work to specified locations, connecting components and accessories and documenting installation work.
UEENEEJ007B	Install refrigeration and air conditioning systems, major components and associated equipment	This unit covers the installation of unitary equipment, compressors, condensers, evaporators, liquid receivers, safety and cycling controls, ventilation and air handling (excluding central plant) and associated equipment. It encompasses working safely and to installation standards to match equipment with that specified for a given specification and location, connecting pipe work and components, and complete the necessary installation documentation.
UEENEEJ008B	Recover, pressure and leak test, evacuate and charge refrigerants	This unit covers pressure and leak testing, evacuating, charging and recovery of refrigerants and lubricants from refrigeration systems and air conditioning systems. It encompasses working safely and to standards, following regulations and industry practices for handling refrigerants and lubricants, and completing the necessary documentation. Note: <i>Refrigeration systems may be those used for refrigerating or for air conditioning.</i>
UEENEEJ009B	Verify compliance and functionality of refrigeration and air conditioning installations	This unit covers testing and visual inspection for verifying that a refrigeration and air conditioning system and components are safe, comply with requirements and functions as intended. It encompasses working safely,

Unit Code	Unit Title	Scope/Descriptor
		conducting compliance tests, conducting visual inspections, identifying non-compliance defects and mandatory reporting requirements.
UEENEEJ010B	Select refrigerant pipe/tube, accessories and associated controls	This unit covers the selection of refrigerant pipe/tube, accessories and controls for refrigeration and air conditioning installations to comply with regulations, standards and specifications. It encompasses developing pipe work arrangements, selecting pipe work, refrigeration equipment and mechanical and electrical control devices based on calculated and deemed-to comply solutions and documenting all selection information.
UEENEEJ011B	Diagnose and rectify faults in refrigeration and air conditioning systems and components	This unit covers diagnosing, repairing faults and replacing faulty components in refrigeration and air conditioning systems, components, interconnecting circuits and equipment operating at voltages up to 1,000 V a.c. It encompasses working safely, reading electrical circuit diagrams, refrigeration, hydronic and air distribution system diagrams and manufacturers reference material, sketching diagrams from traced wiring and piping systems, applying logical fault finding procedures, conducting repairs, replacing components and completing the necessary service documentation.
UEENEEJ012B	Deleted	
UEENEEJ013B	Commission refrigeration and air conditioning systems	This unit covers commissioning of refrigeration and air conditioning systems. It encompasses working safely and to standards to commission the whole system and includes pre-commissioning tests, starting up the system, optimising the refrigerant charge, basic air and water balancing and adjustment, checking and adjusting components and controls to ensure their efficient and balanced operation, and completing commissioning documentation.
UEENEEJ014B	Deleted	

Unit Code	Unit Title	Scope/Descriptor
UEENEEJ015B	Solve problems in beverage dispensers	This unit covers solving problems in beverage dispensers. It encompasses working safely and to standards, applying knowledge of the components and operation of beverage dispensers, using effective problem solving techniques and documenting solutions.
UEENEEJ016B	Deleted	
UEENEEJ017B	Deleted	
UEENEEJ018B	Solve problems in post mix refrigeration systems	This unit covers solving problems in post mix refrigeration systems. It encompasses working safely and to standards, applying knowledge of the components and operation of post mix refrigeration systems, using effective problem solving techniques and documenting solutions.
UEENEEJ019B	Solve problems in ice making systems	This unit covers solving problems in ice making systems. It encompasses working safely and to standards, applying knowledge of the components and operation of ice making systems, using effective problem solving techniques and documenting solutions.
UEENEEJ020B	Solve problems in industrial refrigeration systems	This unit covers solving problems in industrial refrigeration systems. It encompasses working safely and to standards, applying knowledge of the components and operation of industrial refrigeration systems, using effective problem solving techniques and documenting solutions.
UEENEEJ021B	Monitor and adjust energy management systems on refrigeration systems	This unit covers the setting up and adjusting energy management systems on refrigeration systems for effective energy use. It encompasses safe working practices, system parameter testing and analysis, adjusting equipment and controls, following procedures and documenting final operating parameters and settings.
UEENEEJ022B to UEENEEJ039B	Deleted	

Unit Code	Unit Title	Scope/Descriptor
UEENEEJ040B	Manage refrigeration and air conditioning projects	This unit covers the management of refrigeration and air conditioning projects involving design, modifications, installation, and/or maintenance of systems and equipment. It encompasses covers management of safety, budget, variation, personnel, resources, and critical path timelines all necessary progress and completion documentation.
UEENEEJ041B to UEENEEJ052B	Deleted	
UEENEEJ053B	Find and rectify faults in appliance motors and associated controls	This unit covers finding and repairing faults in appliance motors and associated controls. It encompasses working safely, applying knowledge of appliance motor systems and their controls, reading circuit diagrams, sketching diagrams from traced circuits, applying logical fault finding procedures, conducting repairs and completing the necessary service documentation
UEENEEJ054B to UEENEEJ066B	Deleted	
UEENEEJ067B	Solve problems in central plant air conditioning systems	This unit covers solving problems in central plant air conditioning systems. It encompasses working safely and to standards, applying knowledge of the components and operation of central plant systems, using effective problem solving techniques and documenting solutions.
UEENEEJ068B	Deleted	
UEENEEJ069B	Plan refrigeration and air conditioning projects	This unit covers development and documentation of Refrigeration and air conditioning project proposals, milestones and completions. It encompasses, establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines.

Unit Code	Unit Title	Scope/Descriptor
UEENEEJ070B	Diagnose and rectify faults in refrigeration and air conditioning control systems	This unit covers diagnosing, repairing faults and replacing faulty components in refrigeration and air conditioning control systems, components, interconnecting circuits and equipment operating at voltages up to 1000 V a.c. It encompasses working safely, reading circuit diagrams, system diagrams and manufacturers reference material, sketching diagrams from traced wiring, applying logical fault finding procedures, conducting repairs, replacing components and completing the necessary service documentation.
UEENEEJ071B	Deleted	
UEENEEJ072B to UEENEEJ091A	Deleted	
UEENEEJ102A	Prepare and connect refrigerant tubing and fittings	This unit covers the basic connection of refrigeration and air conditioning piping/tubing and fittings. It encompasses the safe use of hand, fixed and portable power tools for cutting, flaring, bending, swaging, silver brazing copper tube to copper tube, Bundy tube and brass and steel fittings, measurement and reading drawings and diagrams
UEENEEJ103A	Establish the basic operating conditions of vapour compression systems	This unit covers the determination of the operating conditions of vapour compression systems. It encompasses working safely, determining refrigerant pressures and temperatures and relevant air and water temperatures using measurement and basic calculation methods.
UEENEEJ104A	Establish the basic operating conditions of air conditioning systems	This unit covers the determination of basic operating conditions of air conditioning systems. It encompasses working safely, determining air temperature, air flow rates and relative humidity using measurement and basic calculation methods.
UEENEEJ105A	Position, assemble and start up single head split air	This unit covers the assembly, installation and starting up and de-commissioning of single

Unit Code	Unit Title	Scope/Descriptor
	conditioning and water heating heat pump systems	head split air conditioning systems and split water heating heat pump systems up to a maximum of 18kW _r refrigeration capacity. It encompasses working safely and to standards, following routine procedures to install equipment, connecting pipe work, pressure testing, evacuating, perform functional checks and complete installation / regulatory documentation. Note: The Ozone Protection and Synthetic Greenhouse Gas Legislation Amendment Bill 2003 may apply to this unit. Prior to planning the delivery of any training and/or assessment activities all legislative and regulatory requirements shall be identified and included.
UEENEEJ106A	Install refrigerant pipe work, flow controls and accessories	This unit covers the installation, in buildings and premises, of refrigerant piping/tubing, fittings, flow controls and accessories for refrigeration and air conditioning systems. It encompasses working safely and to installation standards, routing pipe work to specified locations, connecting components and accessories and documenting installation work.
UEENEEJ107A	Install air conditioning and refrigeration systems, major components and associated equipment	This unit covers the installation of refrigeration and air conditioning systems including unitary equipment, compressors, condensers, evaporators, liquid receivers, , pipework, ventilation and air handling (excluding central plant) and associated equipment. It encompasses working safely and to installation standards to match equipment with that specified for a given specification and location, connecting pipe work and components, and complete the necessary installation documentation.
UEENEEJ108A	Recover, pressure test, evacuate, charge and leak test refrigerants	This unit covers recovery, pressure testing, evacuating, charging and leak testing recovery of refrigerants and lubricants from refrigeration systems and air conditioning systems. It encompasses working safely and to standards, following regulations and industry practices for handling refrigerants and lubricants, and completing the necessary documentation.

Unit Code	Unit Title	Scope/Descriptor
		Note: Refrigeration systems may be those used for refrigerating or for air conditioning.
UEENEEJ109A	Verify functionality and compliance of refrigeration and air conditioning installations	This unit covers testing and visual inspection for verifying that a refrigeration and air conditioning system and components are safe, comply with requirements and functions as intended. It encompasses working safely, conducting compliance tests, conducting visual inspections, identifying non-compliance defects and mandatory reporting requirements
UEENEEJ110A	Select refrigerant piping, accessories and associated controls	This unit covers the selection of refrigerant piping, accessories and controls for refrigeration and air conditioning installations to comply with regulations, standards and specifications. It encompasses developing refrigerant pipe work arrangements, selecting pipe work and fittings, refrigerant flow controls and accessories, and mechanical and electrical control devices based on specifications, standards and manufacturer catalogues to determine calculated and deemed to comply solutions and documenting all selection information.
UEENEEJ111A	Diagnose and rectify faults in air conditioning and refrigeration systems and components	This unit covers diagnosing, repairing faults and replacing faulty components in refrigeration and air conditioning systems, components, interconnecting circuits and equipment operating at voltages up to 1,000 V a.c. It encompasses working safely, reading electrical circuit diagrams, refrigeration, hydronic and air distribution system diagrams and manufacturers reference material, sketching diagrams from traced wiring and piping systems, applying logical fault finding procedures, conducting repairs, replacing components and completing the necessary service documentation.
UEENEEJ112A	Diagnose and rectify faults in complex air conditioning/ refrigeration systems	This unit covers diagnosing and rectifying faults in complex refrigeration/air conditioning systems. It encompasses safe working practices, interpreting technical data, applying

Unit Code	Unit Title	Scope/Descriptor
		knowledge of complex refrigeration/air conditioning systems operating parameters to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEJ113A	Commission air conditioning and refrigeration systems	This unit covers commissioning of refrigeration and air conditioning systems. It encompasses working safely and to standards to commission the whole system and includes pre-commissioning tests, starting up the system, optimizing the refrigerant charge, basic air and water balancing and adjustment, checking and adjusting components and controls to ensure its efficient and balanced operation, and completing commissioning documentation.
UEENEEJ114A	Resolve problems in hydronic systems	This unit covers resolving problems in hydronic systems. It encompasses working safely and to standards, applying knowledge of the components and resolving problems in hydronic systems, using effective problem solving techniques and documenting solutions.
UEENEEJ115A	Resolve problems in beverage dispensers	This unit covers resolving problems in beverage dispensers. It encompasses working safely and to standards, applying knowledge of the components and operation of beverage dispensers, using effective problem resolving techniques and documenting solutions
UEENEEJ116A	Resolve problems in transport refrigeration systems	This unit covers resolving problems in transport refrigeration systems. It encompasses working safely and to standards, applying knowledge of the components and operation of transport refrigeration systems, using effective problem solving techniques and documenting solutions.
UEENEEJ117A	Resolve problems in ultra-low temperature refrigeration systems	This unit covers resolving problems in ultra-low temperature refrigeration systems, including compound and cascade systems. It encompasses working safely and to standards, applying knowledge of the components and operation of ultra-low temperature refrigeration systems, using effective problem

Unit Code	Unit Title	Scope/Descriptor
		resolving techniques and documenting solutions.
UEENEEJ118A	Resolve problems in post mix refrigeration systems	This unit covers resolving problems in post mix refrigeration systems. It encompasses working safely and to standards, applying knowledge of the components and operation of post mix refrigeration systems, using effective problem resolving techniques and documenting solutions.
UEENEEJ119A	Resolve problems in ice making systems	This unit covers resolving problems in ice making systems. It encompasses working safely and to standards, applying knowledge of the components and operation of ice making systems, using effective problem resolving techniques and documenting solutions.
UEENEEJ121A	Monitor and adjust refrigeration energy management systems	This unit covers the setting-up and adjusting energy management systems on refrigeration systems for effective energy use. It encompasses safe working practices, system parameter testing and analysis, adjusting equipment and controls, following procedures and documenting final operating parameters and settings.
UEENEEJ122A	Diagnose faults in complex HVAC /refrigeration control systems	This unit covers diagnosing and rectifying faults in complex heating, ventilation and air conditioning (HVAC) or refrigeration control systems. It encompasses safe working practices, interpreting technical data, applying knowledge of complex refrigeration or heating, ventilation and air conditioning (HVAC) control systems operating parameters to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.
UEENEEJ123A	Commission complex (HVAC) heating, ventilation and air conditioning systems	This unit covers the setting-up and adjusting complex (HVAC) heating, ventilation and air conditioning systems for optimum performance. It encompasses safe working practices, system parameter testing and analysis, adjusting equipment and controls, following procedures and documenting final

Unit Code	Unit Title	Scope/Descriptor
		operating parameters and settings.
UEENEEJ124A	Commission refrigeration/air conditioning hydronic systems	This unit covers the setting-up and adjusting hydronic systems for refrigeration and/or air conditioning optimum performance. It encompasses safe working practices, system parameter testing and analysis, adjusting equipment and controls, following procedures and documenting final operating parameters and settings.
UEENEEJ125A	Commission complex refrigeration systems and equipment	This unit covers the setting-up and adjusting complex refrigeration systems for optimum performance. It encompasses safe working practices, system parameter testing and analysis, adjusting equipment and controls, following procedures and documenting final operating parameters and settings.
UEENEEJ126A	Commission complex refrigeration/air conditioning control systems	This unit covers the setting-up and adjusting complex control systems for refrigeration or air conditioning optimum performance. It encompasses safe working practices, system parameter testing and analysis, adjusting equipment and controls, following procedures and documenting final operating parameters and settings.
UEENEEJ127A	Establish the thermodynamic parameters of refrigeration and air conditioning systems	This unit covers the determination of the thermodynamic parameters of refrigeration and air conditioning systems. It encompasses working safely, determining thermodynamic parameters of using measurement and basic calculation methods and documenting results.
UEENEEJ128A	Produce HVAC/R system design drawings	This unit covers interpreting technical data and project specifications and produce HVAC/R system design drawings. It encompasses safe working practices, interpreting technical data and specifications, applying knowledge heating, ventilation, air conditioning and/or refrigeration systems design drawing protocols, using appropriate drawing tools and documenting design.
UEENEEJ129A	Establish heat loads for commercial refrigeration	This unit covers the determination of the heat loads for commercial refrigeration and air

Unit Code	Unit Title	Scope/Descriptor
	and/or air conditioning applications	conditioning applications. It encompasses working safely; determining heat loads using quick selection, short form paper and computer based methods and documenting results.
UEENEEJ130A	Produce HVAC/R control system diagrams	This unit covers interpreting technical data and project specifications and produce HVAC/R control system diagrams. It encompasses safe working practices, interpreting technical data and specifications, applying knowledge heating, ventilation, air conditioning and/or refrigeration control systems drawing protocols, using appropriate drawing tools and documenting design.
UEENEEJ131A	Determine noise and vibration encountered in HVAC/R applications	This unit covers the measurement of noise and vibration encountered in HVAC/R system. It encompasses working safely, problem solving procedures, including using measuring instruments, applying appropriate theorems and providing interpretations derived from measurements and calculations and justification for such interpretations.
UEENEEJ132A	Design commercial refrigeration systems and select components	This unit covers the design of commercial refrigeration systems. It encompasses applying knowledge of refrigeration and food storage technology, refrigeration system components and piping, safety and regulatory requirements, following design specifications and customer requirements and documenting system designs.
UEENEEJ133A	Design industrial refrigeration systems and select components	This unit covers the design of industrial refrigeration systems. It encompasses applying knowledge of refrigeration and food storage technology, industrial refrigeration system components and piping, safety and regulatory requirements, following design specifications and customer requirements and documenting system designs.
UEENEEJ134A	Design heating, ventilation and air conditioning (HVAC) systems and select components	This unit covers the design of heating, ventilation and air conditioning systems and selection of components. It encompasses applying knowledge of commercial air conditioning systems, components and piping, safety and regulatory requirements, following

Unit Code	Unit Title	Scope/Descriptor
		design specifications and customer requirements and documenting system designs.
UEENEEJ135A	Design control systems for refrigeration or heating, ventilation and air conditioning systems	This unit covers the design control systems for a heating, ventilation and air conditioning or refrigeration systems. It encompasses applying knowledge of refrigeration and air conditioning, control systems components, safety and regulatory requirements, following design specifications and customer requirements and documenting system designs.
UEENEEJ136A	Evaluate and report on building services energy management systems	This unit covers evaluation of energy management building services plant and machinery. It encompasses working safely, setting up and conducting evaluation measurements, evaluating energy use from measured parameters and reporting results including recommending any resulting corrective actions.
UEENEEJ137A	Evaluate and report on the indoor air quality of buildings	This unit covers evaluation of air quality in a building. It encompasses working safely, setting up and conducting evaluation measurements, evaluating air quality from measured parameters and reporting results including recommending any resulting corrective actions.
UEENEEJ138A	Analyse vibration and noise in refrigeration and air conditioning systems	This unit covers the analysis of refrigeration and air conditioning systems to provide solutions to noise and vibration issues. It encompasses working safely, apply extensive knowledge of noise and vibration parameters, gathering and analysing data, applying problem solving techniques, developing and documenting results and solutions for use in design work.
UEENEEJ139A	Develop specifications and prepare drawings for HVAC/Refrigeration projects	This unit covers specification development and documentation of HVAC/Refrigeration projects. It encompasses safe working practices, following a design brief, applying knowledge heating, ventilation, air conditioning and/or refrigeration systems to selecting system components, operating within established project budget and developing

Unit Code	Unit Title	Scope/Descriptor
		project specifications and design drawings.
UEENEEJ141A	Design complex commercial refrigeration systems and select equipment	This unit covers the design of complex commercial refrigeration systems. It encompasses applying knowledge of complex commercial refrigeration systems, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system designs.
UEENEEJ142A	Design complex industrial refrigeration systems and select equipment	This unit covers the design of complex industrial refrigeration systems. It encompasses applying knowledge of industrial refrigeration systems, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system designs.
UEENEEJ143A	Design complex air conditioning systems and select equipment	This unit covers the design of complex air conditioning systems. It encompasses applying knowledge of complex air conditioning systems, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system designs.
UEENEEJ144A	Design mechanical ventilation/exhaust systems and select equipment	This unit covers the design of mechanical ventilation/exhaust systems. It encompasses applying knowledge mechanical ventilation/exhaust systems, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system designs.
UEENEEJ145A	Design hydronic systems and select equipment	This unit covers the design of hydronic systems. It encompasses applying knowledge of hydronic systems, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system designs.
UEENEEJ146A	Design complex control systems for refrigeration or heating, ventilation, air	This unit covers the design of complex control systems for heating, ventilation, air conditioning or refrigeration system. It encompasses applying knowledge of complex

Unit Code	Unit Title	Scope/Descriptor
	conditioning systems	control systems for a heating, ventilation, air conditioning or refrigeration system, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system designs.
UEENEEJ147A	Audit energy use for commercial HVAC/Refrigeration systems	This unit covers assessing the energy used by commercial HVAC and refrigeration systems in relation to its performance for the purpose of improving efficiency and/or certification as meeting energy efficiency standards. It encompasses safe working practices, determining efficiency requirements, setting up performance and energy tests, evaluating results and documenting test outcomes.
UEENEEJ148A	Audit HVAC/R control systems for compliance with regulations and standards	This unit covers control safety and performance evaluation of heating, ventilating, air conditioning and refrigeration control systems across their operating range. It encompasses working safely, setting up and conducting evaluation measurements, evaluating performance from measured parameters and documenting results and recommending any resulting corrective actions.
UEENEEJ149A	Develop heat exchanger design specifications	This unit covers the analysis of refrigeration parameters and develop specification for heat exchanger design. It encompasses working safely, apply extensive knowledge of refrigeration parameters, gathering and analysing data, developing and documenting results and solutions for use in design work.
UEENEEJ150A	Evaluate new and alternative technologies applicable to electrotechnology applications	This unit covers evaluation of alternative and new technologies applicable to electrotechnology applications. It encompasses working safely, comparing manufacturer's technical data for alternative or new technologies with specifications for a proposed project, conducting evaluation tests, evaluating systems/components from technical data, calculations and/or measured parameters and reporting findings for use in design work.

Unit Code	Unit Title	Scope/Descriptor
UEENEEJ151A	Service small electrical appliances and power tools	This unit covers maintaining the effective and efficient operation of small electrical appliances and hand power tools. It encompasses working safely, applying knowledge of small appliances and power tools, following service manuals, testing appliance function, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ153A	Find and rectify faults in motors and associated controls in refrigeration and air conditioning systems	This unit covers finding and repairing faults in motors and associated controls in refrigeration and air conditioning systems. It encompasses working safely, applying knowledge of motor systems and their controls, reading circuit diagrams, sketching diagrams from traced circuits, applying logical fault finding procedures, conducting repairs and completing the necessary service documentation.
UEENEEJ154A	Find and rectify faults in appliance control systems and devices	This unit covers finding and repairing faults in appliance control systems and devices. It encompasses working safely, applying knowledge of appliance control systems and devices, reading circuit diagrams, sketching diagrams from traced circuits, applying logical fault finding procedures, conducting repairs and completing the necessary service documentation.
UEENEEJ155A	Service refrigeration appliances	This unit covers maintaining the effective and efficient operation of refrigerated appliances. It encompasses working safely, applying knowledge of refrigerated appliance, following service manuals, testing appliance function, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ156A	Service clothes washing machines and dryers	This unit covers maintaining the effective and efficient operation of clothes washing machines and dryers. It encompasses working safely, applying knowledge of clothes washing machines and dryers, following service manuals, testing appliance function, locating

Unit Code	Unit Title	Scope/Descriptor
		and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ157A	Service electrical heating appliances	This unit covers maintaining the effective and efficient operation of electric heating appliances. It encompasses working safely, applying knowledge of electric heating appliances, following service manuals, testing appliance function, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ158A	Service dishwasher machines	This unit covers maintaining the effective and efficient operation of dish washing machines. It encompasses working safely, applying knowledge of dish washing machines, following service manuals, testing appliance function, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ159A	Service gas heating appliances	This unit covers maintaining the effective and efficient operation of gas heating appliances. It encompasses working safely, applying knowledge of the gas appliance, following service manuals, testing appliance function, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ161A	Verify functionality and compliance of appliances	This unit covers testing and visually inspecting appliances to verifying that they are safe and comply with requirements. It encompasses procedures for conducting safety and functionality tests, conducting visual inspections, identifying non-compliance defects, documenting results and recommendations and initiating the rectification of any defect.
UEENEEJ162A	Recover, pressure test, evacuate, charge and leak test refrigerants — appliances	This unit covers the recovery of refrigerants from appliances, pressure and leak testing evacuation and charging refrigerants in self contained appliances. It encompasses working safely and to standards, following regulations

Unit Code	Unit Title	Scope/Descriptor
		and industry practices for handling refrigerants and completing the necessary documentation.
UEENEEJ164A	Analyse the operation of HVAC air and hydronic systems	This unit covers the analysis the operating parameters of heating, ventilating and air conditioning air and hydronic systems to determine whether performance requirements are being met. It encompasses working safely, apply knowledge of operating parameters, gathering and analysing data, applying problem solving techniques, developing and documenting results and solutions for use in design work.
UEENEEJ165A	Evaluate thermodynamic and fluid parameters of refrigeration systems	This unit covers evaluation of thermodynamic and fluid parameters of refrigeration systems. It encompasses working safely, setting up and conducting evaluation measurements, evaluating thermodynamic and fluid parameters from measured parameters and reporting results for use in design work.
UEENEEJ166A	Resolve problems in dairy refrigeration systems	This unit covers resolving problems in dairy refrigeration systems. It encompasses working safely and to standards, applying knowledge of the components and operation of dairy refrigeration systems, using effective problem resolving techniques and documenting solutions.
UEENEEJ167A	Resolve problems in central plant air conditioning systems	This unit covers resolving problems in central plant air conditioning systems. It encompasses working safely and to standards, applying knowledge of the components and operation of central plant systems, using effective problem solving techniques and documenting solutions.
UEENEEJ168A	Maintain microbial control of refrigeration and air conditioning systems	This unit covers the quality assurance and risk management compliance processes for maintenance of the air and water systems associated with refrigeration and air conditioning. It encompasses working safely and to technical, quality and risk management standards, work specifications and maintenance schedules, sample inspections, evaluating components and completing the

Unit Code	Unit Title	Scope/Descriptor
		necessary maintenance documentation.
UEENEEJ170A	Diagnose and rectify faults in air conditioning and refrigeration control systems	This unit covers diagnosing, repairing faults and replacing faulty components in refrigeration and air conditioning control systems, components, interconnecting circuits and equipment operating at voltages up to 1000 V a.c. It encompasses working safely, reading circuit diagrams, system diagrams and manufacturers reference material, sketching diagrams from traced wiring, applying logical fault finding procedures, conducting repairs, replacing components and completing the necessary service documentation.
UEENEEJ171A	Resolve problems in refrigerated beverage vending cabinets	This unit covers resolving problems in refrigerated beverage vending cabinets. It encompasses working safely and to standards, applying knowledge of the components and operation of refrigerated beverage vending cabinets, using effective problem solving techniques and documenting solutions.
UEENEEJ172A	Recover, pressure test, evacuate, charge and leak test refrigerants — split systems	This competency standard unit covers the recovery of refrigerant, pressure and leak testing, evacuation and refrigerant charging in split air conditioning and heat pump systems. It encompasses working safely and to standards, following regulations and industry practices for handling refrigerants and completing the necessary documentation. Note: The Ozone Protection and Synthetic Greenhouse Gas Legislation Amendment Bill 2003 may apply to this competency standard unit. Prior to planning the delivery of any training and/or assessment activities all legislative and regulatory requirements shall be identified and included.
UEENEEJ173A	Service and repair microwave ovens	This unit covers maintaining the effective and efficient operation of microwave ovens. It encompasses working safely, applying knowledge of microwave ovens, following service manuals, testing appliance function, locating and rectifying faults and defective

Unit Code	Unit Title	Scope/Descriptor
		components and completing the necessary service documentation.
UEENEEJ174A	Apply safety awareness and legal requirements for hydrocarbon refrigerants	This unit covers the safety and legal requirements to handle, use and store hydrocarbon refrigerants. All safety aspects are covered to Australian and International standards. Legal requirements are covered at local, State & National level.
UEENEEJ175A	Service and repair self contained hydrocarbon air conditioning and refrigeration systems	This unit covers specialised procedures for servicing and repairs to achieve the effective and efficient operation of primarily self contained air conditioning and refrigeration equipment using Hydrocarbon as the refrigerant. It reinforces safe working practice and encompasses applying specialised knowledge of refrigeration principles that apply to Hydrocarbon, following service manuals, testing, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ176A	Install and commission hydrocarbon refrigeration systems, components and associated equipment	This unit covers specialised procedures for the installation and commissioning of refrigeration equipment using Hydrocarbon as the refrigerant. It encompasses working safely and to installation standards matching equipment, location, components and piping to given specifications. After installation, to commission the complete system including: pre commissioning tests, starting the system, ensuring correct refrigerant charge, basic air or water balancing, adjusting components and controls to efficient operation. Completing all necessary installation and commissioning documentation.
UEENEEJ177A	Design hydrocarbon refrigerated systems	This unit covers the design of refrigeration systems using Hydrocarbon as a refrigerant. It encompasses applying knowledge of complex refrigeration systems, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system design.

Unit Code	Unit Title	Scope/Descriptor
UEENEEJ178A	Apply safety awareness and legal requirements for ammonia refrigerant	This unit covers the safety and legal requirements to handle, use and store Ammonia refrigerant. All safety aspects are covered to Australian and International standards. Legal requirements are covered at local, State & National level.
UEENEEJ179A	Repair and service ammonia refrigeration systems	This unit covers specialised procedures for servicing and repairs to achieve the effective and efficient operation of refrigeration equipment using Ammonia as the refrigerant. It reinforces safe working practice and encompasses applying specialised knowledge of refrigeration principles that apply to Ammonia, following service manuals, testing, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ180A	Install and commission ammonia refrigeration systems, components and associated equipment	This unit covers specialised procedures for the installation and commissioning of refrigeration equipment using Ammonia as the refrigerant. It reinforces safe working practice and encompasses applying specialised knowledge of refrigeration principles that apply to Ammonia, interpreting plans and specifications, project management principles, supervision of installation, commissioning and completing the necessary commissioning documentation.
UEENEEJ181A	Design ammonia refrigerated systems	This unit covers the design of refrigeration systems using ammonia as a refrigerant. It encompasses design skills including overall systems design, selection of components and definition of control logic.
UEENEEJ182A	Repair and service secondary refrigeration systems	This unit covers maintaining the effective and efficient operation of refrigeration equipment using non phase changing secondary refrigerant systems. It reinforces safe working practice, utilises service manuals, encompasses applying specialised knowledge of refrigeration principles to test and perform maintenance operations to these systems and to locate defective components and repair faults,

Unit Code	Unit Title	Scope/Descriptor
		completing reports on service and performance outcomes.
UEENEEJ183A	Design secondary refrigerant systems	This unit covers the design of secondary refrigeration systems. It encompasses design skills including overall systems design, selection of components and definition of control logic.
UEENEEJ184A	Apply safety awareness and legal requirements for carbon dioxide refrigerant	This unit covers the safety and legal requirements to handle, use and store hydrocarbon refrigerants. All safety aspects are covered to Australian and International standards. Legal requirements are covered at local, State & National level.
UEENEEJ185A	Repair and service carbon dioxide refrigeration systems	This unit covers specialised procedures for servicing and repairs to achieve the effective and efficient operation of refrigeration equipment using carbon dioxide (CO ₂) as a refrigerant excluding self contained systems. It reinforces safe working practice and encompasses applying specialised knowledge of refrigeration principles that apply to carbon dioxide, following service manuals, testing, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ186A	Install and commission carbon dioxide refrigeration systems, components and associated equipment	This unit covers specialised procedures for the installation and commissioning to achieve effective and efficient operation of refrigeration equipment using carbon dioxide (CO ₂) as a refrigerant excluding self contained systems. It reinforces safe working practice and encompasses applying specialised knowledge of refrigeration principles that apply to carbon dioxide, following design specifications, testing, locating and rectifying faults and defective components and completing the necessary installation and commissioning documentation.
UEENEEJ187A	Design carbon dioxide refrigerated systems	This unit covers the design of refrigeration systems using carbon dioxide as a refrigerant. It encompasses applying knowledge of complex refrigeration systems, safety and

Unit Code	Unit Title	Scope/Descriptor
		regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system design.
UEENEEJ188A	Repair and service self contained carbon dioxide refrigeration and heat pump systems	This unit covers specialised procedures for servicing and repairs to achieve the effective and efficient operation of self contained refrigeration and heat pump equipment using carbon dioxide (CO ₂) as a refrigerant. It reinforces safe working practice and encompasses applying specialised knowledge of refrigeration principles that apply to carbon dioxide, following service manuals, testing, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ189A	Service room air conditioners	This unit covers maintaining the effective and efficient operation of self contained room air conditioners. It encompasses working safely, applying knowledge of room air conditioners, following service manuals, testing appliance function, locating and rectifying faults and defective components and completing the necessary service documentation.
UEENEEJ190A	Select basic commercial refrigeration system equipment, components and accessories	This unit covers the selection of basic commercial refrigeration system equipment and components, pipe work and controls. It encompasses the selection of the refrigerant, condensing unit, evaporator, refrigerant controls, accessories, refrigerant and condensate pipe work, and system controls based on specifications, standards and manufacturer catalogues to determine calculated and deemed-to comply solutions and documenting all selection information. It also includes predicting the refrigeration system's balance point to achieve design conditions.
UEENEEJ191A	Select residential air conditioning system equipment, components and accessories	This unit covers the selection residential air conditioning equipment, pipe work, air distribution components and controls. It encompasses the selection of the unitary air conditioning equipment and components, system controls, refrigerant and condensate

Unit Code	Unit Title	Scope/Descriptor
		pipe work based on specifications, standards and manufacturer catalogues to determine calculated and deemed-to comply solutions and documenting all selection information. It also includes the selection and layout of the air distribution system and components. Note: Residential air conditioning applications are those covered under the Building Code of Australia – Class 1A Residential Buildings.
UEENEEJ192A	Analyse the psychrometric performance of HVAC/R systems	This unit covers the analysis of heating, ventilating, air conditioning and refrigeration (HVAC/R) systems to provide solution to psychrometric performance issues. It encompasses working safely, apply extensive knowledge of psychrometric parameters, gathering and analysing data, applying problem solving techniques, developing and documenting results and solutions for use in design work.
UEENEEJ193A	Analyse the thermodynamic performance of HVAC/R systems	This unit covers the analysis of heating, ventilating, air conditioning and refrigeration (HVAC/R) systems to provide solution to thermodynamic performance issues. It encompasses working safely, apply extensive knowledge of thermodynamic parameters, gathering and analysing data, applying problem solving techniques, developing and documenting results and solutions for use in design work.
UEENEEJ194A	Solve problems in low voltage refrigeration circuits	This unit covers determining correct operation of low voltage d.c. and a.c. circuits and providing solutions as they apply to refrigeration work functions. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in single and multiple path circuits.
UEENEEJ195A	Establish the basic operating conditions of vapour compression	This unit covers the determination of the operating conditions of vapour compression systems of self contained refrigerated

Unit Code	Unit Title	Scope/Descriptor
	systems – appliances	appliances. It encompasses working safely, determining refrigerant pressures and temperatures and relevant air temperatures using measurement and basic calculation methods.
UEENEEJ196A	Operate Ammonia Refrigeration Plant	This unit covers specialised procedures for operating an industrial refrigeration plant using ammonia as the refrigerant. It encompasses applying specialised knowledge of refrigeration principles that apply to ammonia, specifying the normal operating parameters for the plant, rectifying faults and defective components within organisational guidelines and completing the necessary service documentation.

Discipline K – Renewable and Sustainable

Unit Code	Unit Title	Scope/Descriptor
UEENEEK001B	Maintain safety and tidiness of remote area power supply (RAPS) systems	This unit covers maintaining safety of RAPS system by ensuring that only RAPS equipment is present and is in its allotted place and that the system is free of litter. It encompasses working safely, regularly checking systems, cleaning techniques and reporting safety issues.
UEENEEK002B	Work safely with remote area power supply (RAPS) systems	This unit covers safety practices for working on RAPS systems. It encompasses identifying safety hazards, using risks control measures and following routine procedures for prescribed system maintenance. Note: <i>Components of this unit are included in the critical aspects of evidence in each applicable unit to ensure that OHS practices are demonstrated as they apply to RAPS system servicing work functions and situations.</i>
UEENEEK003B	Conduct periodic maintenance of remote area power supply (RAPS) battery banks	This unit covers maintenance of remote area power supply battery banks where the exposed voltage is not greater than 50 V a.c. or 120 V d.c. It encompasses working safely and to maintenance standards and following

Unit Code	Unit Title	Scope/Descriptor
		maintenance routines, identifying known types of battery faults using routine procedures and completing the necessary maintenance reporting.
UEENEEK004B	Conduct periodic maintenance of remote area power supply (RAPS) generator sets	This unit covers maintenance of remote area power supply generator sets where the exposed voltage is not greater than 50 V a.c. or 120 V d.c. It encompasses working safely and to maintenance standards and following maintenance routines, identifying known types of generator faults using routine procedures and completing the necessary maintenance reporting.
UEENEEK005B	Conduct periodic maintenance of remote area power supply (RAPS) photo voltaic arrays	This unit covers maintenance of remote area power supply photo voltaic arrays where the exposed voltage is not greater than 50 V a.c. or 120 V d.c. It encompasses working safely and to maintenance standards and following maintenance routines, identifying known types of photo voltaic array faults using routine procedures and completing the necessary maintenance reporting.
UEENEEK006B	Conduct periodic maintenance of remote area power supply (RAPS) wind generators	This unit covers maintenance of remote area power supply wind generators where the exposed voltage is not greater than 50 V a.c. or 120 V d.c. It encompasses working safely and to maintenance standards and following maintenance routines, identifying known types of wind generator faults using routine procedures and completing the necessary maintenance reporting.
UEENEEK007B	Conduct checks in the demand side use of remote area power supplies	This unit covers checking the community's use of a remote area power supply. This encompasses working safely, taking system readings, replacing the data logging chip, identifying known types of systems faults caused by inappropriate use of electrical apparatus supplied from a remote area power supply system and completing the necessary check report.
UEENEEK008B	Plan periodic maintenance schedules of remote area power supplies	This unit covers plant maintenance planning and scheduling. It encompasses developing and self managing a simple maintenance programs, replacing some specified components and

Unit Code	Unit Title	Scope/Descriptor
		reporting of maintenance work
UEENEEK009B	Attend to breakdowns in remote area power supplies	This unit covers attending to a breakdown of remote area power supplies. It encompasses working safely, ascertaining the nature of a breakdown, the extent of repairs required and the personnel needed to repair the breakdown, and reporting so arrangements can be made for the repair work to be carried out. It also encompasses undertaking specified minor repairs.
UEENEEK010B	Coordinate maintenance of renewable energy apparatus and systems	This unit covers coordinating the maintenance of renewable energy apparatus and systems. It encompasses working safely, following maintenance schedules, ascertaining the extent of any repairs required, and the personnel needed to repair the breakdown, providing technical support to maintenance personnel and reporting.
UEENEEK011B	Assemble and connect remote area power supplies (RAPS)	This unit covers installation of remote area power supply systems where the exposed voltage is not greater than 50 V a.c. or 120 V d.c. It encompasses working safely and to installation standards, matching equipment with that specified for a given location, placing and securing equipment accurately, making required circuit connections and completing the necessary installation documentation.
UEENEEK012B	Provide basic sustainable energy solutions for energy reduction in domestic premises	This unit covers monitoring energy use and providing basic sustainable energy options to reduce the energy consumption in domestic residences. It encompasses working safely and providing basic sustainable energy solutions for energy reduction in domestic premises.
UEENEEK013B	Apply sustainable energy practice in daily activities	This unit covers applying sustainable energy practices in daily activities both at and outside the workplace. It encompasses applying sustainable energy practice in daily activities.
UEENEEK014B	Promote sustainable energy practice in the community	This unit covers the promotion of recognised, safe, sustainable energy practices to others in the community.
UEENEEK015B	DELETED	

Unit Code	Unit Title	Scope/Descriptor
UEENEEK016A	Maintain and repair remote area power generation facilities	This unit covers basic maintenance of power generation facilities in remote areas. It encompasses working safely, following maintenance schedules to inspect, repair, and replace and adjustment equipment, maintaining a clean and efficient generation facility and completing the necessary reporting.
UEENEEK017B	Maintain and repair facilities associated with remote area essential services operation	This unit covers basic maintenance of remote area infrastructure facilities. It encompasses working safely and to maintenance standards and following maintenance routines, identifying deterioration and damage to facilities using routine procedures and completing the necessary maintenance reporting.
UEENEEK018B	DELETED	
UEENEEK019B	DELETED	
UEENEEK020B	Maintain operation of remote area power plant	This unit covers maintenance of remote area power plant where the exposed voltage is not greater than 50 V a.c. or 120 V d.c. It encompasses working safely and to maintenance standards and following maintenance routines, identifying known types of power plant faults using routine procedures and completing the necessary maintenance reporting.
UEENEEK021B	Manage renewable energy projects	This unit covers the management of renewable energy projects involving design, modifications, installation, and/or maintenance of systems and equipment. It encompasses management of safety, budget, variation, personnel, resources, and critical path timelines all necessary progress and completion documentation.
UEENEEK022B	Plan renewable energy projects	This unit covers development and documentation of renewable energy project proposals, milestones and completions. It encompasses, establishing budgets, critical path analysis, development of workflow strategies, documenting, presenting and negotiating budgets and timelines.
UEENEEK023B	Carry out basic repairs	This unit deals with the replacement of electrical

Unit Code	Unit Title	Scope/Descriptor
	to renewable energy apparatus by replacement of components	and non-electrical components of renewable energy apparatus. It encompasses safe working practices, following written and oral instructions and procedures, basic testing techniques, disconnecting and reconnecting electrical/electronic components, dismantling and assembling apparatus and reporting repair activities.
UEENEEK024B	DELETED	
UEENEEK025C	Solve basic problems in photovoltaic energy apparatus	This unit covers providing known solutions to predictable problems in photovoltaic energy apparatus operated at extra-low voltage. It encompasses working safely, problem solving procedures, including the use of basic voltage, current and resistance measuring devices, providing known solutions to predictable circuit problems.
UEENEEK026B	Install and set up grid connected photovoltaic power systems	This unit covers the installation, adjustment and set-up of photovoltaic power systems and connecting to a supply grid inverter. It encompasses working safely and to installation standards, matching components with that specified for a given location, placing and securing system components accurately, making required circuit connections and completing the necessary installation documentation.
UEENEEK027B	Diagnose faults in renewable energy control systems	This unit covers diagnosing and rectifying faults in renewable energy control systems. It encompasses working safely, reading circuit diagrams, and sketching diagrams from traced wiring, logically applying fault finding procedures, conducting repairs and completing the necessary service documentation.
UEENEEK028B	Solve problems in stand-alone renewable energy systems	This unit covers providing known solutions to predictable problems in stand-alone renewable energy systems operated at extra-low voltage. It encompasses working safely, problem solving procedures, including the use of basic voltage, current and resistance measuring devices, providing known solutions to predictable circuit problems.

Unit Code	Unit Title	Scope/Descriptor
UEENEEK029B	Design renewable energy heating systems	This unit covers the design of renewable energy heating systems and their installation. It encompasses following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunction, ensuring other safety and performance standards and functional requirements are meet and documenting design calculations and criteria.
UEENEEK030B	Solve problems in wind energy conversion systems	This unit covers providing known solutions to predicable problems in wind energy conversion systems. It encompasses working safely, problem solving procedures, including the use of basic voltage, current and resistance measuring devices, providing known solutions to predicable circuit problems.
UEENEEK031B	Design wind energy conversion systems rated to 10 kW	This unit covers the design of wind energy conversion systems and their installation. It encompasses following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunction, ensuring other safety and performance standards and functional requirements are meet and documenting design calculations and criteria.
UEENEEK032B	Develop strategies to address sustainability issues	This unit covers developing strategies to address greenhouse gases and sustainability issues. It encompasses working safely, apply extensive knowledge of sustainable energy systems and components and their operating parameters, gathering and analysing data, applying problem solving techniques, developing and documenting alternatives solutions.
UEENEEK033B	Design set up hybrid power systems	This unit covers the design of hybrid power systems and their installation. It encompasses following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunction, ensuring other safety and performance standards and functional requirements are meet and documenting design calculations and criteria.

Unit Code	Unit Title	Scope/Descriptor
UEENEEK034B	Install standalone photovoltaic power systems	This competency standard unit covers the installation, adjustment and set up of stand-alone photovoltaic power systems. It encompasses working safely and to installation standards, matching components with that specified for a given location, placing and securing system components accurately, making required circuit connections and completing the necessary installation documentation.
UEENEEK035C	Design grid connected power supply systems	This unit covers the design of grid connected power supply systems and their installation. It encompasses following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunction, ensuring other safety and performance standards and functional requirements are met and documenting design calculations and criteria.
UEENEEK036B	Prepare grid connected photovoltaic power systems for LV connection	This competency standard unit covers the preparation of grid connected photovoltaic power systems for connection to an electricity supply grid via an inverter. It encompasses working safely and to installation standards, matching components with that specified for a given location, placing and securing system components accurately, preparing for the required circuit connections and completing the necessary installation documentation.
UEENEEK037B	Install and set up micro-hydro systems	This unit covers the installation and adjustment and set-up of micro-hydro systems. It encompasses working safely and to installation standards, matching components with that specified for a given location, placing and securing system components accurately, making required circuit connections and completing the necessary installation documentation.
UEENEEK038B	Design micro-hydro systems	This unit covers the design of micro-hydro systems and their installation. It encompasses following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunction, ensuring other safety and performance standards and functional

Unit Code	Unit Title	Scope/Descriptor
		requirements are meet and documenting design calculations and criteria.
UEENEEK039B	Design stand-alone renewable energy systems	This unit covers the design of stand-alone renewable energy systems and their installation. It encompasses following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunction, ensuring other safety and performance standards and functional requirements are meet and documenting design calculations and criteria.
UEENEEK040B	Develop engineering solution to renewable energy problems	This unit covers developing engineering solutions to resolve problems with renewable energy. It encompasses working safely, apply extensive knowledge of renewable energy systems and components and their operating parameters, gathering and analysing data, applying problem solving techniques, developing and documenting alternatives solutions.
UEENEEK042A	Participate in environmentally sustainable work practices	This competency standard unit requires the worker to undertake methods of work practice that minimises energy and material usage and to seek energy reduction strategies in the workplace. The unit seeks to minimise negative impacts on the environment.
UEENEEK043A	Install small wind energy conversion systems for stand-alone applications	This competency standard unit covers the installation, adjustment and set up of small wind energy conversion systems for stand-alone applications. It encompasses working safely and to installation standards, matching components with that specified for a given location, placing and securing system components accurately, making required circuit connections and completing the necessary installation documentation.
UEENEEK044A	RESERVED	
UEENEEK045A	Implement & monitor, policies & procedures for environmentally sustainable electrotech	This Competency Standard Unit specifies the outcomes for the collecting, interpretation and application of environmental management information, the identification of environmental impacts and the assessment of risks. It also

Unit Code	Unit Title	Scope/Descriptor
	work practice	consists of monitoring while implementing environmentally sustainable work policies and plans an, the development of modifications as part of the review process.
UEENEEK046A	Design energy management controls for electrical installations in buildings	This competency standard unit covers designing and developing methods to reduce the energy use without compromising occupancy standards in new buildings and structures. The unit encompasses working safely, setting up and conducting evaluation measurements, predicting energy use from plans and specifications and designing and documenting strategies to effectively reduce energy use in the completed installation. It draws on some multi-disciplinary skills.
UEENEEK047A	Maintain and monitor remote area essential service operations	This unit covers basic maintenance power station compound of remote area infrastructure facilities, monitoring power station performance and developing a basic maintenance schedule. It encompasses working safely, to maintenance standards and following maintenance routines, identifying deterioration and damage to facilities using routine procedures, reading and recording performance information from instruments/meters and completing the necessary reporting.
UEENEEK048A	Install, configure and commission grid connected photovoltaic power systems	This unit covers the installation, adjustment and set-up of photovoltaic power systems and connecting to a supply grid inverter. It encompasses working safely and to installation standards, matching components with that specified for a given location, placing and securing system components accurately, making required circuit connections and completing the necessary installation documentation.
UEENEEK049A	Verify compliance and functionality of a renewable energy installation	This competency standard unit covers inspection and testing to verify whether a Stand-alone Power System is safe and complies with all requirements. It encompasses working safely, visual inspections and mandatory, optional and functional test procedures, identifying non-compliance defects and mandatory reporting

Unit Code	Unit Title	Scope/Descriptor
		requirements.
UEENEEK050A	Assemble and set up photovoltaic apparatus in a domestic dwelling	This unit covers assembling and setting up of ELV photovoltaic apparatus in domestic dwellings. It encompasses safe working practices; secure placement of apparatus, following written and oral instruction and procedures and customer relations.
UEENEEK051A	Develop effective strategies for energy reduction in buildings	This unit covers evaluating energy used in buildings and developing and documenting strategies/methods to effectively reduce energy use without compromising occupancy standards. It encompasses working safely, setting up and conducting evaluation measurements and evaluating energy use from measured parameters.

Discipline L – Imported units

Unit Code	Unit Title	Scope/Descriptor
ICTTEN3056A	Install telecommunications network equipment	This unit describes the performance outcomes, skills and knowledge required to effectively install and test telecommunications network equipment. It includes processes for checking plans, obtaining and proper handling of equipment and supplies. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN5083A	Locate, diagnose and rectify complex faults	This unit describes the performance outcomes, skills and knowledge required to locate, diagnose and rectify complex faults in telecommunications networks and equipment. It includes identification of faults in upstream or downstream services that may require involvement of third party providers. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users

Unit Code	Unit Title	Scope/Descriptor
		should confirm requirements with the relevant federal, state or territory authority.
ICTTEN4085A	Monitor, analyse and action telecommunications network alarms	This unit describes the performance outcomes, skills and knowledge required to take appropriate action in response to network alarms. It includes network impact, problem diagnosis, network restoration and normalisation of alarms. The alarms may be monitored locally on site, or remotely by technical field staff or by personnel at the Network Operations Centre (NOC). No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN4081A	Locate, diagnose and rectify faults	This unit describes the performance outcomes, skills and knowledge required to locate, diagnose and rectify faults in telecommunications networks. Telecommunications networks include cabling, customer premises equipment (CPE), access, telephony, broadband deployment, local area networks (LAN), wide area networks (WAN) and internet protocol (IP) networks for enterprise and customer systems and installations. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN3089A	Repair and replace telecommunications network hardware	This unit describes the performance outcomes, skills and knowledge required to repair and replace network hardware in a telecommunications network as part of fault restoration. This unit involves work performed under the direction of the Network Operations

Unit Code	Unit Title	Scope/Descriptor
		Centre (NOC), where control of the network is coordinated. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
UETTDNIS04B	Perform high voltage field switching operation to a given schedule	This competency standard unit covers the carrying out of high voltage switching operations involving the operation of circuit breaking and isolation devices from a given switching schedule and according to enterprise procedures. It also encompasses the process of; communicating with the Switching Control Officer or Electrical Control Officer, isolating the electrical equipment and the line or work site, as well as proving that the area is de-energised and earthed, issuing/accepting electrical permits and the returning of the affected circuits to service.
ICTTEN2207A	Install and configure a home or small office network	This unit describes the performance outcomes, skills and knowledge required for entry level networking support to establish a small office or home office (SOHO) internet connected PC network. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN2208A	Install and configure a small to medium business network	This unit describes the performance outcomes, skills and knowledge required to establish and support a small to medium business network capable of providing wide area network (WAN) connectivity and common web internet services. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of

Unit Code	Unit Title	Scope/Descriptor
		endorsement but users should confirm requirements with the relevant federal, state or territory authority
ICTTEN2209A	Build and maintain a secure network	This unit describes the performance outcomes, skills and knowledge required to build a simple and secure wired local area network (LAN) or wide area network (WAN). No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN4210A	Implement and troubleshoot enterprise routers and switches	This unit describes the performance outcomes, skills and knowledge required to implement and troubleshoot routers and switches. It involves configuring and programming routers and switches to establish voice and data services and applications over local area networks (LAN) and wide area networks (WAN) connections for enterprise networks. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN4211A	Design, install and configure an internetwork	This unit describes the performance outcomes, skills and knowledge required to design, install and configure an enterprise local area network (LAN) and wide area network (WAN) internetwork. It involves testing and troubleshooting an internetwork. The design involves determining network requirements and topology selection for wired and wireless infrastructure. Advanced routing and addressing schemes are also used in the design. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users

Unit Code	Unit Title	Scope/Descriptor
		should confirm requirements with the relevant federal, state or territory authority.
ICTTEN4212A	Apply advanced routing protocols to network design	This unit describes the performance outcomes, skills and knowledge required to use software tools, equipment, software and protocols to configure and troubleshoot network routers. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN4213A	Configure and troubleshoot advanced network switching	This unit describes the performance outcomes, skills and knowledge required to perform network switch configuration and troubleshooting, including network management by remote access for wired and wireless networks. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
ICTTEN4214A	Install and maintain a wide area network	This unit describes the performance outcomes, skills and knowledge required to use appropriate tools, equipment, software and protocols to install and maintain a wide area network (WAN). No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
BSBITU306A	Design and produce business documents	This unit describes the performance outcomes, skills and knowledge required to design and produce various business documents and publications. It includes selecting and using a range of functions on a variety of computer

Unit Code	Unit Title	Scope/Descriptor
		applications. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement. This unit relates to BSBCMN213A Produce simple word processed documents and BSBCMN405A Analyse and present research information. Consider co-assessment with BSBCMN305A Organise workplace information.
BSBSMB405A	Monitor and manage small business operations	This unit is concerned with the operation of the business and with implementing the business plan. The strategies involve monitoring, managing and reviewing operational procedures. It is suitable for existing micro and small businesses or a department in a larger organisation.
BSBMGT502B	Manage people performance	This unit describes the performance outcomes, skills and knowledge required to manage the performance of staff who report to them directly. Development of key result areas and key performance indicators and standards, coupled with regular and timely coaching and feedback, provide the basis for performance management. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement.
BSBINM501A	Manage an information or knowledge management system	This unit describes the performance outcomes, skills and knowledge required to organise learning to use an information or knowledge management system and to manage the use of the system. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement.
BSBMGT516C	Facilitate continuous	This unit describes the performance outcomes, skills and knowledge

Unit Code	Unit Title	Scope/Descriptor
	improvement	required to lead and manage continuous improvement systems and processes. Particular emphasis is on the development of systems and the analysis of information to monitor and adjust performance strategies, and to manage opportunities for further improvements. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement.
BSBINN502A	Build and sustain an innovative work environment	This unit describes the performance outcomes, skills and knowledge required to create an environment that enables and supports the application of innovative practice. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement.
BSBWOR502B	Ensure team effectiveness	This unit describes the performance outcomes, skills and knowledge required to facilitate all aspects of teamwork within the organisation. It involves taking a leadership role in the development of team plans, leading and facilitating teamwork and actively engaging with the management of the organisation. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement.
CPCCOHS1001A	Work safely in the construction industry	This unit of competency specifies the outcomes required to undertake Occupational Health and Safety (OHS) induction training within the construction industry. It requires the ability to demonstrate personal awareness of OHS legislative requirements, and the basic principles of risk management and prevention of injury and illness in the construction industry. Licensing requirements will apply to this unit of competency depending on the regulatory

Unit Code	Unit Title	Scope/Descriptor
		requirements of each jurisdiction.
HLTCPR201A	Perform CPR	This unit of competency describes the skills and knowledge required to perform Cardiopulmonary Resuscitation (CPR) in line with the Australian Resuscitation Council (ARC) Guidelines
HLTFA301B	Apply first aid	This unit of competency describes the skills and knowledge required to provide first aid response, life support, management of casualty(s), the incident and other first aiders, until the arrival of medical or other assistance
MEM16006A	Organise and communicate information	This unit covers accessing, organising and communicating information related to processes or tasks.
MEM16008A	Interact with computing technology	This unit covers accessing, inputting and storing information used in manufacturing, engineering or related environments, using computing technology.
MEM30001A	Use computer aided drafting systems to produce basic engineering drawings	This unit covers producing basic engineering drawings using a CAD system, under the direction of a supervisor.
MEM30002A	Produce basic engineering graphics	This unit covers producing drawings or similar graphical representations where the critical dimensions and associated tolerances and design specifications are predetermined.
MEM30003A	Produce detailed engineering drawings	This unit covers producing detailed drawings of engineering components complete with surface texture details and dimensions.
MEM30004A	Use CAD to create and display 3D models	This unit covers using a CAD program to produce and plot basic three dimensional view drawings.
MEM05012C	Perform routine manual metal	This unit covers preparing the materials

Unit Code	Unit Title	Scope/Descriptor
	arc welding	and carrying out routine manual metal arc welding (MMAW)
MEM05007C	Perform manual heating and thermal cutting	This unit covers performing manual heating, thermal cutting and gouging including the assembly and disassembly and operation of the equipment on a range of materials (ferrous, non-ferrous and non-metallic) using a variety of methods.
MSACMS200A	Apply competitive manufacturing practices	This unit covers the skills needed to implement basic improvement practices within a competitive manufacturing organisation. The unit focuses on bringing together the basic concepts and the holistic application of these basic concepts and processes to manufacturing. It would typically be carried out working as part of a team.
MSACMT220A	Apply quick changeover procedures	This unit covers the knowledge and skills needed to do quick changeovers.
		Note: <i>The unit applies to a typical scenario, an organisation is pursuing quick changeover as one of its competitive manufacturing tools. This unit covers the carrying out of these quick changeovers and also recommending improvements within the scope and authority of the person's job. Particular technical skills may also be required in some manufacturing sectors and for some jobs. These will be contained in the relevant industry Training Package.</i>
MSACMT221A	Apply Just in Time (JIT) procedures	This unit covers the knowledge and skills needed to work in a JIT system.
		Note: <i>The unit applies in a typical scenario, a person working in an organisation following JIT will need to follow procedures which are specific to JIT</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>such as the controlled flow of material (e.g. the use of kanban, and elimination of waste etc). This will involve the operator in the application of the pull system to their job and the authorisation of product/material flows, in accordance with procedures and their level of authority</i>
MSACMT240A	Apply 5S procedures in a manufacturing environment	This unit covers the knowledge and skills needed for an employee to apply 5S procedures (a structured approach to housekeeping) to their own job and work area.
MSACMT280A	Undertake root cause analysis	This unit covers the knowledge and skills needed to undertake root cause analysis (RCA) by any person. This will often be done by people working in a team. This unit also covers the competencies needed by operators to contribute to an advanced maintenance strategy using RCA coupled with diagrams and charts.
MSACMT281A	Contribute to the application of a proactive maintenance strategy	This unit covers the knowledge and skills required to make a positive contribution to proactive maintenance strategies which include things like plant uptime and Overall Equipment Efficiency (OEE).
NWP209B	Use maps, plans, drawings and specifications	This unit of competency describes the outcomes required to read and interpret maps, plans, drawings and specifications.
NWP218B	Perform and record sampling	This unit of competency describes the outcomes required to collect and prepare water and wastewater samples according to legislative and organisational standard operating procedures.
NWP226B	Prepare and restore work site	This unit of competency describes the outcomes required to prepare work sites prior to work and restore them on

Unit Code	Unit Title	Scope/Descriptor
		completion of work. The ability to follow work instructions, use a range of equipment and tools to prepare a safe work site and subsequently to restore the site to the required condition is essential to satisfactory performance.
NWP227B	Control vegetation on a site	This unit of competency describes the outcomes required to control vegetation on a site by inspecting, identifying and treating weeds, plants and shrubs. The ability to plan and undertake work safely, including the safe handling of chemicals and equipment, is essential to performance.
NWP229B	Repair minor structures	This unit of competency describes the outcomes required to construct and repair minor structural assets of the water industry, such as meter pits, erosion barriers and small weirs.
NWP243B	Operate bore fields and groundwater source systems	This unit of competency describes the outcomes required to operate bore fields and groundwater source systems. Monitoring the availability and quality of supply and control of water flows from the source are also required, in conjunction with the ability to apply legislative and organisational requirements.
NWP245B	Maintain tanks and water storage assets	This unit of competency describes the outcomes required to maintain and repair tanks and water storage assets, including reservoirs, balancing storages, sand dams and ring dams.
NWP247A	Maintain catchment and surrounding areas	This unit of competency describes the outcomes required to maintain surface catchment areas and associated rivers, lakes, water bodies, dams, water storages and groundwater areas in a manner that meets organisational standards and contributes to the maintenance of water quality, and the protection of the environment and the

Unit Code	Unit Title	Scope/Descriptor
		public. The ability to apply organisational procedures, apply procedures to maintain environmental conditions, undertake maintenance and report outcomes is essential to performance.
NWP253B	Install and repair water services	This unit of competency describes the outcomes required to install and repair water service pipes running from the main supply to the consumer connection.
NWP255B	Maintain and repair wastewater collection assets	This unit of competency describes the outcomes required to maintain and repair pipes, drains and wastewater collection assets.
NWP256B	Monitor and report water distribution systems	This unit of competency describes the outcomes required to inspect water distribution systems, detect faults and report on water distribution system performance.
NWP257B	Maintain and repair wastewater collection systems	This unit of competency describes the outcomes required to investigate reported problems in wastewater collection systems and to conduct appropriate maintenance and repair work on wastewater collection assets.
NWP259B	Operate, monitor and maintain pump stations	This unit of competency describes the outcomes required to operate and monitor the performance of pump stations in water and wastewater systems and undertake minor maintenance, or organise more complex maintenance, of pump stations according to organisational operating procedures.
NWP260A	Monitor and report water treatment processes	This unit of competency describes the outcomes required to monitor and report on water treatment processes within potable community and industrial water treatment plants in urban and rural

Unit Code	Unit Title	Scope/Descriptor
		areas.
NWP261A	Operate and maintain water treatment plant and equipment	This unit of competency describes the outcomes required to operate water treatment processes within potable community and industrial water treatment plants in urban and rural areas. The ability to operate water treatment processes in compliance with relevant water legislation and regulations, and Australian Drinking Water Guidelines is vital to performance.
NWP262A	Monitor and report wastewater treatment processes	This unit of competency describes the outcomes required to monitor and report on wastewater treatment processes within domestic and industrial wastewater treatment plants in urban and rural areas. The ability to monitor processes to ensure that wastewater disposal or re-use meets state or territory licensing requirements is essential to performance.
NWP263A	Operate and maintain wastewater treatment plant and equipment	This unit of competency describes the outcomes required to operate and maintain wastewater treatment processes within domestic and industrial wastewater treatment plants in urban and rural areas. The ability to operate wastewater treatment processes to ensure that wastewater disposal or reuse meets state or territory licensing requirements is essential to performance.
NWP268B	Monitor, operate and report chlorine disinfection systems	This unit of competency describes the outcomes required to monitor and operate chlorine disinfection systems and to report on process quality control.
PMBQUAL390A	Solve problems using 'quality tools'	This competency covers the solving of process and other problems, beyond those associated directly with the process unit, using a structured approach such as problem solving tools

Unit Code	Unit Title	Scope/Descriptor
		and techniques to achieve the organisation's quality objectives. The competency is typically performed by an experienced operator, leading hand or supervisor.
PRMPFES43A	Prevent ozone depleting substance and synthetic greenhouse gas emissions	This unit of competency specifies fire protection industry work outcomes required to interpret and explain agreements, protocols, legislation, regulations, codes of practice and handling licences developed to control ozone layer depletion and global warming. The unit also covers assessing the impact of ozone layer depletion and global warming on fire protection industry work practices and proposing changes to work practices in the fire protection industry to tackle the threat of ozone layer depletion and global warming.
RIIOHS202A	Enter and work in confined spaces	This unit covers the entering and working in confined spaces in resources and infrastructure industries. It includes planning and preparing for entry of confined spaces; entry and working in confined spaces, exiting confined spaces and cleaning up.
RIIOHS204A	Work safely at heights	This unit covers working safely at heights in resources and infrastructure industries. It includes: identifying the work requirements, work procedures and instructions for the task; accessing and installing equipment; performing work at heights; and cleaning up the work area.
RIIOHS205A	Control traffic with stop-slow bat	This unit covers controlling of traffic with a stop-slow bat in resources and infrastructure industries. It includes: planning and preparing; coordinating traffic; operating radios; and cleaning up.

Unit Code	Unit Title	Scope/Descriptor
RIIRAI609A	Establish and maintain electrical installations, reticulation and protection system	This unit covers establishing and maintaining the mine electrical installations, reticulation and protection systems in the coal mining industry. It includes providing the following: power supply systems; electrical protection systems; cables from power source to point of usage; mobile machinery and electrical apparatus; overall electrical services that apply to production systems; and safe electrical work procedures.
RIIRIS601A	Establish and maintain the risk management system	This unit covers the establishing and maintaining of risk management systems in resources and infrastructure industries. It includes: establishing the framework processes to support the system; planning and facilitating the implementation of the system; auditing the risk management processes; and ensuring completion of records and reports.
TLIB3407B	Maintain poles and associated hardware	This unit involves the skills and knowledge required to maintain poles and associated hardware in accordance with safe working and regulatory requirements and workplace procedures, including planning for the maintenance of poles and associated hardware, preparing the worksite, conducting the maintenance of poles and associated hardware, and completing all of the work requirements.
TLIB4007B	Inspect poles and associated hardware	This unit involves the skills and knowledge required to inspect poles and associated hardware in accordance with safe-working and regulatory requirements and workplace procedures, including planning and preparing for the inspection, conducting the inspection of the poles and associated hardware, and completing the inspection in accordance with workplace requirements.

Unit Code	Unit Title	Scope/Descriptor
TLIB4807B	Carry out off-site repair, overhaul and assembly of mechanical signalling equipment	This unit involves the skills and knowledge required to carry out off-site repair, overhaul and assembly of mechanical signalling equipment in accordance with safe working and regulatory requirements and workplace procedures, including assessing equipment condition, replacing out-of-specification components, producing components where required, assembling components, and testing and adjusting equipment to ensure overall system integrity.
TLIB5307B	Maintain mechanical signalling locking and interlocking devices	This unit involves the skills and knowledge required to maintain mechanical signalling locking and interlocking devices in accordance with safe working and regulatory requirements and workplace procedures, including diagnosing and correcting faults in the devices, and testing and adjusting the repaired equipment to meet workplace and manufacturers standards.
TLIB5807B	Maintain aerial signal/telecommunications lines and cables	This unit involves the skills and knowledge required to maintain aerial signal/telecommunications lines and cables in accordance with safe working and regulatory requirements and workplace procedures, including inspecting and servicing line and cable routes, diagnosing any identified line and cable faults and repairing any line and cable faults to the standards specified to ensure system integrity.
TLID3507C	Operate a boom type elevating work platform	This unit involves the skills and knowledge required to operate a boom type elevating work platform, including inspecting and testing the elevating work platform, assessing job requirements and work, planning work and setting up for lift, carrying out the elevation, implementing planned hazard

Unit Code	Unit Title	Scope/Descriptor
		control and strategies, and packing up the work platform after operations. Licensing, legislative, regulatory or certification requirements are applicable to this unit.
TLILIC508A	Licence to operate a boom-type elevating work platform (boom length 11 metres or more)	This unit specifies the outcomes required to operate a boomtype elevating work platform (boom length 11 metres or more) for licensing purposes, and involves the operation of a telescoping device, hinged device, or articulated device or any combination of these used to support a platform on which personnel, equipment and materials may be elevated to perform work. The 11 metre boom length shall be taken to mean the greater of the following: (a) The vertical distance from the floor of the platform to the surface supporting the elevating work platform with the platform at its maximum height; or (b) The nominal reach, measured horizontally from the centre point of rotation to the outer edge of the platform in its most extended position.
TLIS507B	Install mechanical infrastructure for signalling	This unit involves the skills and knowledge required to install mechanical infrastructure for signalling in accordance with safe working and regulatory requirements and workplace procedures, including assembling components, installing the equipment and components to specifications, and testing and adjusting the equipment to workplace requirements.
TLIS807B	Decommission electrical and electromechanical signalling infrastructure equipment from service	This unit involves the skills and knowledge required to decommission electrical and electromechanical signalling infrastructure equipment from service in accordance with safe working and regulatory requirements and

Unit Code	Unit Title	Scope/Descriptor
		workplace procedures. It includes disconnecting the electrical/electromechanical equipment and components; testing and adjusting the remaining equipment; and certifying and securing the operational equipment in accordance with workplace requirements.
TLIS907B	Install mechanical signalling locking and interlocking devices	This unit involves the skills and knowledge required to install mechanical signalling locking and interlocking devices in accordance with safe working and regulatory requirements and workplace procedures, including assembling components, installing equipment and components to specifications, and testing and adjusting the equipment in accordance with workplace procedures.
TLIX1107B	Install overhead wiring structure	This unit involves the skills and knowledge required to install overhead wiring structures in accordance with safe working and regulatory requirements and workplace procedures including planning and preparing for the installation, installing the required components to specification, and completing all required documentation.
TLIX1607B	Erect and mount structures and housings for signalling equipment	This unit involves the skills and knowledge required to erect and mount structures and housings for signalling equipment in accordance with safe working and regulatory requirements and workplace procedures including installing the foundations, assembling the components, and installing and mounting the structures and housings in accordance with specifications.
UEPOPS234A	Perform Routine Oxyacetylene (Fuel Gas) Welding (OAW)	This unit deals with the skills and knowledge required to be applied in a maintenance environment where welding is not required to meet Australian Standard 1554 general

Unit Code	Unit Title	Scope/Descriptor
		purpose or equivalent Codes and/or licensing requirements. This unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training.
UEPOPS235A	Perform routine manual arc welding	This unit deals with the skills and knowledge required to be applied in a maintenance environment where welding is not required to meet Australian Standard 1554 general purpose or equivalent Codes and/or licensing requirements. This unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training.
UEPOPS236A	Perform manual heating, thermal cutting and gouging	This unit deals with the skills and knowledge required to be applied in a maintenance environment and would be used to facilitate a wide range of maintenance activities. This unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training.
One unit from an endorsed TP	One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF	A competency standard unit may be selected from a relevant nationally endorsed National Quality Council (NQC) Training Package. The unit selected as an elective must be aligned to the qualification level being completed.

Discipline M – Hazardous

Unit Code	Unit Title	Scope/Descriptor

Unit Code	Unit Title	Scope/Descriptor
UEENEEM019A	Attend to breakdowns in hazardous areas — coal mining	This unit covers the explosion-protection aspects of attending to a breakdown in a hazardous area or of explosion-protected and associated equipment. It requires the ability to ascertain the nature of a breakdown, the extent of repairs required and the personnel needed to repair the breakdown. This unit is directly equivalent to the Unit 2.3 Attend to breakdowns in hazardous areas in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM020A	Attend to breakdowns in hazardous areas — gas atmospheres	This unit covers the explosion-protection aspects of attending to a breakdown in a hazardous area or of explosion-protected and associated equipment. It requires the ability to ascertain the nature of a breakdown, the extent of repairs required and the personnel needed to repair the breakdown. This unit is directly equivalent to the Unit 2.3 Attend to breakdowns in hazardous areas in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM021A	Attend to breakdowns in hazardous areas — dust atmospheres	This unit covers the explosion-protection aspects of attending to a breakdown in a hazardous area or of explosion-protected and associated equipment. It requires the ability to ascertain the nature of a breakdown, the extent of repairs required and the personnel needed to repair the breakdown. This unit is directly equivalent to the Unit 2.3 Attend to breakdowns in hazardous areas in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards.</i> Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM022A	Attend to breakdowns in hazardous areas — pressurisation	This unit covers the explosion-protection aspects of attending to a breakdown in a hazardous area or of explosion-protected and associated equipment. It requires the ability to ascertain the nature of a breakdown, the extent of repairs required and the personnel needed to repair the breakdown. This unit is directly equivalent to the Unit 2.3 Attend to breakdowns in hazardous areas in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM023A	Install explosion-protected equipment and wiring systems — coal mining	This unit covers the explosion-protection aspects for installing explosion-protected and associated equipment and wiring systems. It requires the ability to match equipment with that specified for a given location, work safely, and to installation standards and complete the necessary installation documentation. This unit is directly equivalent to the Unit 2.5 Install explosion-protected equipment and wiring systems in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM024A	Install explosion-protected equipment and wiring systems — gas atmospheres	This unit covers the explosion-protection aspects for installing explosion-protected and associated equipment and wiring systems. It requires the ability to match equipment with that specified for a given location, work safely, and to installation standards and complete the

Unit Code	Unit Title	Scope/Descriptor
		necessary installation documentation. This unit is directly equivalent to the Unit 2.5 <i>Install explosion-protected equipment and wiring systems</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM025A	Install explosion-protected equipment and wiring systems — dust atmospheres	This unit covers the explosion-protection aspects for installing explosion-protected and associated equipment and wiring systems. It requires the ability to match equipment with that specified for a given location, work safely, and to installation standards and complete the necessary installation documentation. This unit is directly equivalent to the Unit 2.5 <i>Install explosion-protected equipment and wiring systems</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM026A	Install explosion-protected equipment and wiring systems — pressurisation	This unit covers the explosion-protection aspects for installing explosion-protected and associated equipment and wiring systems. It requires the ability to match equipment with that specified for a given location, work safely, and to installation standards and complete the necessary installation documentation. This unit is directly equivalent to the Unit 2.5 <i>Install explosion-protected equipment and wiring systems</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.

Unit Code	Unit Title	Scope/Descriptor
UEENEEM027A	Maintain equipment in hazardous areas — coal mining	This unit covers the explosion-protection aspects for maintaining explosion-protected and associated equipment and wiring systems. It requires the ability to follow a maintenance program, work safely, carry out maintenance to standards and manufacturer instructions and complete the necessary maintenance documentation. This unit is directly equivalent to the Unit 2.7 <i>Maintain equipment in hazardous areas</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM028A	Maintain equipment in hazardous areas — gas atmospheres	This unit covers the explosion-protection aspects for maintaining explosion-protected and associated equipment and wiring systems. It requires the ability to follow a maintenance program, work safely, carry out maintenance to standards and manufacturer instructions and complete the necessary maintenance documentation. This unit is directly equivalent to the Unit 2.7 <i>Maintain equipment in hazardous areas</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM029A	Maintain equipment in hazardous areas — dust atmospheres	This unit covers the explosion-protection aspects for maintaining explosion-protected and associated equipment and wiring systems. It requires the ability to follow a maintenance program, work safely, carry out maintenance to standards and manufacturer instructions and complete the necessary maintenance documentation. This unit is directly equivalent to the Unit 2.7

Unit Code	Unit Title	Scope/Descriptor
		<i>Maintain equipment in hazardous areas in the Australian/New Zealand Standard AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards.</i> Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM030A	Maintain equipment in hazardous areas — pressurisation	This unit covers the explosion-protection aspects for maintaining explosion-protected and associated equipment and wiring systems. It requires the ability to follow a maintenance program, work safely, carry out maintenance to standards and manufacturer instructions and complete the necessary maintenance documentation. This unit is directly equivalent to the Unit 2.7 <i>Maintain equipment in hazardous areas in the Australian/New Zealand Standard AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards.</i> Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM031A	Overhaul and repair of explosion-protected equipment — coal mining	This unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment and the activities required of the responsible person. It requires the ability to establish and document the level of work required, arranging for the overhaul/repair to be carried, verify compliance of overhauled/repared equipment and complete the necessary documentation. This unit is directly equivalent to the Unit 2.8 <i>Overhaul and repair of explosion-protected equipment in the Australian/New Zealand Standard AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards.</i> Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.

Unit Code	Unit Title	Scope/Descriptor
UEENEEM032A	Overhaul and repair of explosion-protected equipment — flameproof enclosures	This unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment and the activities required of the responsible person. It requires the ability to establish and document the level of work required, arranging for the overhaul/repair to be carried, verify compliance of overhauled/repared equipment and complete the necessary documentation. This unit is directly equivalent to the Unit 2.8 <i>Overhaul and repair of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM033A	Overhaul and repair of explosion-protected equipment — gas atmospheres	This unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment and the activities required of the responsible person. It requires the ability to establish and document the level of work required, arranging for the overhaul/repair to be carried, verify compliance of overhauled/repared equipment and complete the necessary documentation. This unit is directly equivalent to the Unit 2.8 <i>Overhaul and repair of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM034A	Overhaul and repair of explosion-protected equipment — dust atmospheres	This unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment and the activities required of the responsible person. It requires the ability to establish and document the level of work required, arranging for the overhaul/repair to be carried, verify compliance of

Unit Code	Unit Title	Scope/Descriptor
		overhauled/repaired equipment and complete the necessary documentation. This unit is directly equivalent to the Unit 2.8 <i>Overhaul and repair of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM035A	Conduct a conformity assessment of explosion-protected equipment — coal mining	This Competency Standard Unit covers assessing the Certification documentation of explosion-protected equipment with a certificate of conformity other than an IEC Ex, ANZ Ex or AUS Ex Certificate, and producing a conformity assessment document. It encompasses skills and knowledge to examine and compare document content, compare requirements of IEC or AS/NZS Standards with alternative Standards on which the original certification was based, knowledge of explosion-protection techniques and technical report writing. This unit is directly equivalent to the Unit 2.9 <i>Conduct a conformity assessment of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit. Note This unit is for the preparation of a conformity assessment document, including Standards to alternative Standards assessment only.
UEENEEM036A	Conduct a conformity assessment of explosion-protected equipment — gas atmospheres	This Competency Standard Unit covers assessing the Certification documentation of explosion-protected equipment with a certificate of conformity other than an IECEx, ANZEx or AUS Ex Certificate, and producing a

Unit Code	Unit Title	Scope/Descriptor
		conformity assessment document. It encompasses skills and knowledge to examine and compare document content, compare requirements of IEC or AS/NZS Standards with alternative Standards on which the original certification was based, knowledge of explosion-protection techniques and technical report writing. This unit is directly equivalent to the Unit 2.9 <i>Conduct a conformity assessment of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
		Note This unit is for the preparation of a conformity assessment document, including Standards to alternative Standards assessment only.
UEENEEM037A	Conduct a conformity assessment of explosion-protected equipment — dust atmospheres	This Competency Standard Unit covers assessing the Certification documentation of explosion-protected equipment with a certificate of conformity other than an IEC Ex, ANZ Ex or AUS Ex Certificate, and producing a conformity assessment document. It encompasses skills and knowledge to examine and compare document content, compare requirements of IEC or AS/NZS Standards with alternative Standards on which the original certification was based, knowledge of explosion-protection techniques and technical report writing. This unit is directly equivalent to the Unit 2.9 <i>Conduct a conformity assessment of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the

Unit Code	Unit Title	Scope/Descriptor
		Range statement of this unit. Note This unit is for the preparation of a conformity assessment document, including Standards to alternative Standards assessment only.
UEENEEM038A	Conduct testing of hazardous areas installations — coal mining	This unit covers the explosion-protection aspects for electrical, electronic, instrument and data communication installations for hazardous areas. It requires the ability to select, prepare and use appropriate testing devices, work safely and to Standards and to interpret and record test results. This unit is directly equivalent to the Unit 2.10 <i>Conduct testing of hazardous areas installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit. Note. This unit is directly equivalent to the Unit in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>
UEENEEM039A	Conduct testing of hazardous areas installations — gas atmospheres	This unit covers the explosion-protection aspects for electrical, electronic, instrument and data communication installations for hazardous areas. It requires the ability to select, prepare and use appropriate testing devices, work safely and to Standards and to interpret and record test results. This unit is directly equivalent to the Unit 2.10 <i>Conduct testing of hazardous areas installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the

Unit Code	Unit Title	Scope/Descriptor
		Range statement of this unit.
UEENEEM040A	Conduct testing of hazardous areas installations — dust atmospheres	This unit covers the explosion-protection aspects for electrical, electronic, instrument and data communication installations for hazardous areas. It requires the ability to select, prepare and use appropriate testing devices, work safely and to Standards and to interpret and record test results. This unit is directly equivalent to the Unit 2.10 <i>Conduct testing of hazardous areas installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM041A	Conduct testing of hazardous area installations — pressurisation	This unit covers the explosion-protection aspects for electrical, electronic, instrument and data communication installations for hazardous areas. It requires the ability to select, prepare and use appropriate testing devices, work safely and to Standards and to interpret and record test results. This unit is directly equivalent to the Unit 2.10 <i>Conduct testing of hazardous areas installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM042A	Conduct visual inspection of hazardous areas installations	This unit covers the explosion-protection aspects for conducting visual inspections of explosion-protected equipment and installations. It requires the ability to work safely in a hazardous area and to identify conditions that affect the integrity of explosion-protection and document inspection findings. This unit is directly equivalent to the Unit 2.11 <i>Conduct visual inspection of hazardous areas</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>installations in the Australian/New Zealand Standard AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.</i>
UEENEEM043A	Conduct detailed inspection of hazardous areas installations — coal mining	This unit covers the explosion-protection aspects of conducting close and detailed inspections of explosion-protected equipment and installations. It requires the ability to use a verification dossier, work safely in a hazardous area, inspect against Standards and report and act on inspection results. This unit is directly equivalent to the Unit 2.12 <i>Conduct detailed inspection of hazardous areas installations</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM044A	Conduct detailed inspection of hazardous areas installations — gas atmospheres	This unit covers the explosion-protection aspects of conducting close and detailed inspections of explosion-protected equipment and installations. It requires the ability to use a verification dossier, work safely in a hazardous area, inspect against Standards and report and act on inspection results. This unit is directly equivalent to the Unit 2.12 <i>Conduct detailed inspection of hazardous areas installations</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM045A	Conduct detailed inspection of hazardous areas installations — dust	This unit covers the explosion-protection aspects of conducting close and detailed inspections of explosion-protected equipment and installations. It requires the ability to use a

Unit Code	Unit Title	Scope/Descriptor
	atmospheres	verification dossier, work safely in a hazardous area, inspect against Standards and report and act on inspection results. This unit is directly equivalent to the Unit 2.12 <i>Conduct detailed inspection of hazardous areas installations</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM046A	Conduct detailed inspection of hazardous areas installations — pressurisation	This unit covers the explosion-protection aspects of conducting close and detailed inspections of explosion-protected equipment and installations. It requires the ability to use a verification dossier, work safely in a hazardous area, inspect against Standards and report and act on inspection results. This unit is directly equivalent to the Unit 2.12 <i>Conduct detailed inspection of hazardous areas installations</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM047A	Develop and manage maintenance programs for hazardous areas electrical equipment — coal mining	This unit covers the explosion-protection aspects of plant maintenance schemes. It requires the ability to develop and manage maintenance programs incorporating strategies for inspections, repair/overhaul/replacement of components and recording of maintenance outcomes. This unit is directly equivalent to the Unit 2.13 <i>Develop and manage maintenance programs for hazardous areas electrical equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the

Unit Code	Unit Title	Scope/Descriptor
		explosion-protection techniques listed in the Range statement of this unit.
UEENEEM048A	Develop and manage maintenance programs for hazardous areas electrical equipment — gas atmospheres	This unit covers the explosion-protection aspects of plant maintenance schemes. It requires the ability to develop and manage maintenance programs incorporating strategies for inspections, repair/overhaul/replacement of components and recording of maintenance outcomes. This unit is directly equivalent to the Unit 2.13 <i>Develop and manage maintenance programs for hazardous areas electrical equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM049A	Develop and manage maintenance programs for hazardous areas electrical equipment — dust atmospheres	This unit covers the explosion-protection aspects of plant maintenance schemes. It requires the ability to develop and manage maintenance programs incorporating strategies for inspections, repair/overhaul/replacement of components and recording of maintenance outcomes. This unit is directly equivalent to the Unit 2.13 <i>Develop and manage maintenance programs for hazardous areas electrical equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM050A	Develop and manage maintenance programs for hazardous areas electrical equipment — pressurisation	This unit covers the explosion-protection aspects of plant maintenance schemes. It requires the ability to develop and manage maintenance programs incorporating strategies for inspections, repair/overhaul/replacement of components and recording of maintenance

Unit Code	Unit Title	Scope/Descriptor
		outcomes. This unit is directly equivalent to the Unit 2.13 <i>Develop and manage maintenance programs for hazardous areas electrical equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM051A	RESERVED	
UEENEEM052A	Classify hazardous areas — gas atmospheres	This unit covers knowledge and skills to classify areas where flammable/combustible materials may exist. It requires the ability to gather and analyse data relative to explosion hazards, determine the extent of risk and establish and document zones. This unit is directly equivalent to the Unit 2.16 <i>Classify hazardous areas</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM053A	Classify hazardous areas — dust atmospheres	This unit covers knowledge and skills to classify areas where flammable/combustible materials may exist. It requires the ability to gather and analyse data relative to explosion hazards, determine the extent of risk and establish and document zones. This unit is directly equivalent to the Unit 2.16 <i>Classify hazardous areas</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM054A	Plan electrical	This unit covers the explosion-protection

Unit Code	Unit Title	Scope/Descriptor
	installations for hazardous areas — gas atmospheres	aspects planning electrical installations for hazardous areas It requires the ability to identify hazardous area zones from classification diagrams or from examples of previously classified areas or those given in standards, and to select and locate explosion-protected equipment and wiring systems and other items that may influence the explosion-protection technique. This unit is directly equivalent to the Unit 2.17 <i>Plan electrical installations for hazardous areas</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM055A	Plan electrical installations for hazardous areas — dust atmospheres	This unit covers the explosion-protection aspects planning electrical installations for hazardous areas It requires the ability to identify hazardous area zones from classification diagrams or from examples of previously classified areas or those given in standards, and to select and locate explosion-protected equipment and wiring systems and other items that may influence the explosion-protection technique. This unit is directly equivalent to the Unit 2.17 <i>Plan electrical installations for hazardous areas</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM056A	Plan electrical installations for hazardous areas — pressurisation	This unit covers the explosion-protection aspects planning electrical installations for hazardous areas It requires the ability to identify hazardous area zones from classification diagrams or from examples of previously classified areas or those given in standards, and to select and locate explosion-protected

Unit Code	Unit Title	Scope/Descriptor
		equipment and wiring systems and other items that may influence the explosion-protection technique. This unit is directly equivalent to the Unit 2.17 <i>Plan electrical installations for hazardous areas</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM057A	Design explosion-protected electrical systems and installations — gas atmospheres	This unit covers the explosion-protection aspects of designing electrical power, control and instrumentation systems and installations. It requires the ability to establish design briefs and to pursue economical and effective design solutions. This unit is directly equivalent to the Unit 2.18 <i>Design explosion-protected electrical systems and installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM058A	Design explosion-protected electrical systems and installations — dust atmospheres	This unit covers the explosion-protection aspects of designing electrical power, control and instrumentation systems and installations. It requires the ability to establish design briefs and to pursue economical and effective design solutions. This unit is directly equivalent to the Unit 2.18 <i>Design explosion-protected electrical systems and installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.

Unit Code	Unit Title	Scope/Descriptor
UEENEEM059A	Design explosion-protected electrical systems and installations — pressurisation	This unit covers the explosion-protection aspects of designing electrical power, control and instrumentation systems and installations. It requires the ability to establish design briefs and to pursue economical and effective design solutions. This unit is directly equivalent to the Unit 2.18 <i>Design explosion-protected electrical systems and installations</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM060A	Carry out overhaul and repair of explosion-protected equipment — coal mining	This Competency Standard Unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment at a craftsperson level. It requires the ability to identify and select authorized components, follow repair specifications to effect the overhauled/repared of equipment and complete repair documentation. This unit is directly equivalent to the Unit 2.20 <i>Carry out overhaul and repair of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM061A	Carry out overhaul and repair of explosion-protected equipment — flameproof enclosures	This Competency Standard Unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment at a craftsperson level. It requires the ability to identify and select authorized components, follow repair specifications to effect the overhauled/repared of equipment and complete repair documentation. This unit is directly equivalent to the Unit 2.20 <i>Carry out overhaul and repair of</i>

Unit Code	Unit Title	Scope/Descriptor
		<i>explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i> . Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM062A	Carry out overhaul and repair of explosion-protected equipment — gas atmospheres	This Competency Standard Unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment at a craftsperson level. It requires the ability to identify and select authorized components, follow repair specifications to effect the overhauled/repared of equipment and complete repair documentation. This unit is directly equivalent to the Unit 2.20 <i>Carry out overhaul and repair of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM063A	Carry out overhaul and repair of explosion-protected equipment — dust atmospheres	This Competency Standard Unit covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment at a craftsperson level. It requires the ability to identify and select authorized components, follow repair specifications to effect the overhauled/repared of equipment and complete repair documentation. This unit is directly equivalent to the Unit 2.20 <i>Carry out overhaul and repair of explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the

Unit Code	Unit Title	Scope/Descriptor
		Range statement of this unit.
UEENEEM064A	Conduct audit of hazardous areas installations — coal mining	This Competency Standard Unit covers the explosion-protection aspects of conducting an audit of an electrical installation. It requires the ability to verify whether an installation complies with the relevant hazardous areas Standards for that installation and includes the verification of design and certification documentation (verification dossier), maintenance, overhaul and repair, work safety, inspection against Standards and reporting of audit results. This unit is directly equivalent to the Unit 2.21 <i>Conduct audit of hazardous areas installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM065A	Conduct audit of hazardous areas installations — gas atmospheres	This Competency Standard Unit covers the explosion-protection aspects of conducting an audit of an electrical installation. It requires the ability to verify whether an installation complies with the relevant hazardous areas Standards for that installation and includes the verification of design and certification documentation (verification dossier), maintenance, overhaul and repair, work safety, inspection against Standards and reporting of audit results. This unit is directly equivalent to the Unit 2.21 <i>Conduct audit of hazardous areas installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM066A	Conduct audit of hazardous areas installations — dust	This Competency Standard Unit covers the explosion-protection aspects of conducting an audit of an electrical installation. It requires the ability to verify whether an installation complies

Unit Code	Unit Title	Scope/Descriptor
	atmospheres	with the relevant hazardous areas Standards for that installation and includes the verification of design and certification documentation (verification dossier), maintenance, overhaul and repair, work safety, inspection against Standards and reporting of audit results. This unit is directly equivalent to the Unit 2.21 <i>Conduct audit of hazardous areas installations</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM067A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — coal mining	This Competency Standard Unit covers the explosion-protection aspects of permanently installed explosion-protected equipment, which has no acceptable certification and a conformity assessment document cannot be prepared to determine the level of conformity with current IEC or AS/NZS Standards. It requires the ability to gather, establish and evaluate technical information on relevant explosion-protection techniques and to report evaluations and findings, including recommendations based on safety requirements and economic considerations. This unit is directly equivalent to the Unit 2.22 <i>Assess the fitness-for-purpose of hazardous areas explosion-protected equipment</i> in the Australian/New Zealand Standard <i>AS/NZS 4761.1 Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM068A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — gas	This Competency Standard Unit covers the explosion-protection aspects of permanently installed explosion-protected equipment, which has no acceptable certification and a conformity assessment document cannot be prepared to determine the level of conformity with current

Unit Code	Unit Title	Scope/Descriptor
	atmospheres	IEC or AS/NZS Standards. It requires the ability to gather, establish and evaluate technical information on relevant explosion-protection techniques and to report evaluations and findings, including recommendations based on safety requirements and economic considerations. This unit is directly equivalent to the Unit 2.22 <i>Assess the fitness-for-purpose of hazardous areas explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM069A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — dust atmospheres	This Competency Standard Unit covers the explosion-protection aspects of permanently installed explosion-protected equipment, which has no acceptable certification and a conformity assessment document cannot be prepared to determine the level of conformity with current IEC or AS/NZS Standards. It requires the ability to gather, establish and evaluate technical information on relevant explosion-protection techniques and to report evaluations and findings, including recommendations based on safety requirements and economic considerations. This unit is directly equivalent to the Unit 2.22 <i>Assess the fitness-for-purpose of hazardous areas explosion-protected equipment</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM070A	Repair reeling, trailing and flexible cables	This Competency Standard Unit covers sheathing, insulation and conductor repair of reeling, trailing and flexible cables. It requires the ability to work safely and to Standards,

Unit Code	Unit Title	Scope/Descriptor
		follow repair instructions, apply repair techniques and document the repair work. This unit is directly equivalent to the Unit 2.23 <i>Repair reeling, trailing and flexible cables</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit. Note: Although this unit is primarily intended for the repair of cable types specified by AS/NZS 1802 and AS/NZS 2802 and used in mining, it may be applied to the repair of other similar cables.
UEENEEM071A	Test reeling, trailing and flexible cables	This Competency Standard Unit covers the pre and post repair testing of reeling, trailing and flexible cables. It requires the ability to work safely and to Standards, evaluate the condition of cables, conduct cable tests, write repair specifications, and document test results and cable repair history. This unit is directly equivalent to the Unit 2.24 <i>Test reeling, trailing and flexible cables</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit. Note: Although this unit is primarily intended for the repair of cable types specified by AS/NZS 1802 and AS/NZS 2802 and used in mining, it may be applied to the repair of other similar cables.
UEENEEM072A	Inspect and fit plugs/couplers for reeling, trailing and flexible cables	This Competency Standard Unit covers the inspection, component replacement and fitting of plugs/couplers on reeling, trailing and flexible cables. It requires the ability to work safely and to Standards, to evaluate the condition of the plugs/couplers, to identify

Unit Code	Unit Title	Scope/Descriptor
		correct core and pin configurations, to apply repair techniques and to document repair/replacement work. This unit is directly equivalent to the Unit 2.25 <i>Inspect and fit plugs/couplers for reeling, trailing and flexible cables</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit. Note: Although this unit is primarily intended for the repair of cable types specified by AS/NZS 1802 and AS/NZS 2802 and used in mining, it may be applied to the repair of other similar cables.
UEENEEM073A	Verify compliance of repaired reeling, trailing and flexible cables	This Competency Standard Unit covers compliance verification of repaired and tested reeling, trailing and flexible cables and their plugs/couplers assemblies by a responsible person. It requires the ability to work safely and to Standards, evaluate repairs against required standard and to maintain required repair records. This unit is directly equivalent to the Unit 2.26 <i>Verify compliance of repaired reeling, trailing and flexible cables</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit. Note: Although this unit is primarily intended for the repair of cable types specified by AS/NZS 1802 and AS/NZS 2802 and used in mining, it may be applied to the repair of other similar cables.
UEENEEM074A	Plan electrical installations in hazardous	This unit covers the explosion-protection aspects planning electrical installations for hazardous areas It requires the ability to identify

Unit Code	Unit Title	Scope/Descriptor
	areas — Coal mining	hazardous area zones from classification diagrams or from examples of previously classified areas or those given in standards, and to select and locate explosion-protected equipment and wiring systems and other items that may influence the explosion-protection technique. This unit is directly equivalent to the Unit 2.17 <i>Plan electrical installations for hazardous areas</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM075A	Design explosion-protected electrical systems — Coal mining	This unit covers the explosion-protection aspects of designing electrical power, control and instrumentation systems and installations. It requires the ability to establish design briefs and to pursue economical and effective design solutions. This unit is directly equivalent to the Unit 2.18 <i>Design explosion-protected electrical systems and installations</i> in the Australian/New Zealand Standard AS/NZS 4761.1 <i>Competencies for working with electrical equipment for hazardous areas (EEHA) Part 1: Competency Standards</i>. Equivalence includes endorsement in the explosion-protection techniques listed in the Range statement of this unit.
UEENEEM076A	Use and maintain the integrity of a portable gas detection device	This unit covers the gas detection aspects of ensuring a work place is safe from explosive and toxic gases and vapours. It requires the ability to use measuring instruments accurately, follow written instructions and to write instructions for others.
UEENEEM077A	Install and maintain the integrity of fixed gas detection equipment	This unit covers the installation, calibration and response checking of permanent gas detection equipment. It requires the ability to match equipment with that specified for a given location and to use manufacturer manuals to

Unit Code	Unit Title	Scope/Descriptor
		maintain accuracy of gas monitoring devices.
UEENEEM078A	Manage compliance of hazardous areas	This unit covers the explosion-protection aspects of ensuring that potentially explosive atmospheres, generated by production, processing or servicing activities, do not pose a hazard to persons, property or the environment.
UEENEEM079A	Design of gas detection systems	This unit covers the selection aspects of gas detection equipment for the design of gas detection systems for hazardous areas. It requires the ability to establish equipment parameters and to evaluate these against manufacturer's specifications.
UEENEEM080A	Report on the integrity of explosion-protected equipment in a hazardous area	This unit covers the explosion-protection aspects of plant and machinery operation and maintenance. It requires the ability to visually identify any damage or deterioration of explosion-protected equipment, monitor changes in the explosion hazard and to implement procedures established to limit the risk of an explosion.

Discipline N – Rail

Unit Code	Unit Title	Scope/Descriptor
UEENEEN001B	Service mechanical signalling equipment and infrastructure	This unit covers servicing and cleaning of mechanical signalling and infrastructure. It encompasses safe working, regulatory requirements, following cleaning and servicing work procedures, checking operation and functionality of signalling equipment and infrastructure, and reporting.
UEENEEN002B	Assemble and wire internal electrical signalling equipment	This unit covers assembly and wiring internal signalling equipment. It encompasses safe working, regulatory requirements and following work procedures assembling and mounting components, performing internal wiring, terminating cables, and wiring and testing to confirm system integrity.

Unit Code	Unit Title	Scope/Descriptor
UEENEEN003B	Install and maintain track circuit leads and bonds	This unit covers insulation of track circuit leads and bonds. It encompasses safe working, regulatory requirements and following work procedures, job planning, running and positioning, connecting track leads and bonds, maintaining and testing track leads and bonds and completing required documentation.
UEENEEN004B	Perform cable tests	This unit covers testing of signal and communication cables. It encompasses safe working, regulatory requirements and following work procedures determining the tools required setting up and conducting test, interpreting test results, determining activities to maintain system integrity and reporting activities.
UEENEEN005B	Install and maintain signalling power supplies	This unit covers installation and maintenance of signalling power supplies. It encompasses working safely and to installation/maintenance standards, matching equipment with that specified for a given location, terminating cables and connecting wiring, compliance and functional testing and completing the necessary installation documentation.
UEENEEN006B	Maintain remote control and non-vital interlocking control systems	This unit covers maintenance and repair of remote and non-vital interlocking control systems on rail networks. It encompasses safe working, regulatory requirements and following work procedures performing scheduled maintenance, finding and repairing faults, testing control and indicating equipment and reporting.
UEENEEN007B	Maintain power signalling and protected level crossing equipment	This unit covers maintenance and repairing faults in power signalling and level crossing equipment on rail networks. It encompasses safe working, regulatory requirements and following work procedures, performing scheduled maintenance findings and repairing faults, performing operational tests and reporting.
UEENEEN008B	Maintain on-site power operated point-activating	This unit covers on-site maintenance of power point activating devices in rail networks. It

Unit Code	Unit Title	Scope/Descriptor
	devices	encompasses safe working, regulatory requirements and following work procedures performing scheduled maintenance, repairing point activity devices, testing, verifying integrity of the maintenance work and reporting.
UEENEEN009B	Maintain track circuit equipment	This unit covers maintenance, fault finding and repair of track circuit equipment in a rail network. It encompasses safe working, regulatory requirements and following work procedures, performing maintenance finding, finding and repairing faults, adjusting and testing to verify operational integrity and reporting.
UEENEEN010B	Maintain electronic signalling and communication equipment	This unit covers maintain and repair faults electronic signalling and communications systems in a rail network. It encompasses safe working, regulatory requirements and following work procedures diagnosing and rectifying system faults, repairing and replacing faulty equipment, calibrating and testing and report work activities.
UEENEEN011B	Install and maintain power operated signalling equipment	This unit covers installation and maintenance of power operated signalling equipment. It encompasses safe working, regulatory requirements and following work procedures, assembling signal control equipment, installing equipment, components, wiring, connecting and checking and testing.
UEENEEN012B	Maintain power signalling and protective relay interlocking systems	This unit covers maintenance and repair of power signalling and protective relay interlocking systems in a rail network. It encompasses safe working, regulatory requirements and following work procedures, performing scheduled maintenance, diagnosing and repairing system faults, performing operational tests and reporting.
UEENEEN013B	Install and test computer based interlocking equipment	This unit covers installation and testing of computer based interlocking equipment for rail network signalling. It encompasses safe working, regulatory requirements and following installation specifications, installing

Unit Code	Unit Title	Scope/Descriptor
		computer equipment, associated electronic equipment and track side interfaces, pre-commissioning activities, operational testing and reporting.
UEENEEN014B	Maintain computer based and solid state interlocking systems	This unit covers maintenance and repair of faults in computer based electronic equipment for rail network signalling system. It encompasses safe working, regulatory requirements and following work procedures monitoring system, responding to fault information, and replacing faulty equipment.
UEENEEN015B	Conduct routine inspecting and testing of new signal cables and lines	This unit covers testing or newly installed signal and power cables for a rail network signalling system. It encompasses safe working, regulatory requirements and following work procedures, visual inspection, cable testing, rectifying defects and verifying and certifying integrity of cables.
UEENEEN016B	Maintain electronic switched and microprocessor-based remote control systems	This unit covers maintain operational status of electronic switched microprocessor based remote control system for a rail network signalling system. It encompasses safe working, regulatory requirements and following work procedures, including co-ordinating and fault finding and repairs, inspecting and rectifying defects, analysing and determining the cause of faults, rectifying faults and recording.
UEENEEN017B	Install and maintain transmission interface equipment	This unit covers installing and maintaining transmission interface equipment for a rail network system. It encompasses safe working, regulatory requirements and following work procedures, scheduled maintenance, equipment installation and testing, diagnosing and rectifying faults and reporting.
UEENEEN018B	Find and repair wiring system faults	This unit covers finding and repairing faults with signal, data, and power wiring systems. It encompasses safe working, regulatory requirements and following work procedures, predicting likely wiring system faults, using appropriate fault finding techniques, repairing

Unit Code	Unit Title	Scope/Descriptor
		or rectifying faults and reporting.
UEENEEN019B	Test equipment and isolate faults	This unit covers the testing and isolation of signalling equipment and infrastructure. It encompasses safe working, regulatory requirements, work procedures, checking of operational and functional capabilities and the isolation of signalling equipment and infrastructure and reporting.
UEENEEN020B	Install electrical power and control equipment for rail networks	This unit covers installation of electrical power and control equipment. It encompasses working safely and to installation/maintenance standards, matching equipment with that specified for a given location, terminating cables and connecting wiring, compliance and functional testing and completing the necessary installation documentation.
UEENEEN021A	Repair rail signalling cables	This unit covers repair of signalling power cables and multi core signalling control cables up to 50 cores. It encompasses safe working, regulatory requirements and following work procedures, selecting and using appropriate cable joining methods, testing continuity and insulation resistance of repaired cable cores and reporting repair activities.
UEENEEN022A to UEENEEN024A	RESERVED	
UEENEEN025B	Coordinate and manage track protection	This unit covers the coordination and management of track protection. It encompasses safe working, regulatory requirements and work procedures, including planning, establishing, monitoring and withdrawing track protection, and documentation
UEENEEN026B	Develop rail signalling maintenance programs	This unit covers the development of programs for the maintenance of rail signalling equipment and infrastructure. It encompasses safe working, regulatory requirements, and work procedures including identifying tasks and work responsibilities and reporting.

Unit Code	Unit Title	Scope/Descriptor
UEENEEN027B	Decommission electrical and electro-mechanical signalling from service	This unit covers the de-commissioning of electrical and electro-mechanical signalling systems from service on rail networks. It encompasses safe working, regulatory requirement work procedures, disconnection of operating and redundant circuitry, equipment and components, testing of remaining circuitry and equipment, finding and repairing faults, testing of control and indicating equipment and reporting.
UEENEEN028B	Test and commission power signalling equipment	This unit covers the testing and commissioning of power signalling equipment into service on rail networks. It encompasses safe working, regulatory requirement work procedures, connection of wiring circuitry, equipment and components, testing of wiring circuitry, equipment and components, finding and repairing faults, testing of control and indicating equipment and reporting.

Discipline P – Restricted

Unit Code	Unit Title	Scope/Descriptor
UEENEEN001B	Disconnect and reconnect fixed wired electrical equipment connected to a Low Voltage supply	This unit covers disconnecting and reconnecting fixed wired electrical equipment. This may be incidental to or a primary and regular function of work related to a principle work function. It encompasses working safely, identifying supply arrangements, following isolation procedures, selecting and using testing and measuring devices, terminating and connecting cables and conductors, safely testing and reporting and excludes disconnecting or reconnecting circuits at a switchboard or to general electrical accessories (including switches, socket outlets, circuit protective devices etc); or installation of or alteration to any part of the fixed electrical wiring system (defined as electrical installing work).
UEENEEN002B	Attach cords and plugs to	This unit covers attaching flexible cords and

Unit Code	Unit Title	Scope/Descriptor
	electrical equipment for connection to a single phase 250 Volt supply	plugs to electrical equipment for connection to supplies up to 250V a.c . This may be incidental to or a primary and regular function of work related to a principle function in the workplace. It encompasses working safely, identifying plug configurations, selecting and using testing and measuring devices, terminating and connecting cords/plugs and conductors, safety testing and reporting.
UEENEPP003B	Attach cords and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply	This unit covers attaching flexible cords/cables and plugs to electrical equipment connected to a supply up to 1000V a.c. or 1500V d.c. This may be incidental to or a primary and regular function of work related to a principle function in the workplace. It encompasses working safely, identifying plug configurations, selecting and using testing and measuring devices, terminating and connecting flexible cords/plugs and conductors, safety testing and reporting.
UEENEPP004B	Disconnect and reconnect explosion-protected electrical equipment connected to Low Voltage supply	This unit covers isolating, disconnecting and reconnecting flame proof, increased safety and intrinsic safety electrical equipment to supply up to 1000V a.c. or 1500V d.c. under restrictions of designated electrical equipment and conditions specified. It encompasses working safely in hazardous area, identifying supply arrangements, following isolation procedures, handling explosion-protection equipment, selecting and using testing and measuring devices, terminating and connecting cables and conductors, safety testing and reporting.
UEENEPP005B	Disconnect and reconnect 3.3 kV electric propulsion components of self-propelled earth moving vehicles	This unit covers isolating, disconnecting and reconnecting HV electric propulsion components on engine driven, self-propelled earth moving vehicles under the restrictions of designated electrical equipment and conditions specified, operating at 3300 volts. It encompasses working safely, identifying circuit and isolation arrangements, following isolation procedures, selecting and using HV testing and measuring devices, terminating and connecting

Unit Code	Unit Title	Scope/Descriptor
		HV cables and conductors, safety testing and reporting
UEENEOP006B	Attach flexible cables and plugs to electrical equipment connected to a high voltage supply	This unit covers the attaching of flexible cable(s) and plug(s), including trailing and feeder cables, to high voltage electrical equipment connected to a supply exceeding 1000 volts a.c. or 1500 volts d.c. This may be incidental to or a primary and regular function of work related to a principle function in the workplace – typically mining. It encompasses working safely, identifying plug configurations, selecting and using testing and measuring devices, terminating and connecting HV flexible cables, plugs and conductors, safety testing and reporting.
UEENEOP007B	Locate and rectify faults in electrical low voltage equipment following prescribed procedures	This unit covers locating and rectifying fault(s) in electrical equipment intended to operate to a connected supply up to 1,000 volts a.c. or 1,500 volts d.c. This may be incidental to or a primary and regular function in the workplace. It encompasses following prescribed procedures, working safely, reading circuit diagrams, isolation procedures, identifying faults according to procedures, identifying like for like replacement/repair components according to procedures, selecting and using testing and measuring devices, terminating and connecting cables and conductors, safety testing and reporting.
UEENEOP008B	Conduct in-service safety testing of electrical cord assemblies and cord connected equipment	This unit covers safety testing of electrical cord assemblies and cord connected equipment. It encompasses working safely, using portable apparatus tester, identifying faults, applying tagging, arranging for repair of faulty equipment and complete testing documentation.
UEENEOP009B	Deleted	
UEENEOP012A	Disconnect / reconnect composite appliances connected to low voltage installation wiring	This unit covers disconnecting and reconnecting composite appliances connected to low voltage installation wiring. This may be incidental to or a primary and regular function of work related to a principle work function. It

Unit Code	Unit Title	Scope/Descriptor
		encompasses working safely, identifying supply arrangements, following isolation procedures, selecting and using testing and measuring devices, terminating and connecting cables and conductors, safely testing and reporting and excludes disconnecting or reconnecting circuits at a switchboard or to general electrical accessories (including switches, socket outlets, circuit protective devices etc); or installation of or alteration to any part of the fixed electrical wiring system (defined as electrical installing work).
UEENEEP017A	Locate and rectify faults in low voltage composite appliances using set procedures	This unit covers locating and rectifying fault(s) in composite appliances intended to operate to a connected supply up to 1,000 volts a.c. or 1,500 volts d.c. This may be incidental to or a primary and regular function in the workplace. It encompasses following prescribed procedures, working safely, reading circuit diagrams, isolation procedures, identifying faults according to procedures, identifying like for like replacement/repair components according to procedures, selecting and using testing and measuring devices, terminating and connecting cables and conductors, safety testing and reporting.
UEENEEP024A	Attach cords and plugs to electrical equipment for connection to a single phase 230 Volt supply	This unit covers attaching flexible cords and plugs to electrical equipment for connection to supplies up to 230V a.c. This may be incidental to or a primary and regular function of work related to a principle function in the workplace. It encompasses working safely, identifying plug configurations, selecting and using testing and measuring devices, terminating and connecting cords/plugs and conductors, safety testing and reporting.
UEENEEP025A	Attach cords, cables and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply	This unit covers attaching flexible cords, cables and plugs to electrical equipment connected to a supply up to 1,000V a.c. or 1,500V d.c. This may be incidental to or a primary and regular function of work related to a principle function in the workplace. It encompasses working safely, identifying plug configurations,

Unit Code	Unit Title	Scope/Descriptor
		selecting and using testing and measuring devices, terminating and connecting flexible cords/plugs and conductors, safety testing and reporting.

Discipline R – Research

Unit Code	Unit Title	Scope/Descriptor
UEENEER001B	Contribute to the planning of a research project	This unit covers the ability to gather background information relevant to a research project, understand the context of the research project and contribute to the development of a research plan to achieve quality outcomes.
UEENEER002B	Contribute to the conduct of a research project	This unit covers the ability to identify information sources and collect and analyse information in accordance with confirmed research project objectives and compile and present results in accordance with current business practices
UEENEER003B	Contribute to the development of a product/application/service	This unit covers the ability to assist managers to plan, coordinate and report on the development of a product/application/service.
UEENEER004B	Contribute to the trial of a product/application/service	This unit covers the ability to assist manager's plan, coordinate and report on a product/application/service trial.
UEENEER005B	Contribute to intellectual property management	This unit covers the ability to assist in the planning, management and protection of an organisation's Intellectual Property.
UEENEER006B	Contribute to the commercialisation of products/applications/services	This unit covers the ability to assist managers to identify and investigate opportunities for commercialisation within the organisation, to commercialise a product, application or service and to critically assess the commercialisation process.

1.2.09 Unit relationships

2.9 Unit relationships

Included in this section is a summary of:

- a list of the revised Electrotechnology competency standard units in this Training Package
- AQF alignment and strand unit total of each competency standard unit
- Qualifications and Possible Skills Sets in which the CSUs reside
- prerequisite requirements.

Prerequisites of each competency standard unit are in Table 2 below. The correlation of the units within a range of selected qualification(s) is in flowchart diagrams in Volume 1 Part 1 Qualification Framework

The units in Table 2 are listed in alphabetical and discipline order and include level, strand, qualifications, schedules, and possible skills set.

Table 2 Index of Competency Standard Units

Note:

1. The following is a summary. The relevant parts of Volumes 1 and 2 should be consulted for detailed information of prerequisites and qualification completion requirements.

2. The competency standard unit and its place within a qualification structure (detailed under **Qualification and Schedule**) is defined by the following:

- use of the AQF number means the unit is a core
- use of the schedule (S) number means it is an elective

3. The competency standard unit(s) may be placed within a Possible Skill Cluster and is defined by the following:

- means use of the unit(s) is in a Possible Skill Cluster (PSC)

4. A unit(s) may reside in the core of a qualification and in one or more Schedules of Electives and/or a Possible Skill Cluster.

5. There are six schedules of Electives.

6. The term 'Maintain' or 'Maintenance' is used broadly to mean "to ensure continued safe and function operation ..." which encompasses attending to breakdowns, serving, fault finding/diagnosis and formal maintenance. Competency in relation to formal (periodic and/or scheduled) maintenance is covered in the UEE07 version of the Training Package by Unit UEENEEE009B Comply with scheduled & preventative maintenance program processes.

A – Assembly units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by <i>italicised text</i>) (All units have a prefix UEENEE)	Qualification and Schedule
UEENEEA001B	Assemble electronic apparatus	2/3	2	40	None	UEE20907; S2; S3;
UEENEEA002B	Select electronic components	2/3	1	20	None	S2; S3
UEENEEA003B	Set up and check electronic component placement machines	2/3	2	40	A001B; A002B	S2; S3
UEENEEA004B	Rework electronic sub assemblies	2/3	2	40	A001B; A002B; E002B; E003B;	UEE20907; S2; S3
UEENEEA005B	Conduct functional and quality tests on assembled electronic apparatus	2/3	1	20	A004B; <i>A001B; A002B; E002B; E003B</i>	UEE20907; S2; S3
UEENEEA006B	Apply lead-free soldering techniques	2/3	2	40	None	S2; S3; PSC
UEENEEA007A to UEENEEA009A	RESERVED					
UEENEEA010B	Assemble, mount and connect switchgear and	3/4	6		E002B; E005B; E007B;	UEE30710; S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by <i>italicised text</i>) (All units have a prefix UEENEE)	Qualification and Schedule
	controlgear					
UEENEEA011A	RESERVED					
UEENEEA012B	Make up and assemble bus bars	3	3		E002B; E005B; E007B;	UEE30710; S3
UEENEEA013B	Assemble and wire control panels	3	3		E002B; E005B; E007B;	UEE30710; S3

B – Broadcast technology units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by <i>italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEB001B	Operate and maintain an amateur radio communication station	1/2	2	40	None	S1; S2; PSC

C – Commercial units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEC001B	Maintain documentation	2	SC/1	20	None	UEE10110; UEE20107; UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610; UEE21710; UEE21810; UEE21910; UEE22010; UEE22107; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
						UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE61710;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE61810; UEE61910; UEE62010; UEE62110;
UEENEEC002B	Source and purchase material/parts for installation or service jobs	3	SC/1	20	None	UEE10110; UEE20107; UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE 2 11 7; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610; UEE21710; UEE21810; UEE 2 19 7; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
						UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
						UEE61710; UEE61810; UEE61910; UEE62010; UEE62110;
UEENEEC003B	Provide quotations for installation or service jobs	3	SC/1	20	None	UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE61710; UEE61810; UEE61910; UEE62010; UEE62110;
UEENEEC004B	Prepare specifications for the supply of materials and equipment for electrotechnology projects	4	2	40	None	S4
UEENEEC005B	Estimate electrotechnology projects	4	2	40	None	S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEC006B	Prepare tender submissions for electrotechnology projects	5	3	60	C005B	S5
UEENEEC007B	Manage contract variations	6	2	40	None	S6
UEENEEC008B	Receive and store materials and equipment for electrotechnology work	2	SC/1	20	None	UEE10110; UEE20107; UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610; UEE21710; UEE21810; UEE21910;
UEENEEC009B	Provide quotations for inspection and compliance audit services	4	SC/1		None	
UEENEEC010B	Deliver a service to customers	2	SC/1	20	None	UEE10110; UEE20107; UEE20207;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
						UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610; UEE21710; UEE21810; UEE21910; UEE22010; UEE22107; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
						UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE61710; UEE61810; UEE61910; UEE62010; UEE62110;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEC011A	RESERVED					
UEENEEC012B	Direct technical and non-technical enquiries to appropriate personnel	2	SC/1		None	
UEENEEC013B	Participate in business equipment work and competency development activities	3	5		None	UEE30107
UEENEEC014B	Participate in computer equipment work and competency development activities	3	5		None	UEE30210
UEENEEC015B	Participate in custom electronic installations work and competency development activities	3	5		None	UEE30310
UEENEEC016B	Participate in voice and data communications work and competency development	3	5		None	UEE30407

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
	activities					
UEENEEC017B	Participate in appliance servicing work and competency development activities	3	3		J061B	UEE30510
UEENEEC018B	Participate in electrical machine repair work and competency development activities	3	3		None	UEE30607
UEENEEC019B	Participate in switchgear and controlgear work and competency development activities	3	3		None	UEE30707
UEENEEC020B	Participate in electrical work and competency development activities	3	3		None	UEE30807
UEENEEC021B	Participate in electronics and communications work and competency development	3	3	60	None	UEE30910; UEE32010

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	activities					
UEENEEC022B	Participate in fire protection control work and competency development activities	3	5		None	UEE31007
UEENEEC023B	Participate in gaming electronic work and competency development activities	3	5		None	UEE31107
UEENEEC024B	Participate in instrumentation and control work and competency development activities	3	3		None	UEE31210
UEENEEC025B	Participate in refrigeration and air conditioning work and competency development activities	3	3	60	None	UEE31307
UEENEEC026B	Participate in security equipment work and competency development	3	5		None	UEE31410

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	activities					
UEENEEC027B	Participate in rail communications and networks work and competency development activities	3	5		None	UEE31507
UEENEEC028B	Participate in hazardous areas work and competency development activities	3	3		None	UEE31710; UEE31810
UEENEEC029B	Participate in explosion-protected equipment overhaul work and competency development activities	3	3		None	UEE31910

D – Computerised systems units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEE001B	Use basic computer applications relevant to a workplace	1 Core/ 2 S/Core	Core/SC/ 1	20	None	UEE10110; UEE20207; UEE20407; UEE20510; UEE21107; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610; UEE22010; UEE22107; UEE30107; UEE30207; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE61710; UEE61810; UEE61910; UEE62010; UEE62110;
UEENEE002B	Assemble, set up and test personal	2/3	4	80	None	UEE20510; UEE30210; UEE40110;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
	computers					UEE61710; UEE61810; UEE62010; S2; S3
UEENEE003B	Evaluate and modify programs written in object oriented code	4/5	2	40	D001B	S4; S5
UEENEE004B	Use engineering applications software	2/3	2	40	None	UEE20510; UEE40110; UEE61710; UEE61810; S2; S3
UEENEE005B	Enter and verify operating instructions in microprocessor equipped devices	2/3/4	1	20	None	UEE21007; UEE21610; UEE30707; UEE31007; S2; S3;S4
UEENEE006A	RESERVED					
UEENEE007B	Develop, enter and verify programs for programmable logic controllers using ladder instruction set	3/4	3	60	None	UEE30707; UEE31210; UEE31810; UEE50210; S3; S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEE008B	Develop, enter and verify programs in Supervisory Control and Data Acquisition systems	4/5	3	60	D009B; <i>D007B</i>	S4; S5
UEENEE009B	Develop, enter and verify programs for industrial control systems using high level instructions	4/5	3	60	D007B;	S4; S5
UEENEE010B	Set up and create content for a web server	5	6	120	None	S5
UEENEE011B	Develop object oriented code	5	7	140	D001B;	S5
UEENEE012B	Support computer hardware and software	2/3/4	6	120	D002B;	UEE30210; UEE40110; UEE61810; S2; S3;S4
UEENEE013B	Install and administer Unix based computers	4	4	80	None	S4
UEENEE014B	Design and manage	6	4	80	None	S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
	enterprise networks					
UEENEE015B	Administer user networks	4	4	80	D024B;	S4
UEENEE016B	Develop network services	5/6	6	120	None	S5; S6
UEENEE017B	Install and configure Internetworking systems	4	6	120	None	UEE61810; S4
UEENEE018B	Design and implement Internetworking systems	5/6	6	120	None	S5; S6
UEENEE019B	Design and implement Internetworking systems — advanced routing	5/6	5	100	None	S5; S6
UEENEE020B	Design and implement Internetworking systems — remote access	5/6	5	100	None	S5; S6
UEENEE021B	Design and implement Internetworking	5/6	5	100	None	S5; S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	systems — multi-layer switching					
UEENEE022B	Design and implement Internetworking systems — security	5/6	5	100	None	S5; S6
UEENEE023B	Design and implement Internetworking systems — wireless LANs/WANs	5/6	5	100	None	S5; S6
UEENEE024B	Integrate multiple computer operating systems on a client server network	4/5	4	80	None	S4; S5
UEENEE025B	Design and configure Human-Machine Interface networks	5/6	3	60	None	S5; S6
UEENEE026B	Design a computer based control system	6	6	120	None	S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEE027B	Develop structured programs to control external devices	4	2	40	None	S4
UEENEE028B	Develop and test code for microcontroller devices	5/6	3	60	None	S5; S6
UEENEE029B	Develop basic web pages for engineering applications	3	2	40	None	S3
UEENEE030B	Select, install, configure and test multimedia devices	3/4	2	40	D002B;	S3; S4
UEENEE031B	Develop and validate basic integrated systems	3/4	3	60	None	UEE30310; S3; S4; PSC
UEENEE032B	Design integrated systems	4	3		D031B;	S4; PSC
UEENEE033B	Design complex integrated systems	4/5	3		D032B;	S4; S5; PSC
UEENEE034B	Configure and maintain	4/5	3		None	S4; S5

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	industrial control system networks					
UEENEE035 A to UEENEE042 A	RESERVED					
UEENEE043B	Install and configure a computer operating system and software	2/3	2	40	None	UEE20510; UEE30210; UEE40110; S2; S3
UEENEE044B	Commission computer systems	5/6	1	20	None	UEE50110; UEE60410; S5; S6
UEENEE045B	Modify-redesign of computer system	5/6	1	20	None	UEE50110; UEE60410; S5; S6
UEENEE046B	Set up and configure basic local area network	2/3	2	40	D002B;	UEE20510; UEE30210; UEE40110; S2; S3
UEENEE047 A	RESERVED				None	
UEENEE048B	Plan computer systems projects	6	3	60	None	S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEE049A	RESERVED					
UEENEE050B	Develop control programs for micro-computer equipped devices	5/6	3	60	None	S5; S6
UEENEE051B	Provide programming solution for engineering problems	5/6	3	60	None;	S5; S6
UEENEE052B	Design embedded controller systems	5/6	4	80	None	UEE60410; S5; S6
UEENEE053B	Set up and test biometric devices	3/4	2	40	D046B;	S3; S4
UEENEE054B	Analyse and implement biometric techniques and applications	4/5	6	120	D053B	S4; S5
UEENEE055B	Develop and validate biometric systems installation	5/6	6	120	None	S5; S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	instructions					

E – Cross-discipline units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEE001B	Apply OHS practices in the workplace	2	1	20	None	UEE10110; UEE20107; UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE21710; UEE21810; UEE21910; UEE22010; UEE22107; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE42010; UEE42110 UEE50110; UEE50210; UEE50310; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50910; UEE60110; UEE60210; UEE61710; UEE60410; UEE61810; UEE60610; UEE60710; UEE61910; UEE60910; UEE62010; UEE61110; UEE61210;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE62110; S2
UEENEEE002B	Dismantle, assemble and fabricate electrotechnology components	1/2	2	40	None	UEE20107; UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610; UEE21710; UEE21810; UEE21910; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE42010; UEE42110; UEE50210; UEE50310; UEE50410; UEE50610; UEE50710; UEE50910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE60110; UEE61810; UEE60610; UEE60710; UEE61910; UEE60910; UEE62010; UEE61210; UEE62110; S1; S2
UEENEEE003B	Solve problems in extra-low voltage single path circuits	1/2	2	40	None	UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21407; UEE21510; UEE21610; UEE21710; UEE21910; UEE22010; UEE22107; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50610 UEE50710; UEE50910; UEE60110; UEE60610; UEE60710; UEE60910; UEE61210; UEE62110; S1; S2
UEENEEE004B	Solve problems in multiple path d.c. circuits	1/2	2	40	E003B;	UEE20207; UEE20407; UEE20707; UEE21007; UEE21107; UEE21207; UEE21510; UEE21610; UEE21710; UEE21910; UEE22010; UEE22107; UEE30107; UEE30310; UEE30407; UEE30607; UEE30707;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210; UEE62110; S1; S2
UEENEE005B	Fix and secure equipment	1/2/3	1	20	None	UEE20107; UEE20607; UEE20707; UEE21007; UEE21107; UEE21207; ; UEE21510; UEE21610; UEE21710; UEE30107; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; ; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31710;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE31810; UEE31910; UEE32010; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41610; UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50610; UEE50710; UEE50910; UEE60110; UEE60610; UEE60710; UEE60910; UEE61210; UEE62110;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						S1; S2; S3
UEENEE006B	Apply methods to maintain currency of industry developments	1/CS U SoA	SC/1	20	None	PSC
UEENEE007B	Use drawings, diagrams, schedules and manuals	2	2	40	None	UEE20107; UEE20207; UEE20407; UEE20607; UEE20707; UEE21007; UEE21107; UEE21207; ; UEE21510; UEE21610; UEE21710; UEE21810; UEE30107; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE31810; UEE31910; UEE32010; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41610; UEE41710; UEE42610; UEE41910; UEE42010; UEE42110; UEE50210; UEE50310; UEE50410; UEE50610; UEE50710; UEE50910; UEE60110; UEE61710; UEE61810; UEE60610; UEE60710;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE61910; UEE60910; UEE62010; UEE61210; UEE62110; S2; S3
UEENEE008B	Lay wiring/cabling and terminate accessories for extra-low voltage circuits	2/3	2	40	E005B; E007B;	UEE20607; UEE20707; UEE21007; UEE21207; ; UEE21510; UEE21610; UEE30310; UEE30407; UEE30807; UEE31007; UEE31410; UEE31710; UEE32010; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41610;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210; UEE62110; S2; S3; PSC
UEENEE009B	Comply with scheduled and preventative maintenance program processes	3	SC/1	20	None	UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910;
UEENEEE01	Develop and implement	4/5	3	60	None	S4; S5

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
0B	maintenance programs					
UEENEE011C	Manage risk in electrotechnology activities	6	5	60	None	UEE60110; UEE60610; UEE60710; UEE60910; UEE61110; S6
UEENEE012B	Manage electrotechnology projects	6	2	40	None	S6
UEENEE013B	Plan electrotechnology projects	6	3	60	None	S6
UEENEE014B	Supervise and coordinate work activities	4	2	40	None	S4
UEENEE015B	Develop design briefs for electrotechnology projects	5/6	2	40	None	UEE60210; UEE61710; UEE60410; UEE61810; S5; S6
UEENEE016B	Write specifications for electrotechnology projects	5	2	40	None	S5
UEENEE017B	Implement and monitor OHS policies and procedures	4	1/ Core units in a qualification	20	None	UEE40110; UEE40210; UEE40310; UEE40410; UEE40510;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50910; UEE60110; UEE60210; UEE60410; UEE60610; UEE60710; UEE60910; UEE61110; UEE61210; S4
UEENEEE01	Establish, maintain and	4/5	3	60	None	S4; S5

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
8B	evaluate OHS systems					
UEENEE019C	Solve problems in multiple path a.c. circuits	2/3	2	40	E004B;	UEE32010; UEE41610; S2; S3;
UEENEE020B	Provide basic instruction in the use of electrotechnology apparatus	1	SC/1	20	None	UEE20107; UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21310; UEE21310; UEE21407; UEE21510; UEE21610; UEE21710; UEE21810; UEE21910; UEE22010; UEE22107; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE30910; UEE31007; UEE31107; UEE31210; UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50110; UEE50210; UEE50310;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE61710; UEE61810; UEE61910; UEE62010; UEE62110; S1
UEENEEE021B	Plan an integrated cabling system	3/4	2	40	E008B <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	S3; S4; PSC
UEENEEE022B	Carry out preparatory electrotechnology work activities	2	3	60	E002B; E005B;	UEE21710; S2
UEENEEE023B	Solve basic problems in electronic and digital equipment	2	4	80	None	S2
UEENEEE024C	Compile and produce an electrotechnology report	4/5	3	60	None	UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610; UEE41910; UEE50210; UEE50310; UEE50410; UEE50610; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61110; UEE61210;
UEENEEE025B	Solve problems in complex multiple path circuits	5/6	3	60	None	UEE61710; UEE60610; UEE61910; UEE62010; UEE61110; UEE61210; S5: S6; PSC
UEENEEE02	Provide computational solutions to basic	5/6	2	40	None	UEE60610; UEE61110;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
6B	engineering problems					UEE61210; S5; S6; PSC
UEENEEE027B	Use advanced computational processes to provide solutions to engineering problems	6	4	80	None	S6
UEENEEE028B	Develop engineering solutions to photonic problems	6	4	80	E025B;	S6
UEENEEE029B	Solve electrotechnical problems	6	3	60	None	UEE61910; UEE62010; S6; PSC
UEENEEE030B	Provide solutions to and report on routine electrotechnology problems	2	3	60	None	S2; PSC
UEENEEE031A	RESERVED					
UEENEEE032B	Document occupational hazards and risks in computer systems	2	1	20	None	UEE20510; UEE30210; UEE40110; UEE50110; UEE60410; S2
UEENEEE033B	Document occupational hazards and risks in electrical	2	1		None	UEE30607; UEE30707; UEE30807;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE31710; UEE31910; UEE62110; S2
UEENEEE034B	Document occupational hazards and risks in electronics	2	1	20	None	UEE20207; UEE21107; UEE21910; UEE30910; UEE31107; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41510; UEE41610; UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50510; UEE50710; UEE50910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE60110; UEE60210; UEE61710; UEE61810; UEE60610; UEE60910; UEE61210; UEE62110; S2
UEENEEE035B	Document occupational hazards and risks in instrumentation	2	1		None	UEE31210; UEE31810; UEE50210; UEE62110; S2
UEENEEE036B	Document occupational hazards and risks in refrigeration and air-conditioning	2	1		None	UEE20107; UEE21810; UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710; S2
UEENEEE037B	Document occupational hazards and risks in electrotechnology	2	1		None	UEE20407; UEE20607; UEE20707; UEE20907; UEE21007; UEE21207; UEE21310; UEE21510;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE21610; UEE21710; UEE30107; UEE30310; UEE30407; UEE30510; UEE31007; UEE31410; UEE31507; UEE32010; UEE41710; UEE62010; UEE61110; UEE62110; S2
UEENEEE038B	Participate in development and follow a personal competency development plan	2	N/A	20	None	All CI, CII, CIV, Diploma and Advanced Diploma Qualifications; PSC
UEENEEE039A	RESERVED					
UEENEEE040B	DELETED					
UEENEEE041B	Use of routine equipment/plant/technologies in an	2	3	60	None	UEE22010; S2

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	electrotechnology environment					
UEENEEE04 2B	Produce routine products for carrying out electrotechnology work activities	2	4		None	S2
UEENEEE04 3B	Produce routine tools/devices for carrying out electrotechnology work activities	1/2	6		None	S1; S2
UEENEEE04 4B	Apply technologies and concepts to electrotechnology work activities	2	6		None	S2
UEENEEE04 5B	Apply computation when using equipment, materials and concepts in an electrotechnology environment	1/2	8		None	S1; S2
UEENEEE04 6B	Identify affects of energy on machinery and materials in an electrotechnology environment	1/2	6	120	None	UEE61710; UEE61810; UEE61910; UEE62010; UEE62110; S1; S2
UEENEEE04	Identify building techniques, methods and	2	6	120	None	S2

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
7B	materials used in electrotechnology work activities					
UEENEEE048C	Carry out routine work activities in an electrotechnology environment	2	2	40	None	UEE10110; UEE22010; S2
UEENEEE049B	Contribute to the operation of support plant and equipment used in electricity supply	2	6		None	S2
UEENEEE050B	Undertake computations in an electrotechnology environment	2	6	120	None	UEE61710; UEE61810; UEE61910; UEE62010; UEE62110; S2
UEENEEE051B	Transport apparatus and materials	2	3	60	None	S2
UEENEEE052A to UEENEEE059A	RESERVED					
UEENEEE060B	Provide solutions for uses of materials and thermodynamic effects	5/6	5	100	None	S5; S6
UEENEEE06	Analyse static and	5/6	4		None	S5; S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
1B	dynamic parameters of equipment					
UEENEEE06 2B	Select drive components for equipment design	5/6	4		E061B; <i>E001B;</i> <i>E002B;</i> <i>E007B</i>	S5; S6
UEENEEE06 3B	Analyse materials for suitability in equipment	5/6	4	80	E061B; <i>E001B;</i> <i>E002B;</i> <i>E007B</i>	S5; S6
UEENEEE06 4B	Design machine drives and production layout plans	5/6	4		E062B; E063B; E026B; <i>E001B;</i> <i>E002B;</i> <i>E007B;</i> <i>E061B</i>	UEE61110; S5; S6
UEENEEE06 5A to UEENEEE06 9A	RESERVED					
UEENEEE07 0B	Write specifications for computer systems engineering projects	5/6	2		None	S5; S6
UEENEEE07 1B	Write specifications for electrical engineering	5/6	2		None	UEE50410; UEE60110; UEE61210;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	projects					S5; S6
UEENEE072B	Write specifications for electronics and communications engineering projects	5/6	2	40	None	S5; S6
UEENEE073B	Write specifications for refrigeration and air conditioning engineering projects	5/6	2		None	; S5; S6
UEENEE074B	Write specifications for renewable energy engineering projects	5/6	2		None	UEE50710; UEE60910; S5; S6
UEENEE075B	Write specifications for industrial electronics and control projects	5/6	2	40	None	UEE50910; UEE60610; UEE61210; S5; S6
UEENEE076A	RESERVED					
UEENEE077B	Write specifications for automated systems projects	5/6	2		None	UEE61110; S5; S6
UEENEE078B	Contribute to risk management in electrotechnology systems	5/6	1	20	None	UEE60210; UEE60410; S5; S6
UEENEE07	Identify and select	1/2	1	20	E048C	UEE10110;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
9A	components, accessories and materials for electrotechnology work activities					UEE22010; S2
UEENEE080A	Apply industry and community standards to engineering activities	6		20	E101A	UEE62211; UEE62311
UEENEE081A	Apply material science to solving electrotechnology engineering problems	6		60	E101A	UEE62211; UEE62311
UEENEE082A	Apply physics to solving electrotechnology engineering problems	6		60	E101A	UEE62211; UEE62311
UEENEE083A	Establish and follow a competency development plan in an electrotechnology engineering discipline	6		120	None	UEE62211; UEE62311
UEENEE084A	Write specifications for electrotechnology engineering projects	5	2	40	None	UEE50210; UEE50310, S5
UEENEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace	1/2		20	None	UEE62211; UEE62311

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEE102A	Fabricate, assemble and dismantle utilities industry components	1/2		40	E101A	UEE62211; UEE62311
UEENEEE104A	Solve problems in d.c. circuits	1/2		80	E101A	UEE62211; UEE62311
UEENEEE105A	Fix and secure electrotechnology equipment	1/2/3		20	E101A	UEE62211; UEE62311
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications	2		40	E101A	UEE62211; UEE62311
UEENEEE125A	Provide engineering solutions for problems in complex multiple path circuit	5/6		60	E126A	UEE62211; UEE62311
UEENEEE126A	Provide solutions to basic engineering computational problems	5/6		60	E029B or G102A or H014B, <i>E004B; OR H069B; E003B</i>	UEE62211; UEE62311
UEENEEE137A	Document and apply measures to control OHS risks associated with electrotechnology work	2		20	E101A	UEE62211; UEE62311

F – Data and voice communication units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEEF001B	DELETED					
UEENEEF002B	Lay and connect cables for multiple access to telecommunication services	2/3	6	120	E002B; E004B; E005B; E007B;	UEE20707; UEE30407; UEE31007; UEE40210; S2; S3; PSC
UEENEEF003B	Install and maintain cabling for telecommunication services in lifts	3/4	2		G016B; <i>G008B</i>	S3; S4
UEENEEF004B	Install and modify performance data communication structured cabling	3/4	2	40	F002B; <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B</i>	UEE30407; UEE40210; S3; S4; PSC
UEENEEF005B	Install and modify performance data communication optical fibre cabling	3/4	2	40	F002B; <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B</i>	UEE30407; UEE40210; S3; S4; PSC
UEENEEF006B	Solve problems in data and voice communications circuits	2	2	40	None	S2; PSC
UEENEEF007B	Set up the wireless capabilities of	2/3	2	40	None	S2; S3

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
	communications and data storage devices					
UEENEEF008B	Select and arrange equipment for wireless networks	3/4	3	60	None	S3; S4
UEENEEF009B	Install and connect voice and data communications equipment	3/4	3	40	F004B; F005B; <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B;</i> <i>F002B</i>	UEE30407; UEE40210; S3; S4
UEENEEF010B	Select and arrange equipment for local area networks	3/4	6	120	F004B; <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B;</i> <i>F002B</i>	UEE30407; S3; S4
UEENEEF011B	Test, report and rectify faults in voice and data installations	3/4	3	60	F004B; F005B; <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B;</i> <i>F002B</i>	UEE30407; UEE40210; S3; S4
UEENEEF012B	Install aerial communication cables	3/4	2		F002B; <i>E002B;</i> <i>E004B;</i> <i>E005B;</i>	S3; S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
					<i>E007B</i>	
UEENEEF013B	Install below ground communication cables	3/4	2		F002B; <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B</i>	S3; S4; PSC
UEENEEF014B	Set up and configure basic data communications systems	3/4	2	40	D002B	S3; S4
UEENEEF015B	Assemble and connect communication frames and cabinets	2	3		E002B; E005B; E007B	UEE30707; S2
UEENEEF016A	Lay and connect cabling for direct access to telecommunications services	2/3	1		E002B; F006B or E003B; E005B E007B;	S2; S3; PSC

G – Electrical units

National Code	Title	AQ F	Stran d	Point s	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualification s
UEENEEG001 B	Solve problems in electromagnetic circuits	2	Core only/3		None	UEE30607; UEE30707; UEE30807; UEE31710; UEE31910; UEE32010; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41610; UEE42610; UEE41910; UEE42010; UEE42110; UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210; UEE62110; S2; PSC;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEG002B	Solve problems in single and three phase low voltage circuits	3	Core only/4		None	UEE30607; UEE30707; UEE30807; UEE31710; UEE31910; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE42610; UEE41910; UEE42010; UEE42110; UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210; UEE62110; UEE41610;
UEENEEG003B	Install wiring and accessories for low voltage circuits	3	Core only/4		E002B; E005B; E007B;	UEE30807; UEE31710; UEE40210; UEE40310; UEE40410;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210;
UEENEEG004B	Install low voltage electrical apparatus and associated equipment	3	Core only/4		E002B; E005B; E007B;	UEE30807; UEE31710; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE42610;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210;
UEENEEG005B	Verify compliance and functionality of general electrical installations	3	Core only/1		E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and elective units as required, from Schedule 3 to a Strand Unit value of 6	UEE30807; UEE31710; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE41110; UEE41210; UEE42610; UEE41910; UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210; UEE42010;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE42110;
UEENEEG006A	Solve problems in single and three phase low voltage machines	6		80	E101A; E102A; E104A; E105A; E107A; G101A; G106A;	UEE62311; UEE62211
UEENEEG007B	Select and arrange equipment for general electrical installations	3/4	6		G002B;	UEE30807; UEE31710; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						S3; S4
UEENEEG008B	Find and repair faults in electrical apparatus and circuits	3	Core only/3		G002B; G003B; G004B;	UEE30807; UEE31710; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210;
UEENEEG009B	Develop and connect control circuits	3	Core only/4		G002B; G003B; G004B;	UEE30807; UEE31710; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610;

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
						UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE42610; UEE41910; UEE42010; UEE42110 UEE50210; UEE50310; UEE50410; UEE50710; UEE50910; UEE60110; UEE60610; UEE60910; UEE61210;
UEENEEG010B	Find and repair faults in d.c. electrical apparatus and circuits	3/4	3		G008B;	S3; S4
UEENEEG011B	Carry out basic repairs to electrical apparatus	2	2	40	E002B;	UEE21710; S2
UEENEEG012B	Solve fundamental problems in electrical systems	6	3		E025B;	UEE61910; UEE62010; S6
UEENEEG013B	Install and maintain emergency systems	3/4	3		G003B; G004B; <i>E002B;</i> <i>E005B;</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					<i>E007B</i>	
UEENEEG014 B	RESERVED					
UEENEEG015 B	Find and rectify faults in energy supply network equipment	3/4	6	120	G008B; <i>G001B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	S3; S4
UEENEEG016 B	Diagnose and rectify faults in lift systems	3/4	4		G008B; <i>G001B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	UEE41110; S3; S4
UEENEEG018 B	Maintain operation of electrical mining equipment	3/4	3		G002B; G008B; and, where applicable M002B and M006B; <i>G001B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>E004B; and M075A if</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					<i>M006B is applicable</i>	
UEENEEG019B	Maintain operation of electrical marine equipment	3/4	3		G002B; G008B; and, where applicable M002B and M006B; <i>G001B; G002B; G003B; G004B; E004B; and M075A if M006B is applicable</i>	S3; S4
UEENEEG020B	Select and arrange equipment for special electrical installations	3/4	3		G007B; <i>G002B; G001B; E004B</i>	S3; S4
UEENEEG021B	Verify compliance and functionality of special electrical installations	3/4	2	40	G005B <i>E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B;</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6	
UEENEEG022B	Conduct compliance inspection of single phase electrical installations	4	3	60	G005B E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6	UEE40310; S4
UEENEEG023B	Conduct compliance inspection of	4	2	40	G022B; G005B;	UEE40310; S4

National Code	Title	AQ F	Stran d	Point s	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualification s
	electrical installations with demand exceeding 100 A per phase				E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6	
UEENEEG024 B	Conduct compliance inspection of special electrical installations	4	3	60	G021B; G023B	S4
UEENEEG025 B	Plan electrical installations with a LV demand up to 400 A per phase	3/4	2	40	G007B; G002B; G001B; E004B	S3; S4
UEENEEG026 B	Install and maintain field power and distribution systems with a LV demand up to 200 A per phase	3/4	4	40	G007B; G008B; G002B; G001B; E004B;	S3; S4

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					G003B; G004B; E002B; E005B; E007B	
UEENEEG027B	Design electrical installations with a LV demand greater than 400 A per phase	4/5	2	40	G025B; G007B; G002B; G001B; E004B	S4; S5
UEENEEG028B	Plan switchboard and control panel layouts	3/4	2	40	G007B; G002B; G001B; E004B	S3; S4
UEENEEG029B	Overhaul and repair major switchgear/controlgear	3/4	3		G064B; E002B; E005B; E007B	UEE30707; UEE31910; S3; S4
UEENEEG030B	Design switchboards rated for high fault levels	5/6	3	60	G028B; G049B; G007B; G002B; G001B; E004B; G048B; G047B; G002B; G001B; E004B	S5; S6
UEENEEG031	Evaluate performance	5	2	40	None	S5

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
B	of electrical apparatus					
UEENEEG032 B	Carry out electrical field testing and report findings	4/5	3	60	G005B; <i>E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6</i>	S4; S5
UEENEEG033 A	Solve problems in single and three phase low voltage electrical apparatus and circuits	6		60	E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A	UEE62311; UEE62211
UEENEEG034 B	Perform high voltage field switching to a	3/4	2		G015B; <i>G008B;</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	given schedule				G002B; G003B; G004B; G001B; E002B; E005B; E007B	
UEENEEG035 B	Diagnose and rectify faults in a.c. motor drive systems	5/6	3	60	H026B; <i>H025B;</i> <i>H013B;</i> <i>H044B</i>	S5; S6
UEENEEG036 B	Diagnose and rectify faults in d.c. motor drive systems	5/6	3	60	H026B; <i>H025B;</i> <i>H013B;</i> <i>H044B</i>	S5; S6
UEENEEG037 B	Diagnose and rectify faults in energy supply apparatus	4/5	3		G015B; <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	S4; S5
UEENEEG038 B	Diagnose and rectify faults in electrical energy distribution systems	4/5	3	60	G015B; <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i>	S4; S5

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					E005B; E007B	
UEENEEG039B	Diagnose and rectify faults in distributed generation systems	4/5	3	60	G015B; <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	S4; S5
UEENEEG040B	Develop engineering solutions for energy supply power transformer problems	5/6	3	60	G038B; or G039B; or G042B and G049B <i>G015B;</i> <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B AND;</i> <i>G048B;</i> <i>G047B;</i> <i>G002B</i>	S5; S6
UEENEEG041B	Diagnose and rectify faults in servo drive systems	5/6	3	60	H026B; <i>H025B;</i> <i>H013B;</i> <i>H044B</i>	S5; S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEG042B	Diagnose and rectify faults in electrical energy supply transmission systems	4/5	3	60	G015B; <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	S4; S5
UEENEEG043B	Develop engineering solution for synchronous machine problems	5/6	3		G049B; <i>G048B;</i> <i>G047B;</i> <i>G002B</i>	S5; S6
UEENEEG044B	Develop engineering solutions for d.c. machine problems	5/6	3		G048B; <i>G047B;</i> <i>G002B</i>	S5; S6
UEENEEG045B	Develop engineering solutions for induction motor problems	5/6	3	60	G049B; <i>G048B;</i> <i>G047B;</i> <i>G002B</i>	S5; S6
UEENEEG046B	Develop engineering solutions for energy supply system protection problems	5/6	3	60	G038B; or G039B; or G042B; and G049B <i>G015B;</i> <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i>	S5; S6

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					E002B; E005B; E007B AND; G048B; G047B; G002B	
UEENEEG047B	Provide computational solutions to power engineering problems	5/6	3		G002B	UEE60110; UEE60610; UEE60910; UEE61210; UEE62110; S5; S6; PSC
UEENEEG048B	Solve problems in complex multiple path power circuits	5/6	3		G047B; G002B	UEE60110; UEE60610; UEE60910; UEE61210; UEE62110; S5; S6; PSC
UEENEEG049B	Solve problems in complex polyphase power circuits	5/6	3		G048B; G047B; G002B	UEE60110; UEE60610; UEE60910; UEE61210; UEE62110; S5; S6
UEENEEG050B	Wind coils	2	2		E002B; E007B;	UEE20407; UEE30607; UEE31910; S2
UEENEEG051B	Place and connect coils	2	2		E004B; G050B; E002B;	UEE20407; UEE30607; UEE31910;

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					<i>E007B</i>	S2
UEENEEG052B	Rewind single phase induction machines	2/3	6		G051B; <i>G050B;</i> <i>E002B;</i> <i>E007B</i>	UEE30607; UEE31910; S2; S3
UEENEEG053B	Rewind three phase induction machines rated for low voltage	3	6		G052B; <i>G051B;</i> <i>G050B;</i> <i>E002B;</i> <i>E007B</i>	UEE30607; UEE31910; S3
UEENEEG054B	Rewind direct current machines rated for low voltage	3	6		G052B; <i>G051B;</i> <i>G050B;</i> <i>E002B;</i> <i>E007B</i>	S3
UEENEEG055B	Rewind three phase induction machines rated for high voltage to 3.3 kV	3/4	3		G053B; <i>G052B;</i> <i>G051B;</i> <i>G050B;</i> <i>E002B;</i> <i>E007B</i>	S3; S4
UEENEEG056B	Rewind three phase induction machines rated for high voltage above 3.3 kV	3/4	3		G055B; <i>G053B;</i> <i>G052B;</i> <i>G051B;</i> <i>G050B;</i> <i>E002B;</i> <i>E007B</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEG057B	Conduct electrical tests on low voltage electrical machines	3/4	2	40	G008B; OR G053B; <i>G053B;</i> <i>G052B;</i> <i>G051B;</i> <i>G050B;</i> <i>E002B;</i> <i>E007B</i> OR <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B</i>	UEE30607; UEE31910; S3; S4
UEENEEG058B	Conduct electrical tests on high voltage electrical machines	3/4	3	60	G057B; <i>G053B;</i> <i>G052B;</i> <i>G051B;</i> <i>G050B;</i> <i>E002B;</i> <i>E007B</i> OR <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>E002B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B</i>	S3; S4
UEENEEG059B	Conduct mechanical tests on electrical	3/4	2	40	G057B; <i>G053B;</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	machines				G052B; G051B; G050B; E002B; E007B OR G008B; G002B; G003B; G004B; E002B; E004B; E005B; E007B	
UEENEEG060B	Evaluate performance of electrical machines	4/5	2	40	G057B; AND (G043B; OR G044B; OR G045B) G053B; G052B; G051B; G050B; E002B; E007B AND G049B; G048B; G047B; G002B; OR; G048B; G047B; G002B; OR G049B; G048B; G047B; G002B	S4; S5

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEG061B	Design and develop modifications to electrical machines	5/6	3	60	G060B; <i>G057B;</i> <i>G053B;</i> <i>G052B;</i> <i>G051B;</i> <i>G050B;</i> <i>E002B;</i> <i>E007B;</i> AND; <i>G043B;</i> <i>G049B;</i> <i>G048B;</i> <i>G047B;</i> <i>G002B;</i> OR <i>G044B;</i> <i>G048B;</i> <i>G047B;</i> <i>G002B;</i> OR; <i>G045B;</i> <i>G049B;</i> <i>G048B;</i> <i>G047B;</i> <i>G002B</i>	S5; S6
UEENEEG062B	Set up and place electrical apparatus and associated circuits into service	3/4	2		G005B; <i>E001B;</i> <i>E002B;</i> <i>E003B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B;</i> <i>E008B;</i> <i>E033B;</i> <i>G001B;</i> <i>G002B;</i> <i>G003B;</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6	
UEENEEG063 A	Arrange circuits, control and protection for general electrical installations	6		40	E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A;	UEE62311; UEE62211
UEENEEG064 B	Repair mechanical components of electrical machines	3/4	3		E002B; E005B; E007B	UEE30607; UEE30707; UEE31910; S3; S4
UEENEEG065 B	Maintain and service traction lifts	3/4	2		G016B; <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	S3; S4
UEENEEG066	Installation and	3/4	2		G016B;	S3; S4

National Code	Title	AQ F	Stran d	Point s	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualification s
B	maintenance of escalators, moving walks and tread ways				<i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	
UEENEEG067 B	Align and install lift equipment	3/4	2		<i>G016B;</i> <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	S3; S4
UEENEEG068 B	Diagnose and rectify faults in complex lift systems	4/5	2		<i>G016B;</i> <i>H043B;</i> <i>H044B;</i> <i>G008B;</i> <i>G002B;</i> <i>G003B;</i> <i>G004B;</i> <i>G001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	UEE41110; S4; S5
UEENEEG069 B	Manage electrical projects	6	2	40	None	UEE60110; S6
UEENEEG070	Plan electrical	6	3	60	None	UEE60110;

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
B	projects					S6
UEENEEG071 C	Install and set up interval metering	4	1		F002; G005B; <i>E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G004B; G007B; G008B; G009B; and elective units as required from Schedule 3 to a Strand Unit Value of 6.</i>	UEE42010; S4; PSC
UEENEEG072 C	Investigate and report on electrical incidents	4/5	3	60	G021B; G023B; G024B <i>G022B; G005B; E001B; E002B; E003B; E004B; E005B; E007B;</i>	S4; S5;

National Code	Title	AQ F	Stran d	Point s	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualification s
					<i>E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6</i>	
UEENEEG073 A	RESERVED					
UEENEEG074 A	RESERVED					
UEENEEG075 A	Develop compliance policies and plans to conduct a contracting business	4	4		<i>None</i>	UEE42110; S4; PSC
UEENEEG076 A	Install and replace low voltage current transformer metering	4		20	G105A; E101A; E102A; E104A; E105A; E107A; E137A; G006A; G033A;	UEE40610

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					G063A; G101A; G102A; G103A; G104A; G106A; G107A; G108A; G109A;	
UEENEEG101A	Solve problems in electromagnetic devices and related circuits	2/3		60	E104A; <i>E101A</i>	UEE62311; UEE62211
UEENEEG102A	Solve problems in low voltage a.c. circuits	3		80	E101A; E104A; G101A;	UEE62311; UEE62211
UEENEEG103A	Install low voltage wiring and accessories	3		20	E101A; E102A; E104A; E105A; E107A; E137A; G006A; G033A; G063A; G101A; G102A; G106A; G107A; G108A; G109A;	UEE62311; UEE62211
UEENEEG104	Install appliances, switchgear and	3		20	E101A; E102A;	UEE62311;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
A	associated accessories for low voltage electrical installations				E104A; E105A; E107A; E137A; G006A; G033A; G063A; G101A; G102A; G103A; G106A; G107A; G108A; G109A;	UEE62211
UEENEEG105A	Verify compliance and functionality of low voltage general electrical installations	3		40	E101A; E102A; E104A; E105A; E107A; E137A; G006A; G033A; G063A; G101A; G102A; G103A; G104A; G106A; G107A; G108A; G109A;	UEE62311; UEE62211
UEENEEG106A	Terminate cables, cords and accessories for low voltage	2/3		40	E101A; E102A; E105A;	UEE62311; UEE62211

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	circuits				E107B	
UEENEEG107A	Select wiring systems and cables for low voltage general electrical installations	3/4		60	E101A; E102A; E104A; E105A; E107A; G006A; G033A; G063A; G101A; G102A; G106A	UEE62311; UEE62211
UEENEEG108A	Trouble-shoot and repair faults in low voltage electrical apparatus and circuits	3		40	E101A; E102A; E104A; E105A; E107A; G006A; G033A; G063A; G101A; G102A; G106A;	UEE62311; UEE62211
UEENEEG109A	Develop and connect electrical control circuits	3		80	E101A; E102A; E104A; E105A; E107A; G006A; G063A; G101A; G102A; G106A;	UEE62311; UEE62211

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEG149A	Provide engineering solutions to problems in complex polyphase power circuits	5/6		60	E125A; <i>E126A;</i> <i>E029B or G102A or H014B,</i> <i>E004B; or H069B;E003 B</i> G102A; <i>E101A;</i> <i>E104A;</i> <i>G101A;</i>	UEE62311; UEE62211
UEENEEG171A	Install, set up and commission interval metering	3		20	G104A; <i>E101A;</i> <i>E102A;</i> <i>E104A;</i> <i>E105A;</i> <i>E107A;</i> <i>E137A;</i> <i>G006A;</i> <i>G033A;</i> <i>G063A;</i> <i>G101A;</i> <i>G102A;</i> <i>G103A;</i> <i>G106A;</i> <i>G107A;</i> <i>G108A;</i> <i>G109A</i>	UEE30807 UEE40610 UEE42010

H – Electronics units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH001B	Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies	2/3	2	40	E002B;	UEE40110; UEE50110; S2; S3
UEENEEH002B	Carry out basic repairs to electronic apparatus by replacement of components	2/3	2	40	E002B;	UEE20907; UEE21910; UEE30107; UEE30910; UEE31107; UEE31507; UEE40710; UEE41510; UEE41710; S2; S3
UEENEEH003B	Carry out routine repairs to business equipment	2/3	6	120	E002B;E005B;E007B;	UEE20207; UEE30107; S2; S3
UEENEEH004B	Set up and test residential audio/video equipment	2/3	2	40	None	UEE30310; S2; S3
UEENEEH005B	Verify compliance and functionality of custom electronic installations	3	2	40	H006B; <i>E008B; E002B; E005B; E007B</i>	UEE30310; S3
UEENEEH006B	Assemble and set up fixed audio/video components and systems in buildings and premises	2/3	6	120	E008B; <i>E002B; E005B; E007B</i>	UEE20607; UEE30310; S2; S3

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH007B	Carry out repairs of predictable faults in general electronic apparatus	3/4	2	40	H012B; H013B; H038B; <i>E002B; H011B (E002B; E004B; E007B; AND E003B; E004B; OR; G001B OR; E025B; G007B)</i>	UEE30107; UEE31107; S3; S4
UEENEEH008B	Assemble and erect reception antennae and signal distribution equipment	2/3	3	60	E002B; E005B; E007B	UEE21207; S2; S3
UEENEEH009B	Set up and test gaming/games equipment	2/3	3	60	None	UEE21107; UEE31107; S2; S3
UEENEEH010B	Install commercial audio/video system components	3	6	120	E002B; E005B; E007B; E008B	S3
UEENEEH011B	Troubleshoot d.c. power supplies with single phase input	3	2	40	H002B; AND H014B OR H069B; OR G002B; OR G012B; <i>E002B; E004B; E007B; AND; E003B; E004B; OR; G001B; OR; E025B; G007B</i>	UEE30107; UEE30910; UEE31107; UEE31507; UEE40710; UEE41510; UEE41710; UEE61710; S3
UEENEEH012B	Troubleshoot digital subsystems	3	4	80	H002B; <i>E002B</i>	UEE30107; UEE30910; UEE31107; UEE31507; UEE40710; UEE41510;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
						UEE41710; UEE61710; UEE61810; S3
UEENEEH013B	Troubleshoot amplifiers	3	4	80	None	UEE30107; UEE30910; UEE31107; UEE31507; UEE40710; UEE41510; UEE41710; S3
UEENEEH014B	Troubleshoot frequency dependent circuits	3	4	80	E004B; OR H069B; <i>E003B</i>	UEE30107; UEE30310; UEE30407; UEE30910; UEE31007; UEE31107; UEE31210; UEE31410; UEE31507; UEE31810; UEE40710; UEE41510; UEE41710; UEE50210; S3
UEENEEH015B	Develop software solutions in microcontroller based systems	3/4	3	60	None	UEE31107; S3; S4
UEENEEH016B	Find and repair faults in the microwave amplifier sections in electronic apparatus	3/4	2	40	H046B; <i>H013B</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH017B	Carry out repairs of predictable faults in audio and video replay/recording apparatus	3/4	6	120	H012B; H013B; H038B; <i>E002B; H011B (E002B; E004B; E007B; AND E003B; E004B; OR; G001B OR; E025B; G007B)</i>	S3; S4
UEENEEH018B	Find and repair faults in electronic apparatus	3	2	40	None	S3
UEENEEH019B	Carry out repairs of predictable faults in television receivers	3/4	6	120	H012B; H013B; H038B; <i>E002B; H011B (E002B; E004B; E007B; AND E003B; E004B; OR; G001B OR; E025B; G007B)</i>	UEE41510; S3; S4
UEENEEH020B	Find and repair faults in gaming and games equipment	3/4	4	80	H009B; H011B; H012B; H013B; H038B; <i>E002B; H011B (E002B; E004B; E007B; AND E003B; E004B; OR; G001B OR; E025B; G007B)</i>	UEE31107; S3; S4
UEENEEH021B	Find and repair faults in high volume office equipment	3	6	120	H003B; <i>E002B; E005B; E007B</i>	UEE30107; S3
UEENEEH022B	Find and repair faults in remote	3/4	3	60	H012B; H013B; H038B;	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	control apparatus				<i>E002B; H011B (E002B; E004B; E007B; AND E003B; E004B; OR; G001B OR; E025B; G007B)</i>	
UEENEEH023B	Find and repair faults in microwave heating apparatus	3	2	40	E034B	S3
UEENEEH024B	Carry out repairs of predictable faults in audio components	3/4	2	40	H012B; H013B; H038B; <i>E002B; H011B (E002B; E004B; E007B; AND E003B; E004B; OR; G001B OR; E025B; G007B)</i>	S3; S4
UEENEEH025B	Provide solutions to single phase electronic power control problems	4/5	3	60	H013B; or H044B	S4; S5
UEENEEH026B	Provide solutions to polyphase electronic power control problems	4/5	3	60	H025B; <i>H013B; or H044B</i>	S4; S5
UEENEEH027B	Commission commercial radio frequency (RF) transmission and reception systems	3/4	3	60	H046B; <i>H013B; H046B</i>	S3; S4
UEENEEH028B	Install microwave and antennae and waveguides	2/3	3	60	E002B; E005B; E007B;	S2; S3

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH029B	Diagnose and rectify faults in navigation systems	4	3	60	H016B; H072B; <i>H013B</i>	S4
UEENEEH030B	Diagnose and rectify faults in satellite-based surveillance and observation systems	4/5	3	60	H016B; H072B; <i>H013B</i>	S4; S5
UEENEEH031B	Diagnose and rectify faults in radar apparatus and systems	4/5	6	120	H016B; H072B; <i>H013B</i>	S4; S5
UEENEEH032B	Diagnose and rectify faults in global positioning systems	4/5	3	60	H016B; H072B; <i>H013B</i>	S4; S5
UEENEEH033B	Diagnose and rectify faults in telecommunication apparatus and systems	4/5	3	60	H012B; H013B; H015B; <i>E002B</i>	S4; S5
UEENEEH034B	Diagnose and rectify faults in electronic medical equipment	4/5	6	120	H012B; H013B; H015B; <i>E002B</i>	S4; S5
UEENEEH035B	Design custom electronic installations	4/5	6	120	H005B; <i>H006B</i>	S4; S5
UEENEEH036B	Design commercial audio/video installations	4/5	6	120	H037B; <i>H010B; E002B; E005B; E007B; E008B</i>	S4; S5
UEENEEH03	Program and commission	4	2	40	H010B;	S4

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
7B	commercial audio/video systems				<i>E002B; E005B; E007B; E008B</i>	
UEENEEH038B	Find and repair faults in complex power supplies	3/4	2	40	H011B; <i>E002B; E004B; E007B AND; E003B; E004B OR G001B OR E025B; G007B</i>	UEE30107; UEE30910; UEE31107; UEE31507; UEE40710; UEE41510; UEE41710; S3; S4
UEENEEH039B	Troubleshoot basic amplifiers	3	2	40	H002B; AND H014B; OR G002B <i>E002B; E004B; E007B AND E004B; E003B</i>	UEE30107; UEE30910; UEE31107; UEE31507; UEE40710; UEE41510; UEE41710; UEE61710; S3
UEENEEH040B	Diagnose and rectify faults in sonar apparatus and systems	4	6	120	H012B; H013B; H015B; H016B; H072B; <i>E002B; H046B</i>	S4
UEENEEH041B	Manage electronics/computer systems projects	6	2	40	None	UEE60210; UEE60410; S6
UEENEEH042B	Troubleshoot oscillators	3/4	2	40	H014B; H039B <i>E002B; E004B; AND E004B; E003B</i>	S3; S4
UEENEEH043B	Diagnose and rectify faults in digital subsystems of electronic controls	4	3	60	None	UEE40910; UEE41110; UEE50910; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH04 4B	Diagnose and rectify faults in analogue circuits and components in electronic control systems	4/5	3	60	None	UEE40910; UEE41110; UEE50910; S4; S5
UEENEEH04 5B	Develop solutions to analogue electronic problems	5/6	4	80	H039B; <i>E002B; E004B; E007B AND E004B; E003B</i>	S5; S6
UEENEEH04 6B	Solve fundamental problems in electronic communications systems	3/4	2	40	H013B	UEE30910; UEE40710; UEE41510; S3; S4
UEENEEH04 7B	Assess compliance of electronic apparatus	6	3	60	None	S6
UEENEEH04 8B	Design and develop advanced digital systems	5/6	2	40	None	S5; S6
UEENEEH04 9B	Develop solutions to audio electronic problems	5/6	3	60	H039B; <i>E002B; E004B; E007B AND E004B; E003B</i>	S5; S6
UEENEEH05 0B	Assemble and set up basic wired and wireless security systems	2/3	4	80	E002B; E005B; E007B;	UEE21610; UEE31410; S2; S3
UEENEEH05 1B	Install large wired and wireless security systems	3	5	100	H050B; <i>E002B; E005B; E007B</i>	UEE31410; S3

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH052B	Enter instructions and test basic wired and wireless security systems	3	2	40	H050B; <i>E002B; E005B; E007B</i>	UEE31410; S3
UEENEEH053B	Program and test large wired and wireless security systems	4/5	6	120	H054B; H055B; H056B; <i>H052B; H050B; E002B; E005B; E007B</i>	UEE31410; S4; S5
UEENEEH054B	Program and commission commercial security alarm systems	3/4	3	60	H052B; <i>H050B; E002B; E005B; E007B</i>	UEE31410; S3; S4
UEENEEH055B	Program and commission commercial security access control systems	3/4	3	60	H052B; <i>H050B; E002B; E005B; E007B</i>	UEE31410; S3; S4
UEENEEH056B	Program and commission commercial security closed circuit television (CCTV) systems	3/4	3	60	H052B; <i>H050B; E002B; E005B; E007B</i>	UEE31410; S3; S4
UEENEEH057B	Develop basic integrated security systems plan	4/5	2	40	H053B; <i>H054B; H055B; H056B; H052B; H050B; E002B; E005B; E007B</i>	S4; S5
UEENEEH058B	Design integrated security systems for a single site	5	2	40	H016B; H057B; <i>H053B; H054B; H055B; H056B; H052B; H050B;</i>	S5

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>H046B; H013B; E002B; E005B; E007B</i>	
UEENEEH059B	Design integrated complex security systems	5	3	60	H017B; H058B; <i>H012B; H013B; H016B; H057B; H053B; H054B; H055B; H056B; H052B; H050B; H046B; H013B; E002B; E005B; E007B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B; OR E025B; G007B)</i>	S5
UEENEEH060B	Plan electronic projects	6	3	60	None	S6
UEENEEH061B	Position and terminate fire detection and warning system apparatus	2	2	40	E002B; E005B; E007B	UEE21007; UEE31007; UEE40810; S2
UEENEEH062B	Verify compliance and functionality of fire protection installations	2	3	60	H061B; <i>E002B; E005B; E007B</i>	UEE21007; UEE31007; UEE40810; S2
UEENEEH063B	Enter and verify programs in preparation for commissioning fire protection systems	3	2	40	H062B; <i>H061B; E002B; E005B; E007B</i>	UEE31007; UEE40810; S3
UEENEEH06	Commission	3/4	2	40	H063B;	UEE31007;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
4B	commercial fire protection systems				<i>H062B; H061B; E002B; E005B; E007B</i>	UEE40810; S3; S4
UEENEEH06 5B	Find and repair faults in fire protection systems	3/4	2	40	H064B; <i>H063B; H062B; H061B; E002B; E005B; E007B</i>	UEE31007; UEE40810; S3; S4
UEENEEH06 6B	Fault find Microcontroller based hardware	3	2	40	None	S3
UEENEEH06 7B	Commission electronics and communications systems	5/6	1	20	None	UEE50597; UEE60210; S5; S6
UEENEEH06 8B	Modify-redesign of electronics and communications system	5/6	1	20	None	UEE50510; UEE60210; S5; S6
UEENEEH06 9B	Solve problems in electronic circuits	2/3	5	100	None	UEE61710; S2; S3
UEENEEH07 0B	Terminate and connect components, conductors, wiring and cables for electronic circuits	3	2	40	None	S3
UEENEEH07 1B	Find and repair faults in television receivers	3/4	6	120	H019B <i>H012B; H013B; H038B; E002B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B OR E025B; G007B)</i>	UEE41510; S3; S4

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH07 2C	Find and repair faults in communication systems	3/4	4	80	H046B	S3; S4
UEENEEH07 3B	Find and repair faults in professional audio reproduction components	3/4	6	120	H024B; <i>H012B; H013B; H038B; E002B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B OR E025B; G007B)</i>	S3; S4
UEENEEH07 4B	Find and repair faults in audio/video recording equipment	3/4	6	120	H017B; <i>H012B; H013B; H038B; E002B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B OR E025B; G007B)</i>	S3; S4
UEENEEH07 5B	Find and rectify faults and malfunctions in security system installations	4	3	60	H053B; <i>H054B; H055B; H056B; H052B; H050B; E002B; E005B; E007B</i>	S4
UEENEEH07 6B	Diagnose and rectify faults in display circuits	4	3	60	H071B; <i>H019B; H012B; H013B; H038B; E002B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B OR E025B; G007B)</i>	S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH077B	Diagnose and rectify faults in recording and replay apparatus	4	3	60	H074B; <i>H017B; H012B; H013B; H038B; E002B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B OR E025B; G007B)</i>	S4
UEENEEH078B	Diagnose and rectify faults in camera circuits	4	3	60	H018B	S4
UEENEEH079B	Diagnose and rectify faults in digital television apparatus	4	4	80	H076B; <i>H071B; H019B; H012B; H013B; H038B; E002B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B OR E025B; G007B)</i>	S4
UEENEEH080B	Diagnose and rectify faults in digital transmission systems	4	4	80	H076B; <i>H071B; H019B; H012B; H013B; H038B; E002B; H011B (E002B; E004B; E007B AND E003B; E004B OR G001B OR E025B; G007B)</i>	S4
UEENEEH081B	Design printed circuit boards	4/5	2	40	None	S4; S5
UEENEEH082B	Develop solutions to RF amplifiers	5	2	40	None	S5;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	problems					
UEENEEH083B	Analyse the performance of wireless-based electronic systems	5	2	40	None	S5;
UEENEEH084B	Modify DSP based sub-systems	6	4	80	None	S6
UEENEEH085B	Design a signal-conditioning subsystem	6	4	80	None	S6
UEENEEH086B	Commission microwave and satellite communication systems	4/5	2	40	H016B; <i>H046B; H013B</i>	S4; S5
UEENEEH087B	Solve problems in musical equipment circuits	3/4	2	40	H013B	S3; S4
UEENEEH088B	Design and develop electronics/computer systems project	5/6	2	40	None	UEE60210; UEE61710; UEE60410; UEE61810; S5; S6
UEENEEH089A	RESERVED					
UEENEEH090A	Provide solutions to air traffic control system problems	4/5	2	40	None	S4; S5
UEENEEH091A	Diagnose and rectify faults in air navigation systems	5		120	H027B; H072C; H090A; <i>H013B; H046B</i>	UEE50510

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEH092A	Develop engineering solutions for air surveillance apparatus and systems	5		120	H016B; H072C; H090A <i>H013B; H046B</i>	UEE50510

I – Instrumentation and control units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEI001B	Install and set up transducers and sensing devices	3/4	2	40	E002B; E005B; E007B	UEE31210; UEE31810; UEE40410; UEE50210; S3; S4
UEENEEI002B	Solve problems in pressure measurement systems	3/4	2		I001B; <i>E002B; E005B; E007B</i>	UEE31210; UEE31810; UEE40410; UEE50210; S3; S4
UEENEEI003B	Solve problems in density/level measurement systems	3/4	2		I002B; <i>I001B; E002B; E005B; E007B</i>	UEE31210; UEE31810; UEE40410; UEE50210; S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEEI004B	Solve problems in flow measurement systems	3/4	2		I002B; <i>I001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	UEE31210; UEE31810; UEE40410; UEE50210; S3; S4
UEENEEI005B	Solve problems in temperature measurement systems	3/4	2		I001B; <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	UEE31210; UEE31810; UEE40410; UEE50210; S3; S4
UEENEEI006B	Solve problems in process controllers, transmitters and converters	3/4	6		I003B; I004B; I005B; AND G002B OR H014B; <i>I001B;</i> <i>E002B;</i> <i>E005B;</i> <i>E007B</i> <i>(G001B;</i> <i>E004B) OR</i> <i>(E004B)</i>	UEE31210; UEE31810; UEE50210; S3; S4
UEENEEI007C	Install process instrumentation and control cabling and tubing	3/4	1		I001B; <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	UEE31210; UEE31810; UEE50210; S3; S4
UEENEEI008C	Install process control apparatus and associated equipment	3/4	1		I001B; <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	UEE31210; UEE31810; UEE50210; S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEEI009B	Set up process measuring and control instruments	3/4	6		I006B; <i>I003B; I004B; I005B; AND G002B OR H014B; I001B; E002B; E005B; E007B (G001B; E004B) OR (E004B)</i>	S3; S4
UEENEEI010B	Set up and adjust process control loops	3/4	2		I006B; <i>I003B; I004B; I005B AND G002B OR H014B; I001B; E002B; E005B; E007B (G001B; E004B) OR (E004B)</i>	UEE31210; UEE31810; UEE50210; S3; S4
UEENEEI011B	Find and rectify faults in process control valve and associated equipment	3/4	2		I007B; I008B; <i>I001B; E002B; E005B; E007B</i>	S3; S4
UEENEEI012B	Verify compliance and functionality of process control	3/4	2		I010B; I013B; <i>I006B; I003B;</i>	UEE31210; UEE31810; UEE40910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
	installations				<i>I004B; I005B AND G002B OR H014B; I001B; E002B; E005B; E007B (G001B; E004B) OR (E004B)</i>	UEE42610; UEE50210; UEE50910; UEE60710; UEE61210; S3; S4
UEENEEI013B	Select equipment for process control systems	3/4	4		<i>I010B; I006B; I003B; I004B; I005B AND G002B OR H014B; I001B; E002B; E005B; E007B (G001B; E004B) OR (E004B)</i>	UEE31210; UEE31810; UEE50210; S3; S4
UEENEEI014B	Find and rectify faults in process control systems	3/4	3		<i>I009B; I006B; I003B; I004B; I005B AND G002B OR H014B; I001B; E002B; E005B; E007B (G001B; E004B) OR</i>	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					(E004B)	
UEENEEI015B	Find and rectify faults in medical equipment control systems	4/5	6		None	S4; S5
UEENEEI016A	RESERVED					
UEENEEI017B	Calibrate and test measuring instruments	3/4	2	40	None	S3; S4
UEENEEI018A	RESERVED					
UEENEEI019B	Set up field control devices	4/5	3	60	E002B; E007B	S4; S5
UEENEEI020B	Provide solutions to problems in basic industrial control systems	4/5	3	60	None	S4; S5
UEENEEI021B	Find and repair faults in measuring and analysis systems	4	2		I012B; <i>I006B; I003B; I004B; I005B AND G002B OR H014B; I001B; E002B; E005B; E007B (G001B; E004B) OR (E004B)</i>	S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEI022B	Assist in commissioning process control systems	4/5	2		I012B; <i>I006B; I003B; I004B; I005B AND G002B OR H014B; I001B; E002B; E005B; E007B (G001B; E004B) OR (E004B)</i>	S4; S5
UEENEEI023B	Design electronic control systems	5/6	3	60	H012B; OR H043B <i>E002B; H001B OR H002B OR H070B</i>	S5; S6
UEENEEI024A	RESERVED					
UEENEEI025B	Provide solutions to fluid circuit operations	4/5	3	60	E001B; E002B; E007B	S4; S5
UEENEEI026B	Provide solutions to pneumatic/hydraulic system operations	4/5	4	80	I025B; <i>E001B; E002B; E007B</i>	S4; S5
UEENEEI027B	Analyse complex electronic circuits controlling fluids	4/5	4	80	I025B; <i>E001B; E002B;</i>	S4; S5

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
					<i>E007B</i>	
UEENEEI028B	Set up controls on complex fluid systems	6	4		D025B; D034B; D052B; I019B; I027B; <i>I025B; E001B; E002B; E007B; D027B; D028B; E027B; D015B; D024B; D008B</i>	UEE61110; S6
UEENEEI029B	Set up electronically controlled mechanically operated complex systems	6	4		D025B; D034B; D052B; I019B; I025B; <i>I025B; E001B; E002B; E007B; D027B; D028B; E027B; D015B; D024B; D008B</i>	S6
UEENEEI030B	Set up electronically controlled robotically operated	6	4	80	None	S6

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	complex systems					
UEENEEI031A	RESERVED					
UEENEEI032A	RESERVED					
UEENEEI033A	RESERVED					
UEENEEI034B	Manage control projects	6	2		None	UEE60610; S6
UEENEEI035B	Plan control projects	6	3		None	UEE60610; S6
UEENEEI036B	Manage automated systems projects	6	2		None	UEE61110; S6
UEENEEI037B	Plan automated systems projects	6	3		None	UEE61110; S6
UEENEEI038A	Provide solutions to ELV electro-pneumatic control systems and drives	2		60	E101A	UEE22010
UEENEEI040A	Plan the installation of integrated systems	3		20	E008B; E001B; E005B; E007B OR G106A; E101A; E102A; E104A; E105A; E107A;	UEE30807, UEE40610, UEE40210, UEE41010, UEE50410

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
					<i>G101A;</i>	
UEENEEI041A	Develop integrated systems	3		20	D001B And E008B: <i>E001B;</i> <i>E005B;</i> <i>E007B</i> OR G106A; <i>E101A;</i> <i>E102A;</i> <i>E104A;</i> <i>E105A;</i> <i>E107A;</i> <i>G101A;</i>	UEE30807, UEE40610
UEENEEI042A	Develop an integrated system interface for access through a touch screen	4		20	I041A: <i>D001B</i> And <i>E008B;</i> <i>E001B;</i> <i>E005B;</i> <i>E007B</i> OR <i>G106A;</i> <i>E101A;</i> <i>E102A;</i> <i>E104A;</i> <i>E105A;</i> <i>E107A;</i>	UEE40610

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					<i>G101A;</i>	
UEENEEI043A	Develop access control of integrated systems using logic-based programming tools	4		20	I042A; <i>I041A;</i> <i>D001B</i> <i>And</i> <i>E008B;</i> <i>E001B;</i> <i>E005B;</i> <i>E007B</i> <i>OR</i> <i>G106A;</i> <i>E101A;</i> <i>E102A;</i> <i>E104A;</i> <i>E105A;</i> <i>E107A;</i> <i>G101A;</i>	UEE40610
UEENEEI044A	Develop interfaces for multiple access methods to monitor, schedule and control an integrated system	4		20	I042A; <i>I041A;</i> <i>D001B</i> <i>And</i> <i>E008B;</i> <i>E001B;</i> <i>E005B;</i> <i>E007B</i> <i>OR</i> <i>G106A;</i> <i>E101A;</i> <i>E102A;</i>	UEE40610

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					E104A; E105A; E107A; G101A;	

J – Refrigeration and Air Conditioning units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEJ002B	Prepare refrigerant tubing and fittings	2/3	2		E002B; E007B	UEE20107; UEE21810; UEE30510; UEE31307; UEE40510; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710; S2; S3
UEENEEJ003B	Determine the basic operating conditions of vapour compression systems	2/3	3	60	E002B;	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710; S3
UEENEEJ00	Determine the basic operating	2/3	1		E002B;	UEE31307; UEE41310;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
4B	conditions of air conditioning systems					UEE42510; UEE50310; UEE50610; UEE60710; S2; S3
UEENEEJ005B	Position, assemble and start up split air conditioning systems	2/3	3		J002B; J072B; <i>E002B; E007B</i>	UEE20107; UEE40510; S2; S3
UEENEEJ006B	Install pipework for refrigeration and air conditioning systems	3	Core only		E005B; J002B; J003B <i>E002B; E007B</i>	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710;
UEENEEJ007B	Install refrigeration and air conditioning systems, major components and associated equipment	3	Core only		J006B; J008B; <i>E005B; J002B; J003B; E002B; E007B;</i>	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710;
UEENEEJ008B	Recover, pressure and leak test, evacuate and charge refrigerants	3	Core only		J002B; J003B; <i>E002B; E007B</i>	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710;
UEENEEJ009B	Verify compliance and functionality of refrigeration and air conditioning installations	3	Core only		E001B; E002B; E003B; E005B; E007B; E037B; E038B; J002B; J003B; J004B ; J006B; J007B; J008B; J010B; J011B; J013B;	UEE31307; UEE41010; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					J036B; J070B; P001B; P002B; P003B; P007B; and elective units from Schedule 3 to a Unit Strand value of 3	
UEENEEJ010B	Select refrigerant pipe/tube, accessories and associated controls	3	6		J003B; <i>E002B</i>	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710; S3
UEENEEJ011B	Diagnose and rectify faults in refrigeration and air conditioning systems and components	3	Core only		J007B; J070B; P007B; <i>J006B; J008B; E005B; J002B; J003B; E002B; J004B; J053B; P001B</i>	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710;
UEENEEJ013B	Commission refrigeration and air conditioning systems	3	Core only		J007B; J070B; P007B; <i>J006B; J008B; E005B; J002B; J003B; E002B; J004B; J053B; P001B</i>	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710;
UEENEEJ015B	Solve problems in beverage dispensers	3/4	2		J011B; J013B; <i>J007B; J070B; P007B; J006B; J008B; J002B; J003B; E002B; J004B; J053B; -P001B; J006B; E005B</i>	S3; S4

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEJ018B	Solve problems in post mix refrigeration systems	3/4	2		J011B; J013B; <i>J007B; J070B;</i> <i>P007B; J006B;</i> <i>J008B; J002B;</i> <i>J003B; E002B;</i> <i>J004B; J053B;</i> <i>-P001B; J006B;</i> <i>E005B</i>	S3; S4
UEENEEJ019B	Solve problems in ice making systems	3/4	2		J011B; J013B; <i>J007B; J070B;</i> <i>P007B; J006B;</i> <i>J008B; J002B;</i> <i>J003B; E002B;</i> <i>J004B; J053B;</i> <i>-P001B; J006B;</i> <i>E005B</i>	S3; S4
UEENEEJ020B	Solve problems in industrial refrigeration systems	3/4	2		J011B; J013B; <i>J007B; J070B;</i> <i>P007B; J006B;</i> <i>J008B; J002B;</i> <i>J003B; E002B;</i> <i>J004B; J053B;</i> <i>-P001B; J006B;</i> <i>E005B</i>	S3; S4
UEENEEJ021B	Monitor and adjust energy management systems on refrigeration systems	4	2		J009B; <i>E001B; E002B;</i> <i>E003B; E005B;</i> <i>E007B; E037B;</i> <i>E038B; J002B;</i> <i>J003B; J004B;</i> <i>J006B; J007B;</i> <i>J008B; J010B;</i> <i>J011B; J013B;</i> <i>J036B; J070B;</i> <i>P001B; P002B;</i>	S4

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>P003B; P007B</i>	
UEENEEJ040B	Manage refrigeration and air conditioning projects	6	2		None	UEE60710; S6
UEENEEJ053B	Find and rectify faults in appliance motors and associated controls	3	6		E002B; E003B; E005B; E007B; J008B <i>J002B; J003B</i>	UEE30510; UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710; S3
UEENEEJ067B	Solve problems in central plant air conditioning systems	3/4	1		J011B; J013B; <i>J007B; J070B;</i> <i>P007B; J006B;</i> <i>J008B; J002B;</i> <i>J003B; E002B;</i> <i>J004B; J053B;</i> <i>P001B; J006B;</i> <i>E005B</i>	S3; S4
UEENEEJ069B	Plan refrigeration and air conditioning projects	6	3		None	UEE60710; S6
UEENEEJ070B	Diagnose and rectify faults in refrigeration and air conditioning control systems	3	Core only		J003B; J004B; J007B; J053B; <i>J006B; J008B;</i> <i>E005B; J002B;</i> <i>J003B; E002B;</i> <i>E003B; E007B;</i>	UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710;
UEENEEJ072B	Recover, pressure and leak test, evacuate and charge	2/3	3		J002B <i>E002B; E007B</i>	UEE20107; S2; S3

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	refrigerants – split air conditioning systems					
UEENEEJ10 2A	Prepare and connect refrigerant tubing and fittings	2		30	E101A;	UEE20111; UEE32111; UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ10 3A	Establish the basic operating conditions of vapour compression systems	2		60	E101A;	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ10 4A	Establish the basic operating conditions of air conditioning systems	2		20	E101A;	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ10 5A	Position, assemble and start up single head split air conditioning and water heating heat pump systems	2		70	J172A <i>E101A; J102A;</i>	UEE20111
UEENEEJ10 6A	Install refrigerant pipe work, flow controls and	3		60	E102A; E105A; E137A; J102A; J103A;	UEE32211; UEE42711; UEE42811; UEE42911;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	accessories				<i>E101A</i> ;	UEE51211; UEE62511;
UEENEEJ107A	Install air conditioning and refrigeration systems, major components and associated equipment	3		80	J106A; J170A; <i>E101A; E102A; E105A; E107A; E137A; J102A; J103A; J108A; J194A; J153A</i> ;	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ108A	Recover, pressure test, evacuate, charge and leak test refrigerants	3		60	J102A; J103A <i>E101A</i> ;	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ109A	Verify functionality and compliance of refrigeration and air conditioning installations	3		20	J104A; J111A; J113A; P024A; P025A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A</i> ;	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ110A	Select refrigerant piping, accessories and associated controls	3		50	J103A <i>E101A</i> ;	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ111A	Diagnose and rectify faults in	3		40	J107A; J110A;P017A;	UEE32211; UEE42711;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	air conditioning and refrigeration systems and components				<i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J108A; J153A; J194A; J170A; P012A</i>	UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ11 2A	Diagnose and rectify faults in complex air conditioning/ refrigeration systems	4		100	J109A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE42711;
UEENEEJ11 3A	Commission air conditioning and refrigeration systems	3		40	J107A; J110A; P017A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J170A; J194A; P012A;;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ11 4A	Resolve problems in hydronic systems	3		40	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i>	
UEENEEJ115A	Resolve problems in beverage dispensers	3		40	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ116A	Resolve problems in transport refrigeration systems	3		20	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; ; J194A; P012A; P017A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ117A	Resolve problems in ultra-low temperature refrigeration systems	3		20	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; ; J194A; P012A; P017A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ11	Resolve problems	3		20	J111A; J113A;	UEE32211;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
8A	in post mix refrigeration systems				<i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; ; J194A; P012A; P017A;</i> Or J155A; <i>J154A; J162A</i> <i>J102A; J195A</i> <i>and</i> <i>G006A; E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A;</i> Or <i>J153A; E107A; J103A; J108A; J194A; E101A; E003B;</i>	UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ119A	Resolve problems in ice making systems	3		20	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; ; J194A; P012A; P017A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEJ121A	Monitor and adjust refrigeration energy management systems	4		40	J109A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE42711; UEE42811;
UEENEEJ122A	Diagnose faults in complex HVAC /refrigeration control systems	4		80	J112A; <i>J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE42711; UEE42811;
UEENEEJ123A	Commission complex (HVAC) heating, ventilation and air conditioning systems	4		80	J112A; <i>J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A;</i>	UEE42711; UEE42811;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					P025A	
UEENEEJ124A	Commission refrigeration/air conditioning hydronic systems	4		80	J112A; <i>J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE42711; UEE42811;
UEENEEJ125A	Commission complex refrigeration systems and equipment	4		80	J112A; <i>J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; ; J194A; P012A; P017A; P024A; P025A</i>	UEE42711; UEE42811;
UEENEEJ126A	Commission complex refrigeration/air conditioning control systems	4		80	J122A; <i>J112A; J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A;</i>	UEE42711; UEE42811;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	
UEENEEJ127A	Establish the thermodynamic parameters of refrigeration and air conditioning systems	4		80	J192A J193A OR J109A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE42911; UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ128A	Produce HVAC/R system design drawings	4		80	J164A; <i>J192A; J193A OR J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ129A	Establish heat loads for commercial refrigeration	4		80	J127A; <i>J192A; and J193A or J109A; E101A;</i>	UEE42911; UEE51111; UEE51211; UEE62411;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	and/or air conditioning applications				<i>E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE62511;
UEENEEJ130A	Produce HVAC/R control system diagrams	4		40	J164A; <i>J192A; J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE42911; UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ131A	Determine noise and vibration encountered in HVAC/R applications	4		80	J164A; <i>J192A; J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A;</i>	UEE42911; UEE51111; UEE51211; UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					P025A	
UEENEEJ132A	Design commercial refrigeration systems and select components	5		80	J129A; J165A; <i>J127A; J164A;</i> <i>J192A; and J193A or J109A; E101A;</i> <i>E102A; E003B;</i> <i>E105A; E107A;</i> <i>E137A; J102A;</i> <i>J103A; J104A;</i> <i>J106A; J107A;</i> <i>J108A; J110A;</i> <i>J111A; J113A;</i> <i>J153A; J170A;</i> <i>J194A; P012A;</i> <i>P017A; P024A;</i> <i>P025A</i>	UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ133A	Design industrial refrigeration systems and select components	5		80	J132A; <i>J165A; J127A;</i> <i>J164A;</i> <i>J192A; and J193A or J109A; E101A;</i> <i>E102A; E003B;</i> <i>E105A; E107A;</i> <i>E137A; J102A;</i> <i>J103A; J104A;</i> <i>J106A; J107A;</i> <i>J108A; J110A;</i> <i>J111A; J113A;</i> <i>J153A; J170A;</i> <i>J194A; P012A;</i> <i>P017A; P024A;</i> <i>P025A</i>	UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ134A	Design heating, ventilation and air conditioning (HVAC) systems	5		60	J129A; J165A; <i>J127A; J164A;</i> <i>J192A; and J193A</i>	UEE51111; UEE51211; UEE62411;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	and select components				or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A	UEE62511;
UEENEEJ135A	Design control systems for refrigeration or heating, ventilation and air conditioning systems	5		80	J130A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A	UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ136A	Evaluate and report on building services energy management systems	5		80	J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A;	UEE42811; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					P024A; P025A	
UEENEEJ137A	Evaluate and report on the indoor air quality of buildings	5		40	J109A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE51211; UEE62511;
UEENEEJ138A	Analyse vibration and noise in refrigeration and air conditioning systems	6		80	J165A: <i>J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE62411; UEE62511;
UEENEEJ139A	Develop specifications and prepare drawings for HVAC/Refrigeration projects	6		60	J128A; <i>J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A;</i>	UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A	
UEENEEJ141A	Design complex commercial refrigeration systems and select equipment	6		40	J132A; J138A; J127A; J129A; J165A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A	UEE62411; UEE62511;
UEENEEJ142A	Design complex industrial refrigeration systems and select equipment	6		40	J133A; J138A; J127A; J129A; J132A; J165A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A;	UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					P025A	
UEENEEJ143A	Design complex air conditioning systems and select equipment	6		120	J134A; J138A; <i>J165A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE62411; UEE62511;
UEENEEJ144A	Design mechanical ventilation/exhaust systems and select equipment	6		40	J134A; J138A; <i>J165A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE62411; UEE62511;
UEENEEJ145A	Design hydronic systems and select equipment	6		80	J138A; <i>J165A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B;</i>	UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	
UEENEEJ146A	Design complex control systems for refrigeration, heating, ventilation or air conditioning systems	6		80	J135A; <i>J130A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE62411; UEE62511;
UEENEEJ147A	Audit energy use for commercial HVAC/Refrigeration systems	6		40	J136A; <i>J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A;</i>	UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					P025A	
UEENEEJ148A	Audit HVAC/R control systems for compliance with regulations and standards	6		60	J135A; J130A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A	UEE62511;
UEENEEJ149A	Develop heat exchanger design specifications	6		80	J138A; J165A: J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A	UEE62411; UEE62511;
UEENEEJ150A	Evaluate new and alternative technologies applicable to electrotechnology	6		40	None	UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	applications					
UEENEEJ151A	Service small electrical appliances and power tools	3		60	G006A; <i>E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A;</i> or P024A and J153A; <i>E107A; J103A; J108A ; J194A; E101A; E003B;</i>	UEE32211
UEENEEJ153A	Find and rectify faults in motors and associated controls in refrigeration and air conditioning systems	3		50	E107A; J108A; J194A; <i>E101A; E003B; J103A;</i>	UEE32111; UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ154A	Find and rectify faults in appliance control systems and devices	3		60	G006A; <i>E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A;</i> or J153A; <i>E107A; J103A; J108A ; J194A; E101A; E003B;</i>	UEE32211
UEENEEJ155A	Service refrigeration appliances	3		60	J154A; J162A <i>J102A; J195A</i> and	UEE32211

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					G006A; E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A; or J153A; E107A; J103A; J108A; J194A; E101A; E003B;	
UEENEEJ156A	Service clothes washing machines and dryers	3		40	J154A; G006A; E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A; or J153A; E107A; J103A; J108A ; J194A; E101A; E003B;	UEE32211
UEENEEJ157A	Service electrical heating appliances	3		60	J154A; G006A; E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A; or J153A; E107A; J103A; J108A ; J194A; E101A; E003B;	UEE32211
UEENEEJ158A	Service dishwasher machines	3		40	J154A; G006A; E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A; or J153A;	UEE32211

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>E107A; J103A; J108A ; J194A; E101A; E003B;</i>	
UEENEEJ159A	Service gas heating appliances	3		40	J154A; <i>G006A; E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A; or J153A; E107A; J108A; J194A; E101A; E003B;</i>	UEE32211
UEENEEJ161A	Verify functionality and compliance of appliances	3		20	<i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J151A; J153A; J154A; J155A; J156A; J162A; J194A; J195A; K042A; P012A; P017A; P024A; P025A;.</i>	UEE32211
UEENEEJ162A	Recover, pressure test, evacuate, charge and leak test refrigerants — appliances	3		50	J102A; J195A <i>E101A;</i>	UEE32211
UEENEEJ164A	Analyse the operation of HVAC air and hydronic systems	4		80	J192A; <i>J193A; or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A;</i>	UEE42911; UEE51111; UEE51211; UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	
UEENEEJ165A	Evaluate thermodynamic and fluid parameters of refrigeration systems	5		100	J127A; J164A; <i>J192A; and J193A</i> <i>Or</i> J109A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ166A	Resolve problems in dairy refrigeration systems	3		20	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ167A	Resolve problems in central plant air conditioning systems	3		40	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i>	UEE62511;
UEENEEJ168A	Maintain microbial control of refrigeration and air conditioning systems	3/		20	None	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ170A	Diagnose and rectify faults in air conditioning and refrigeration control systems	3		70	J153A; <i>E107A; J108A; J194A; E101A; E003B;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ171A	Resolve problems in refrigerated beverage vending cabinets	3		20	J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i> OR J154A; J162A <i>J102A; J195A</i> <i>and</i> <i>G006A; E101A; E102A; E104A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>E105A; E107A; G101A; G102A; G106A;</i> <i>or</i> <i>J153A; E107A; J103A; J108A; J194A; E101A; E003B;</i>	
UEENEEJ17 2A	Recover, pressure test, evacuate, charge and leak test refrigerants — split systems	2		60	J102A; <i>E101A;</i>	UEE20111;
UEENEEJ17 3A	Service and repair microwave ovens	3		40	J154A; <i>G006A;</i> <i>E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A;</i> <i>or</i> J153A; <i>E107A; J103A; J108A ; J194A; E101A; E003B;</i>	UEE32111;
UEENEEJ17 4A	Apply safety awareness and legal requirements for hydrocarbon refrigerants	3		10	None	UEE32211; UEE42711; UEE42811; UEE42911; UEE51111; UEE51211 UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEJ175A	Service and repair self contained hydrocarbon air conditioning and refrigeration systems	3		20	J174A; and J155A; <i>J054B;</i> <i>J062B: J102A;</i> <i>J195A and</i> <i>G006A; E101A;</i> <i>E102A; E104A;</i> <i>E105A; E107A;</i> <i>G101A; G102A;</i> <i>G106A;</i> <i>or</i> <i>J153A; E107A;</i> <i>J108A ; J194A;</i> <i>E101A; E003B;</i> <i>Or</i> <i>J111A; J107A;</i> <i>P017A; E101A;</i> <i>E102A; E003B;</i> <i>E105A; E107A;</i> <i>E137A; J102A;</i> <i>J103A; J104A;</i> <i>J106A; J107A;</i> <i>J108A; J110A;</i> <i>J170A; J194A;</i> <i>P012A</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ176A	Install and commission hydrocarbon refrigerant systems, components and associated equipment	3		20	J113A <i>J107A; P017A;</i> <i>E101A; E102A;</i> <i>E003B; E105A;</i> <i>E107A; E137A;</i> <i>J102A; J103A;</i> <i>J104A; J106A;</i> <i>J107A; J108A;</i> <i>J110A; J170A;</i> <i>J194A; P012A;</i> <i>P017A; J174A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					and J175A <i>J155A; J054B; J062B; J102A; J195A ;</i> and <i>G006A; E101A; E102A; E104A; E105A; E107A; G101A; G102A; G106A;</i> or <i>J153A; E107A; J108A; J194A; E101A; E003B;</i> or <i>J111A; J107A; P017A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J170A; J194A; P012A</i>	
UEENEEJ177A	Design hydrocarbon refrigerant systems	5		40	J132A; J174A; <i>J129A; J165A; J127A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A;</i>	UEE51111; UEE51211 UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A;</i>	
UEENEEJ178A	Apply safety awareness and legal requirements for ammonia refrigerant	3		10	None	UEE32211; UEE42711; UEE42811; UEE42911; UEE51111; UEE51211 UEE62411; UEE62511;
UEENEEJ179A	Repair and service ammonia refrigeration systems	3		20	J178A; J111A; J113A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ180A	Install and commission ammonia refrigeration systems, components and associated equipment	3		20	J178A; J179A <u>J111A; J113A;</u> <u>E101A; E102A;</u> <u>E003B; E105A;</u> <u>E107A; E137A;</u> <u>J102A; J103A;</u> <u>J104A; J106A;</u> <u>J107A; J108A;</u> <u>J110A; J153A;</u>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					J170A; J194A; P012A; P017A;	
UEENEEJ181A	Design ammonia refrigerated systems	5		40	J132A; J178A; J129A; J165A; J127A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A	UEE51111; UEE51211 UEE62411; UEE62511;
UEENEEJ182A	Repair and service secondary refrigeration systems	3		20	J111A; J113A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ183A	Design secondary refrigerant systems	5		40	J132A; J129A; J165A; J127A; J164A; J192A; and J193A or J109A; E101A; E102A; E003B;	UEE51111; UEE51211 UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	
UEENEEJ184A	Apply safety awareness and legal requirements for carbon dioxide refrigerant	3		10	None	UEE32211; UEE42711; UEE42811; UEE42911; UEE51111; UEE51211 UEE62411; UEE62511;
UEENEEJ185A	Repair and service carbon dioxide refrigeration systems	3		20	J111A; J113A; J184A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;
UEENEEJ186A	Install and commission carbon dioxide refrigeration systems, components and associated	3		20	J184A; J185A <i>J111A; J113A; E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A;</i>	UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	equipment				<i>J107A; J108A; J110A; J153A; J170A; J194A; P012A; P017A;</i>	
UEENEEJ187A	Design carbon dioxide refrigerated systems	5		40	J132A; J184A; <i>J129A; J165A; J127A; J164A; J192A; and J193A or J109A;</i> <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE51111; UEE51211 UEE62411; UEE62511;
UEENEEJ188A	Repair and service self contained carbon dioxide refrigeration and heat pump systems	3		20	J184A and J155A <i>J054B; J062B; J102A; J195A; and G006A; E101A; E102A; E104A; E105A; E107A; G101A; G106A; or J153A; E107A; J108A ; J194A; E101A; E003B;</i> <i>Or J111A; J107A; P017A; E101A; E102A; E003B; E105A; E107A; E137A; J102A;</i>	UEE32111; UEE32211; UEE42711; UEE42811; UEE42911; UEE51211; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>J103A; J104A; J106A; J107A; J108A; J110A; J170A; J194A; P012A</i>	
UEENEEJ189A	Service room air conditioners	3		30	J104A; <i>E010A</i> and J154A; <i>G006A; E101A; E102A; E104A; E105A; E107A; G101A; G106A; or J153A; E107A; J108A ; J194A; E101A; E003B;</i> or J170A; <i>J153A; E107A; J108A; J194A; E101A; E003B;</i> and J162A; <i>J102A; J195A ; E101A;</i> or J108A <i>E101A; J102A; J103A</i>	UEE32111
UEENEEJ190A	Select basic commercial refrigeration system equipment, components and accessories	4		40	J110A; <i>E101A; J103A</i> J129A; <i>J127A; J192A; and J193A or</i> J109A; <i>E101A; E102A;</i>	UEE42911; UEE51111; UEE51211; UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	
UEENEEJ191A	Select residential air conditioning system equipment, components and accessories	4		40	J129A; <i>J127A; J192A; and J193A</i> J110A <i>J103A; E101A;</i> <i>or</i> J109A; <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A; J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	UEE42911; UEE51111; UEE51211; UEE62411; UEE62511;
UEENEEJ192A	Analyse the psychrometric performance of HVAC/R systems	4		50	J193A or J109A <i>E101A; E102A; E003B; E105A; E107A; E137A; J102A; J103A; J104A; J106A;</i>	UEE42911; UEE51111; UEE51211; UEE62411; UEE62511;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>J107A; J108A; J110A; J111A; J113A; J153A; J170A; J194A; P012A; P017A; P024A; P025A</i>	
UEENEEJ193A	Analyse the thermodynamic performance of HVAC/R systems	4		50	None	UEE51111; UEE62411;
UEENEEJ194A	Solve problems in low voltage refrigeration circuits	3		40	E003B and J103A or J195A <i>E101A;</i>	UEE32111; UEE32211; UEE42711; UEE42811; UEE42911UEE42911; UEE51211; UEE62511;
UEENEEJ195A	Establish the basic operating conditions of vapour compression systems - appliances	3		50	E101A	UEE32111;
UEENEEJ196A	Operate Ammonia Refrigeration Plan	3		40	J178A	Skill Set: Operate Ammonia Refrigeration Systems

K – Renewable/Sustainable Energy

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEEK001B	Maintain safety and tidiness of remote area power supply (RAPS) systems	2	1	20	None	UEE21407; UEE21310; S2
UEENEEK002B	Work safely with remote area power supply (RAPS) systems	2	1	20	None	UEE21407; S2
UEENEEK003B	Conduct periodic maintenance of remote area power supply (RAPS) battery banks	2	2	40	E001B; E002B; E003B; K001B;	S2
UEENEEK004B	Conduct periodic maintenance of remote area power supply (RAPS) generator sets	2	2	40	E001B; E002B; E003B; K001B;	S2
UEENEEK005B	Conduct periodic maintenance of remote area power supply (RAPS) photo voltaic arrays	2	2	40	E001B; E002B; E003B; K001B;	S2

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEEK006B	Conduct periodic maintenance of remote area power supply (RAPS) wind generators	2	2	40	E001B; E002B; E003B; K001B;	S2
UEENEEK007B	Conduct checks in the demand side use of remote area power supplies	2/3	2	40	E001B; K002B; K003B; K004B; K005B; K006B; <i>E001B; E002B; E003B; K001B</i>	S2; S3
UEENEEK008B	Plan periodic maintenance schedules of remote area power supplies	2/3	2	40	E001B; E033B; K002B; K003B; K004B; <i>E001B; E002B; E003B; K001B</i>	S2; S3
UEENEEK009B	Attend to breakdowns in remote area power supplies	3	1		E001B; E002B; E003B; K001B;	S3
UEENEEK010B	Coordinate maintenance of renewable	4	1		E001B; E002B; E003B;	S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
	energy apparatus and systems				K001B;	
UEENEEK011B	Assemble and connect remote area power supplies (RAPS)	2	3	60	E002B; E003B; E007B;	S2
UEENEEK012B	Provide basic sustainable energy solutions for energy reduction in domestic premises	2	2	40	None	UEE22107; S2
UEENEEK013B	Apply sustainable energy practice in daily activities	2	5	100	None	UEE22107; S2
UEENEEK014B	Promote sustainable energy practice in the community	2	2	40	None	UEE22107; S2
UEENEEK016A	Maintain and repair remote area power generation facilities	2	6	120	Competency in this unit shall be assessed in conjunction with other units in a qualification	S2;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEEK017B	Maintain and repair facilities associated with remote area essential services operation	2/3	6	120	E001B; E002B; E003B;	; S2; S3
UEENEEK020B	Maintain operation of remote area power plant	2/3	6	120	K017B;	S2; S3
UEENEEK021B	Manage renewable energy projects	6	2		None	UEE60910; S6;
UEENEEK022B	Plan renewable energy projects	6	3		None	UEE60910; S6;
UEENEEK023B	Carry out basic repairs to renewable energy apparatus by replacement of components	2/3/4	4	80	E004B; E008B; <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	UEE21510; UEE32010; UEE41910; UEE62010; S2; S3; S4;
UEENEEK025C	Solve basic problems in photovoltaic energy apparatus	3/4	1		E004B; E008B; E002B; E033B; <i>E003B;</i> <i>E005B; E007B</i>	UEE32010; UEE41910; UEE42010; UEE62010; S2; S3; S4;
UEENEEK026B	Install and set up grid connected	3/4	2		K025C or K023B;	UEE41910; UEE42010; S3;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	photovoltaic power systems				<i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	S4;
UEENEEK027B	Diagnose faults in renewable energy control systems	4/5	3		K025C; <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	UEE32010; UEE41610; UEE41910; S3; S4; S5
UEENEEK028B	Solve problems in stand-alone renewable energy systems	4/5	3		K023B; <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	UEE32010; UEE41610; UEE41910; UEE62010; S3;S4; S5;
UEENEEK029B	Design renewable energy heating systems	5/6	6		K028B;	S5; S6;
UEENEEK030B	Solve problems in wind energy conversion systems	4/5	3		K023B; <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	S3;S4; S5;
UEENEEK031B	Design wind energy conversion	5/6	3		K030B; <i>K023B;</i> <i>E004B;</i>	S5; S6;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
	systems rated to 10 kW				<i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	
UEENEEK032B	Develop strategies to address sustainability issues	4/5	1	20	None	UEE62010; S4; S5;
UEENEEK033B	Design set up hybrid power systems	5/6	4		K028B; <i>K023B;</i> <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	S5; S6;
UEENEEK034B	Install standalone photovoltaic power systems	4	3		;E019C K023B; ;	UEE32010; UEE41610; UEE41910; S4
UEENEEK035C	Design grid connected power supply systems	4/5	3		K025C; <i>K023B;</i> <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	S5; S6;
UEENEEK036B	Prepare grid connected photovoltaic power systems	3	2		None	UEE32010;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	for LV connection					
UEENEEK037B	Install and set up micro-hydro systems	3/4	1		K023B; <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	S3; S4;
UEENEEK038B	Design micro-hydro systems	4/5	3		K028B; <i>K023B;</i> <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	S4; S5;
UEENEEK039B	Design stand-alone renewable energy systems	5/6	2		K028B; <i>K023B;</i> <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	S5; S6;
UEENEEK040B	Develop engineering solution to renewable energy problems	6	3		K031B; K032B; K035B; K038B; K039B; <i>K030B;</i> <i>K025B;</i> <i>K023B;</i> <i>E004B;</i>	S5; S6;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
					<i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	
UEENEEK042A	Participate in environmentally sustainable work practices	4	SC/1	20	None	UEE10110; UEE20107; UEE20207; UEE20407; UEE20510; UEE20607; UEE20707; UEE20907; UEE21007; UEE21107; UEE21207; UEE21310; UEE21407; UEE21510; UEE21610; UEE21710; UEE21810; UEE21910; UEE22010; UEE22107; UEE30107; UEE30210; UEE30310; UEE30407; UEE30510; UEE30607; UEE30707; UEE30807; UEE30910; UEE31007; UEE31107;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
						UEE31210; UEE31307; UEE31410; UEE31507; UEE31710; UEE31810; UEE31910; UEE32010; UEE41910; SC
UEENEEK043A	Install small wind energy conversion systems for stand-alone applications	3	1		K027B; K028B; K034B;	S3;
UEENEEK044A	RESERVED					
UEENEEK045A	Implement & monitor, policies & procedures for environmentally sustainable electrotech work practice	4	SC/1	20	None	UEE40110; UEE40210; UEE40310; UEE40410; UEE40510; UEE40610; UEE40710; UEE40810; UEE40910; UEE41010; UEE41110; UEE41210; UEE41310; UEE42510; UEE41510; UEE41610; UEE41710; UEE42610;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
						UEE41910; UEE50110; UEE50510; UEE60210; UEE60410; SC; S4;
UEENEEK046A	Design energy management controls for electrical installations in buildings	5/6	4		K032B;	S5; S6;
UEENEEK047A	Maintain and monitor remote area essential service operations	2	6	120	Competency in this unit shall be assessed in conjunction with other units in a qualification	S2
UEENEEK048A	Install, configure and commission grid connected photovoltaic power systems	3/4	2		K023B or K025C;	UEE42010; S3; S4
UEENEEK049A	Verify compliance and functionality of a renewable energy installation	3	Core Only/1		E001B; E002B; E003B; E004B; E005B; E007B; E008B; E019C; E034B;	UEE32010; UEE41610; UEE41910;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
					G001C; K023B; K027B; K028B; K034B; and elective units as required, from Schedule 3 to a Strand Unit value of 16 <i>K025C</i>	
UEENEEK050A	Assemble and set up photovoltaic apparatus in a domestic dwelling	2/3	1	20	K023B <i>E004B;</i> <i>E008B;</i> <i>E002B;</i> <i>E003B;</i> <i>E005B; E007B</i>	UEE21510; S2; S3
UEENEEK051A	Develop effective strategies for energy reduction in buildings	5/6	6		;None	UEE62010; S5; S6;

L – Imported units

National Code	Title	AQ F	Stran d	Point s	Prerequisit es (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
ICTTEN2207A	Install and configure a home or small office network	2		60	As per the rules of the Training Package in which the unit resides	UEE20510
ICTTEN2208A	Install and configure a small to medium business network	2		60	As per the rules of the Training Package in which the unit resides	UEE20510
ICTTEN2209A	Build and maintain a secure network	2		80	As per the rules of the Training Package in which the unit resides	UEE20510
ICTTEN4210A	Implement and troubleshoot enterprise routers and switches	4		100	As per the rules of the Training Package in which the unit resides	UEE40110
ICTTEN4211A	Design, install and configure an internetwork	4		100	As per the rules of the Training Package in which the unit resides	UEE40110

National Code	Title	AQF	Strand	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
ICTTEN4212A	Apply advanced routing protocols to network design	4		80	As per the rules of the Training Package in which the unit resides	UEE40110
ICTTEN4213A	Configure and troubleshoot advanced network switching	4		80	As per the rules of the Training Package in which the unit resides	UEE40110
ICTTEN4214A	Install and maintain a wide area network	4		80	As per the rules of the Training Package in which the unit resides	UEE40110
ICTTEN3056A	Install telecommunications network equipment	3	2		As per the rules of the Training Package in which the unit resides	S3
ICTTEN5083A	Locate, diagnose and rectify complex faults	4	4		As per the rules of the Training Package in which the unit resides	S4
ICTTEN4085A	Monitor, analyse and action	4	2		As per the rules of the	S4

National Code	Title	AQF	Strands	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
	telecommunications network alarms				Training Package in which the unit resides	
ICTTEN4081A	Locate, diagnose and rectify faults	4	4		As per the rules of the Training Package in which the unit resides	S4
ICTTEN3089A	Repair and replace telecommunications network hardware	4	4		As per the rules of the Training Package in which the unit resides	S4
BSBITU306A	Design and produce business documents	5	2		As per the rules of the Training Package in which the unit resides	S5
BSBSMB405A	Monitor and manage small business operations	5	2		As per the rules of the Training Package in which the unit resides	S5
BSBMGT502B	Manage people performance	5/6	SC	70	As per the rules of the Training Package in which the	UEE50110; UEE50210; UEE50310; UEE50410; UEE50510;

National Code	Title	AQF	Strand	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					unit resides	UEE50610; UEE50710; UEE50810; UEE50910; UEE60110; UEE60210; UEE60410; UEE60610; UEE60710; UEE60910; UEE61110; UEE61210;
BSBINM501A	Manage an information or knowledge management system	5/6	SC	50	As per the rules of the Training Package in which the unit resides	UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE60110; UEE60210; UEE61710; UEE60410; UEE61810; UEE60610; UEE60710; UEE61910; UEE60910; UEE62010; UEE61110; UEE61210; UEE62110;
BSBMGT516	Facilitate continuous	5/6	SC	60	As per the	UEE50110;

National Code	Title	AQF	Strands	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
C	improvement				rules of the Training Package in which the unit resides	UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE60110; UEE60210; UEE60410; UEE60610; UEE60710; UEE60910; UEE61110; UEE61210;
BSBINN502A	Build and sustain an innovative work environment	5/6	SC	50	As per the rules of the Training Package in which the unit resides	UEE50110; UEE50210; UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE60110; UEE60210; UEE60410; UEE60610; UEE60710; UEE60910; UEE61110; UEE61210;
BSBWOR502B	Ensure team effectiveness	5/6	SC	60	As per the rules of the	UEE50110; UEE50210;

National Code	Title	AQF	Strands	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					Training Package in which the unit resides	UEE50310; UEE50410; UEE50510; UEE50610; UEE50710; UEE50810; UEE50910; UEE60110; UEE60210; UEE61710; UEE60410; UEE61810; UEE60610; UEE60710; UEE61910; UEE60910; UEE62010; UEE61110; UEE61210; UEE62110;
CPCCOHS1001A	Work safely in the construction industry	2		6	As per the rules of the Training Package in which the unit resides	UEE20111; UEE32111; UEE42911UEE42911
HLTCPR201A	Perform CPR	2		3	As per the rules of the Training Package in which the unit resides	UEE20111; UEE32111; UEE42911UEE42911
HLTFA301B	Apply first aid	2	1		As per the rules of the	S2

National Code	Title	AQF	Strands	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					Training Package in which the unit resides	
MEM16006A	Organise and communicate information			20	As per the rules of the Training Package in which the unit resides	
MEM16008A	Interact with computing technology			20	As per the rules of the Training Package in which the unit resides	
MEM30001A	Use computer aided drafting systems to produce basic engineering drawings			40	As per the rules of the Training Package in which the unit resides	
MEM30002A	Produce basic engineering graphics			40	As per the rules of the Training Package in which the unit resides	
MEM30003A	Produce detailed engineering drawings			80	As per the rules of the Training Package in which the	

National Code	Title	AQ F	Stran d	Point s	Prerequisit es (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					unit resides	
MEM30004A	Use CAD to create and display 3D models			40	As per the rules of the Training Package in which the unit resides	
MEM05012C	Perform routine manual metal arc welding			20	As per the rules of the Training Package in which the unit resides	
MEM05007C	Perform manual heating and thermal cutting			20	As per the rules of the Training Package in which the unit resides	
MSACMS200A	Apply competitive manufacturing practices	3	1		As per the rules of the Training Package in which the unit resides	S3;
MSACMT220A	Apply quick changeover procedures	3	1		As per the rules of the Training Package in which the unit resides	S3;

National Code	Title	AQ F	Stran d	Point s	Prerequisit es (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
MSACMT221 A	Apply Just in Time (JIT) procedures	3	1		As per the rules of the Training Package in which the unit resides	S3;
MSACMT240 A	Apply 5S procedures in a manufacturing environment	3	1		As per the rules of the Training Package in which the unit resides	S3;
MSACMT280 A	Undertake root cause analysis	3	1		As per the rules of the Training Package in which the unit resides	S3;
MSACMT281 A	Contribute to the application of a proactive maintenance strategy	3	1		As per the rules of the Training Package in which the unit resides	S3;
NWP209B	Use maps, plans, drawings and specifications	2	2	30	As per the rules of the Training Package in which the unit resides	S2
NWP218B	Perform and record	2	1	20	As per the	S2

National Code	Title	AQF	Strand	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
	sampling				rules of the Training Package in which the unit resides	
NWP226B	Prepare and restore work site	2	1	30	As per the rules of the Training Package in which the unit resides	S2
NWP227B	Control vegetation on a site	2	1	20	As per the rules of the Training Package in which the unit resides	S2
NWP229B	Repair minor structures	2	1	20	As per the rules of the Training Package in which the unit resides	S2
NWP243B	Operate bore fields and groundwater source systems	2	2	20	As per the rules of the Training Package in which the unit resides	S2

National Code	Title	AQF	Strands	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
NWP245B	Maintain tanks and water storage assets	2	2	30	As per the rules of the Training Package in which the unit resides	S2
NWP247A	Maintain catchment and surrounding areas	2	2	40	As per the rules of the Training Package in which the unit resides	S2
NWP253B	Install and repair water services	2	2	40	As per the rules of the Training Package in which the unit resides	S2
NWP255B	Maintain and repair wastewater collection assets	2	2	20	As per the rules of the Training Package in which the unit resides	S2
NWP256B	Monitor and report water distribution systems	2	2	30	As per the rules of the Training Package in which the	S2

National Code	Title	AQF	Strand	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					unit resides	
NWP257B	Maintain and repair wastewater collection systems	2	2	30	As per the rules of the Training Package in which the unit resides	S2
NWP259B	Operate, monitor and maintain pump stations	2	2	30	As per the rules of the Training Package in which the unit resides	S2
NWP260A	Monitor and report water treatment processes	2	2	30	As per the rules of the Training Package in which the unit resides	S2
NWP261A	Operate and maintain water treatment plant and equipment	2	3	30	As per the rules of the Training Package in which the unit resides	S2
NWP262A	Monitor and report wastewater treatment processes	2	2	30	As per the rules of the Training	S2

National Code	Title	AQF	Strand	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					Package in which the unit resides	
NWP263A	Operate and maintain wastewater treatment plant and equipment	2	3	30	As per the rules of the Training Package in which the unit resides	S2
NWP268B	Monitor, operate and report chlorine disinfection systems	2	2	30	As per the rules of the Training Package in which the unit resides	S2
PMBQUAL390A	Solve problems using 'quality tools'	5	2		As per the rules of the Training Package in which the unit resides	S5
PRMPFES43A	Prevent ozone depleting substance and synthetic greenhouse gas emissions	3	1		As per the rules of the Training Package in which the unit resides	S3
RIIOHS202A	Enter and work in confined spaces	2	1		As per the rules of the Training	S2

National Code	Title	AQF	Strand	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					Package in which the unit resides	
RIIOHS204A	Work safely at heights	2	1		As per the rules of the Training Package in which the unit resides	S2
RIIOHS205A	Control traffic with stop-slow bat	2	1		As per the rules of the Training Package in which the unit resides	S2
RIIRAI609A	Establish and maintain electrical installations, reticulation and protection system			120	As per the rules of the Training Package in which the unit resides	UEE62311
RIIRIS601A	Establish and maintain the risk management system			100	As per the rules of the Training Package in which the unit resides	UEE62311
TLIB3407B	Maintain poles and				As per the	

National Code	Title	AQF	Strand	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
	associated hardware				rules of the Training Package in which the unit resides	
TLIB4007B	Inspect poles and associated hardware				As per the rules of the Training Package in which the unit resides	
TLIB4807B	Carry out off-site repair, overhaul and assembly of mechanical signalling equipment				As per the rules of the Training Package in which the unit resides	
TLIB5307B	Maintain mechanical signalling locking and interlocking devices				As per the rules of the Training Package in which the unit resides	
TLIB5807B	Maintain aerial signal/telecommunications lines and cables				As per the rules of the Training Package in which the unit resides	

National Code	Title	AQF	Strands	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
TLID3507C	Operate a boom type elevating work platform	2	1		As per the rules of the Training Package in which the unit resides	S2
TLILIC508A	Licence to operate a boom-type elevating work platform (boom length 11 meters or more)	2	1		As per the rules of the Training Package in which the unit resides	S2
TLIS507B	Install mechanical infrastructure for signalling				As per the rules of the Training Package in which the unit resides	
TLIS807B	Decommission electrical and electromechanical signalling infrastructure equipment from service	4	1		As per the rules of the Training Package in which the unit resides	S4
TLIS907B	Install mechanical signalling locking and interlocking devices				As per the rules of the Training Package in	

National Code	Title	AQ F	Stran d	Point s	Prerequisit es (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					which the unit resides	
TLIX1107B	Install overhead wiring structure				As per the rules of the Training Package in which the unit resides	
TLIX1607B	Erect and mount structures and housings for signalling equipment				As per the rules of the Training Package in which the unit resides	
UEPOPS234A	Perform routine oxyacetylene (Fuel gas) welding (OAW)	2/3	2		As per the rules of the Training Package in which the unit resides	S2; S3
UEPOPS235A	Perform routine manual arc welding	2/3	2		As per the rules of the Training Package in which the unit resides	S2; S3
UEPOPS236A	Perform manual heating, thermal cutting and gouging	2/3	2		As per the rules of the Training	S2; S3

National Code	Title	AQF	Strands	Points	Prerequisites (for relevant prerequisite or co-requisite refer respective unit)	Qualifications
					Package in which the unit resides	
UETTDRI04B	Perform high voltage field switching operation to a given schedule	3/4	2		As per the rules of the Training Package in which the unit resides	S2; S3
One unit from an endorsed TP	One competency standard unit may be imported from any other National Quality Council (NQC) endorsed Training Package and be aligned to a relevant AQF	2-6	≤3		As per the rules of the Training Package in which the unit resides	S1; S2; S3; S4; S5; S6

M – Hazardous areas units

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEM019A	Attend to breakdowns in hazardous areas — coal mining	3	1	20	M080A and competencies in attending to breakdowns in general	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					electrical or instrumentation equipment mechanical plant/equipment service and maintenance at least at AQF level 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEI012B; MEM7.1B <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM020A	Attend to breakdowns in hazardous areas — gas atmospheres	3	1	20	M080A and competencies in attending to breakdowns in general electrical or instrumentation equipment mechanical plant/equipment service and maintenance at least at AQF level 3 or	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEI012B; MEM7.1B <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM021A	Attend to breakdowns in hazardous areas — dust atmospheres	3	1		M080A and competencies in attending to breakdowns in general electrical or instrumentation equipment mechanical plant/equipment service and maintenance at least at AQF level 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEI012B; MEM7.1B	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to) G005B; I012B; MEM7.1B; PMAOPS201B	
UEENEEM02 2A	Attend to breakdowns in hazardous areas — pressurisation	3	1		M080A and competencies in attending to breakdowns in general electrical or instrumentation equipment mechanical plant/equipment service and maintenance at least at AQF level 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEI012B; MEM7.1B <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at</i>	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM023A	Install explosion-protected equipment and wiring systems — coal mining	3	3	60	M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEM004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	UEE42610; S3; PSC
UEENEEM02	Install	3	3		M080A and	UEE42610;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
4A	explosion-protected equipment and wiring systems — gas atmospheres				competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	S3; PSC
UEENEE025A	Install explosion-protected equipment and wiring systems — dust atmospheres	3	3		M080Aand competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):	UEE42610; S3; PSC

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B	
UEENEEM026A	Install explosion-protected equipment and wiring systems — pressurisation	3	3		M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations,</i>	UEE42610; S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM027A	Maintain equipment in hazardous areas — coal mining	3	3	60	M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF011B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEM028A	Maintain equipment in hazardous areas — gas atmospheres	3	3	60	M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF011B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	S3; PSC
UEENEEM029A	Maintain equipment in hazardous areas — dust atmospheres	3	3		M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples	S3; PSC

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF011B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM030A	Maintain equipment in hazardous areas — pressurisation	3	3		M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF011B; <i>Competency required by a given industry or enterprise for plant or</i>	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM031A	Overhaul and repair of explosion-protected equipment — coal mining	3	3	60	Competencies in overhaul and repair of general low-voltage or extra-low voltage electrical/electronic equipment at AQF level 3 or equivalent Example are (but not limited to): UEENEEG060B; MEM15.20C	UEE31910; S3; PSC
UEENEEM032A	Overhaul and repair of explosion-protected equipment — flameproof enclosures	3	3		Competencies in overhaul and repair of general low-voltage or extra-low voltage electrical/electronic equipment at AQF level 3 or equivalent. Example are (but not limited to): UEENEEG060B; MEM15.20C	UEE31910; S3; PSC
UEENEEM033A	Overhaul and repair of explosion-protect	3	3		Competencies in overhaul and repair of general low-voltage or	UEE31910; S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	ed equipment — gas atmospheres				extra-low voltage electrical/electronic equipment at AQF level 3 or equivalent. Example are (but not limited to): UEENEEG060B; MEM15.20C	
UEENEEM034A	Overhaul and repair of explosion-protected equipment — dust atmospheres	3	3	40	Competencies in overhaul and repair of general low-voltage or extra-low voltage electrical/electronic equipment at AQF level 3 or equivalent. Example are (but not limited to): UEENEEG060B; MEM15.20C	UEE31910; S3; PSC
UEENEEM035A	Conduct a conformity assessment of explosion-protected equipment — coal mining	5	2		Competencies in compliance assessment of electrical / electronic equipment and general technical evaluation and report writing at AQF 5 or equivalent. Example are (but not limited to): C004B; E015B; E016B; E024B.	S5; PSC
UEENEEM036A	Conduct a conformity assessment of explosion-protected equipment —	5	2	40	Competencies in compliance assessment of electrical / electronic equipment and general	S5; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	gas atmospheres				technical evaluation and report writing at AQF 5 or equivalent. Example are (but not limited to): C004B; E015B; E016B; E024B.	
UEENEEM037A	Conduct a conformity assessment of explosion-protected equipment — dust atmospheres	4	2		Competencies in compliance assessment of electrical / electronic equipment and general technical evaluation and report writing at AQF 5 or equivalent. Example are (but not limited to): C004B; E015B; E016B; E024B.	S4; PSC
UEENEEM038A	Conduct testing of hazardous areas installations — coal mining	3/4	2	40	M080A and competencies in conducting testing of general electrical, electronic, instrumentation and/or data communication installations has been achieved at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH062B; UEENEEI012B; UEENEFF011B; <i>Competency required by a given industry or</i>	S3; S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM039A	Conduct testing of hazardous areas installations — gas atmospheres	3/4	2	40	M080A and competencies in conducting testing of general electrical, electronic, instrumentation and/or data communication installations has been achieved at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH062B; UEENEEI012B; UEENE EF011B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited</i>	S3; S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					to) <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM040A	Conduct testing of hazardous areas installations — dust atmospheres	3/4	2		M080A and competencies in conducting testing of general electrical, electronic, instrumentation and/or data communication installations has been achieved at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH062B; UEENEEI012B; UEENEEM011B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	S3; S4; PSC
UEENEEM041A	Conduct testing of hazardous area installations —	3/4	2		M080A and competencies in conducting testing of	S3; S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	pressurisation				general electrical, electronic, instrumentation and/or data communication installations has been achieved at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEI012B; MEM7.1B <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM04 2A	Conduct visual inspection of hazardous areas installations	3/4	2	40	M080A and competencies in conducting testing of general electrical, electronic, instrumentation and/or data communication installations has been achieved at AQF 3 or equivalent. Examples are (but not limited to):	UEE61210; S3; S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					UEENEEG005B; UEENEEH062B; UEENEEI012B; UEENE EF011B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B	
UEENEEM043A	Conduct detailed inspection of hazardous areas installations — coal mining	4	2	40	M023A; or M027A; or (M080A <u>and</u> M054A) or (M080A <u>and</u> G023B) <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> UEENEEG005B; UEENEEH050B; UEENEEI012B;	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B Or M024A; or <i>competencies in planning electrical / instrument installations at AQF level 4 or equivalent</i> <i>Examples are (but not limited to):</i> G025B; I012B; Or G022B; G005B; E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and <i>elective units as required from a</i>	

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>Schedule 3 to a Strand Unit value of 6</i>	
UEENEEM044A	Conduct detailed inspection of hazardous areas installations — gas atmospheres	4	2	40	M024A; or M028A; or (M080A <u>and</u> M054A) or (M080A <u>and</u> G023B) <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B;</i> <i>UEENEEH050B;</i> <i>UEENEEI012B;</i> <i>UEENEEF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B;</i> <i>MEM7.1B;</i> <i>PMAOPS201B</i> Or M024A; or	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>competencies in planning electrical / instrument installations at AQF level 4 or equivalent</i> <i>Examples are (but not limited to):</i> G025B; I012B; Or G022B; G005B; E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and <i>elective units as required from a Schedule 3 to a Strand Unit value of 6</i>	
UEENEEM045A	Conduct detailed inspection of hazardous areas installations — dust atmospheres	4	2		M025A; or M029A; or (M080A <u>and</u> M054A) or (M080A_ <u>and</u> G023B) <i>M080Aand competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i>	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B Or M024A; or <i>competencies in planning electrical / instrument installations at AQF level 4 or equivalent</i> <i>Examples are (but not limited to):</i> G025B; I012B; Or G022B; G005B; E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B;	

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6</i>	
UEENEEM046A	Conduct detailed inspection of hazardous areas installations — pressurisation	4	2		M026A; or M030A; or (M080A <u>and</u> M054A) or (M080A <u>and</u> G023B) <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					Or <i>M024A; or competencies in planning electrical / instrument installations at AQF level 4 or equivalent</i> <i>Examples are (but not limited to):</i> <i>G025B; I012B;</i> Or <i>G022B;</i> <i>G005B; E001B;</i> <i>E002B; E003B;</i> <i>E004B; E005B;</i> <i>E007B; E008B;</i> <i>E033B; G001B;</i> <i>G002B; G003B;</i> <i>G004B; G007B;</i> <i>G008B; G009B; and</i> <i>elective units as required from a Schedule 3 to a Strand</i> <i>Unit value of 6</i>	

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEM047A	Develop and manage maintenance programs for hazardous areas electrical equipment — coal mining	4	1	20	M027A; or (M075A; <u>and</u> E010B) <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B;</i> <i>UEENEEH050B;</i> <i>UEENEEI012B;</i> <i>UEENEEF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B;</i> <i>MEM7.1B;</i> <i>PMAOPS201B</i> Or <i>Competency in designing electrical systems and installations at AQF level 6 or equivalent. Examples are (but not</i>	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>limited to): E015B or G030B or I023B</i>	
UEENEEM048A	Develop and manage maintenance programs for hazardous areas electrical equipment — gas atmospheres	4	1		M028A; or (M080A; <u>and</u> E010B) <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B; UEENEEI012B;</i>	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B	
UEENEEM049A	Develop and manage maintenance programs for hazardous areas electrical equipment — dust atmospheres	4	1		M029A; or (M080A; <u>and</u> E010B) <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations,</i>	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM050A	Develop and manage maintenance programs for hazardous areas electrical equipment — pressurisation	4	1		M030A; or (M080A; and E010B) <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B;</i> <i>UEENEEH050B;</i> <i>UEENEEI012B;</i> <i>UEENEFF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i>	S4; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>G005B; I012B; MEM7.1B; PMAOPS201B</i>	
UEENEEM05 1A	RESERVED					
UEENEEM05 2A	Classify hazardous areas — gas atmospheres	6	2	40	Competencies in gathering and analysing technical data at AQF6 or equivalent Examples are (but not limited to): E071B; E075B; R002B	UEE61210; S6; PSC
UEENEEM05 3A	Classify hazardous areas — dust atmospheres	6	2		Competencies in gathering and analysing technical data at AQF6 or equivalent Examples are (but not limited to): E071B; E075B; R002B	UEE61210; S6; PSC
UEENEEM05 4A	Plan electrical installations for hazardous areas — gas atmospheres	4/5	1	20	M024A; or competencies in planning electrical / instrument installations at AQF level 4 or equivalent Examples are (but not limited to): G025B; I012B; <i>M080A and competencies in installation of general</i>	S4; S5; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B;</i> <i>UEENEEH050B;</i> <i>UEENEEI012B;</i> <i>UEENEEF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B;</i> <i>MEM7.1B;</i> <i>PMAOPS201B</i>	
UEENEEM055A	Plan electrical installations for hazardous areas — dust atmospheres	4/5	1		M025A; or competencies in planning electrical / instrument installations at AQF level 4 or equivalent Examples are (but not limited to): G025B; I012B; <i>M080A and competencies in installation of general</i>	S4; S5; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B;</i> <i>UEENEEH050B;</i> <i>UEENEEI012B;</i> <i>UEENEEF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B;</i> <i>MEM7.1B;</i> <i>PMAOPS201B</i>	
UEENEEM056A	Plan electrical installations for hazardous areas — pressurisation	4/5	1		M026A; or competencies in planning electrical / instrument installations at AQF level 4 or equivalent Examples are (but not limited to): G025B; I012B; <i>M080A and competencies in installation of general</i>	S4; S5; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B;</i> <i>UEENEEH050B;</i> <i>UEENEEI012B;</i> <i>UEENEEF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B;</i> <i>MEM7.1B;</i> <i>PMAOPS201B</i>	
UEENEEM057A	Design explosion-protected electrical systems and installations — gas atmospheres	6	1	20	Competencies in designing electrical systems and installations at AQF level 6 or equivalent. Examples are (but not limited to): E015B; G030B; I023B	S6; PSC
UEENEEM058A	Design explosion-protect	6	1		Competencies in designing electrical	S6; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	ed electrical systems and installations — dust atmospheres				systems and installations at AQF level 6 or equivalent. Examples are (but not limited to): E015B; G030B; I023B	
UEENEEM059A	Design explosion-protected electrical systems and installations — pressurisation	6	1		Competencies in designing electrical systems and installations at AQF level 6 or equivalent. Examples are (but not limited to): E015B; G030B; I023B	S6; PSC
UEENEEM060A	Carry out overhaul and repair of explosion-protected equipment — coal mining	3	3		Competency in general electrical, electronic, and/or mechanical equipment repair job function at AQF 3 or higher. Examples are (but not limited to): G029B; G064B; MEM7.1B	S3; PSC
UEENEEM061A	Carry out overhaul and repair of explosion-protected equipment — flameproof enclosures	3	3		Competency in general electrical, electronic, and/or mechanical equipment repair job function at AQF 3 or higher. Examples are (but not limited to): G029B; G064B;	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					MEM7.1B	
UEENEEM06 2A	Carry out overhaul and repair of explosion-protected equipment — gas atmospheres	3	3		Competency in general electrical, electronic, and/or mechanical equipment repair job function at AQF 3 or higher. Examples are (but not limited to): G029B; G064B; MEM7.1B	S3; PSC
UEENEEM06 3A	Carry out overhaul and repair of explosion-protected equipment — dust atmospheres	3	3		Competency in general electrical, electronic, and/or mechanical equipment repair job function at AQF 3 or higher. Examples are (but not limited to): G029B; G064B; MEM7.1B	S3; PSC
UEENEEM06 4A	Conduct audit of hazardous areas installations — coal mining	5	3	60	Competency in engineering auditing/evaluation AQF 5 or equivalent. Examples are (but not limited to): G031B; G060B;	S5; PSC
UEENEEM06 5A	Conduct audit of hazardous areas installations — gas atmospheres	5	3	60	Competency in engineering auditing/evaluation AQF 5 or equivalent. Examples are (but not limited to): G031B; G060B;	S5; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEM066A	Conduct audit of hazardous areas installations — dust atmospheres	5	3		Competency in engineering auditing/evaluation AQF 5 or equivalent. Examples are (but not limited to): G031B; G060B;	S5; PSC
UEENEEM067A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — coal mining	5/6	3	60	M035A; M043A; M064A <i>Competencies in compliance assessment of electrical / electronic equipment and general technical evaluation and report writing at AQF 5 or equivalent. Example are (but not limited to):</i> <i>C004B; E015B; E016B; E024B.</i> <i>And</i> <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> <i>UEENEEG005B; UEENEEH050B; UEENEEI012B;</i>	S5; S6; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B Or M024A; or <i>competencies in planning electrical / instrument installations at AQF level 4 or equivalent</i> <i>Examples are (but not limited to):</i> G025B; I012B; Or G022B; G005B; E001B; E002B; E003B; E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and <i>elective units as required from a</i>	

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					<i>Schedule 3 to a Strand Unit value of 6</i> <i>And</i> <i>Competency in engineering auditing/evaluation AQF 5 or equivalent. Examples are (but not limited to):</i> <i>G031B; G060B;</i>	
UEENEEM068A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — gas atmospheres	5/6	3	60	M036A; M044A; M065A <i>Competencies in compliance assessment of electrical / electronic equipment and general technical evaluation and report writing at AQF 5 or equivalent. Example are (but not limited to):</i> <i>C004B; E015B; E016B; E024B.</i> <i>And</i> <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited</i>	S5; S6; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					to): <i>UEENEEG005B;</i> <i>UEENEEH050B;</i> <i>UEENEEI012B;</i> <i>UEENEEF004B;</i> <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> <i>G005B; I012B;</i> <i>MEM7.1B;</i> <i>PMAOPS201B</i> Or <i>M024A; or competencies in planning electrical / instrument installations at AQF level 4 or equivalent Examples are (but not limited to):</i> <i>G025B; I012B;</i> Or <i>G022B;</i> <i>G005B; E001B;</i> <i>E002B; E003B;</i> <i>E004B; E005B;</i> <i>E007B; E008B;</i> <i>E033B; G001B;</i> <i>G002B; G003B;</i>	

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6</i> <i>And</i> <i>Competency in engineering auditing/evaluation AQF 5 or equivalent. Examples are (but not limited to):</i> <i>G031B; G060B;</i>	
UEENEEM069A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — dust atmospheres	5/6	3		M037A; M045A; M066A; <i>Competencies in compliance assessment of electrical / electronic equipment and general technical evaluation and report writing at AQF 5 or equivalent. Example are (but not limited to):</i> <i>C004B; E015B; E016B; E024B.</i> <i>And</i> <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic</i>	S5; S6; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B Or <i>M024A; or competencies in planning electrical / instrument installations at AQF level 4 or equivalent Examples are (but not limited to):</i> G025B; I012B; Or G022B; G005B; E001B; E002B; E003B;	

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					<i>E004B; E005B; E007B; E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and elective units as required from a Schedule 3 to a Strand Unit value of 6</i> And <i>Competency in engineering auditing/evaluation AQF 5 or equivalent. Examples are (but not limited to): G031B; G060B;</i>	
UEENEEM070A	Repair reeling, trailing and flexible cables	2/3	3		None	S2; S3; PSC
UEENEEM071A	Test reeling, trailing and flexible cables	2/3	3		None	S2; S3; PSC
UEENEEM072A	Inspect and fit plugs/couplers for reeling, trailing and flexible cables	2/3	3		None	S2; S3; PSC
UEENEEM073A	Verify compliance of repaired reeling, trailing and flexible cables	3	3		M070A; M071A; M072A	S3; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEM074A	Plan electrical installations in hazardous areas — Coal mining	4/5	1	20	M023A Competencies in planning general electrical/instrumentation installations at AQF4 or equivalent. Examples are (but not limited to): G025B or I012B <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to):</i> UEENEEG005B; UEENEEH050B; UEENEEI012B; UEENEFF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B	S4; S5; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEM075A	Design explosion-protected electrical systems — Coal mining	6	1		Competency in designing electrical systems and installations at AQF level 6 or equivalent. Examples are (but not limited to): E015B or G030B or I023B	S6; PSC
UEENEEM076A	Use and maintain the integrity of a portable gas detection device	3	1		UEENEEM080A and Competencies required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent	S3; PSC
UEENEEM077A	Install and maintain the integrity of fixed gas detection equipment	3	1		M023A or M024A or M025A or M027A or M028A or M029A or M080A <i>M080A and competencies in installation of general low-voltage or extra-low voltage electrical /electronic equipment and wiring systems at AQF 3 or equivalent. Examples are (but not limited to): UEENEEG005B; UEENEEH050B;</i>	S3; PSC

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
					UEENEEI012B; UEENEEF004B; <i>Competency required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to)</i> G005B; I012B; MEM7.1B; PMAOPS201B	
UEENEEM078A	Manage compliance of hazardous areas	4	1	20	Competency in general plant management at AQF level 4 Example is (but not limited to) PMASUP410A	S4; PSC
UEENEEM079A	Design of gas detection systems	6	1		M057A or M0058A or M059A <i>Competencies in designing electrical systems and installations at AQF level 6 or equivalent. Examples are (but not limited to):</i> E015B; G030B; I023B	S6; PSC
UEENEEM080A	Report on the integrity of	2	1	20	Competency required by a given industry or	UEE31710; UEE31810;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
	explosion-protected equipment in a hazardous area				enterprise for plant or machinery operation or installations, maintenance or service functions at least at AQF 2 or equivalent. Examples are, (but not limited to) G005B; I012B; MEM7.1B; PMAOPS201B	S2; PSC

N – Rail signalling units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (<i>indicated by italicised text</i>) (All units have a prefix UEENEE)	Qualifications
UEENEEN001B	Service mechanical signalling equipment and infrastructure	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN002B	Assemble and wire internal electrical	3/4	1		G004B; and work place	UEE41210; S3; S4

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	signalling equipment				requirements in 'Work site protection' have been acquired. <i>E002B;</i> <i>E005B;</i> <i>E007B</i>	
UEENEEN003B	Install and maintain track circuit leads and bonds	3/4	1		G017B; and work place requirements in 'Work site protection' have been acquired. <i>G003B;</i> <i>E003B;</i> <i>E005B;</i> <i>E007B</i>	S3; S4
UEENEEN004B	Perform cable tests	3/4	1		G005B; and work place requirements in 'Work site protection' have been acquired. <i>E001B;</i> <i>E002B;</i> <i>E003B;</i> <i>E004B;</i> <i>E005B;</i> <i>E007B;</i>	S3; S4

National Code	Title	AQF	Strands	Points	Prerequisites & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
					<i>E008B; E033B; G001B; G002B; G003B; G004B; G007B; G008B; G009B; and elective units as required, from Schedule 3 to a Strand Unit value of 6.</i>	
UEENEEN005B	Install and maintain signalling power supplies	3/4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S3; S4
UEENEEN006B	Maintain remote control and non-vital interlocking control systems	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN007B	Maintain power signalling and protected level	4	1		Relevant work place requirements in 'Work site	S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	crossing equipment				protection' have been acquired.	
UEENEEN008B	Maintain on-site power operated point-activating devices	3/4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S3; S4
UEENEEN009B	Maintain track circuit equipment	3/4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S3; S4
UEENEEN010B	Maintain electronic signalling and communication equipment	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN011B	Install and maintain power operated signalling equipment	3/4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S3; S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEN012B	Maintain power signalling and protective relay interlocking systems	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN013B	Install and test computer based interlocking equipment	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN014B	Maintain computer based and solid state interlocking systems	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN015B	Conduct routine inspecting and testing of new signal cables and lines	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN016B	Maintain electronic switched and microprocessor-base	4	1		Relevant work place requirements	S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	d remote control systems				in 'Work site protection' have been acquired.	
UEENEEN017B	Install and maintain transmission interface equipment	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN018B	Find and repair wiring system faults	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN019B	Test equipment and isolate faults	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN020B	Install electrical power and control equipment for rail networks	4	1		Relevant work place requirements in 'Work site protection' have been	S4

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
					acquired.	
UEENEEN021A	Repair rail signalling cables	4	1		N002 <i>G004B</i> Work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN022A	RESERVED					
UEENEEN023A	RESERVED					
UEENEEN024A	RESERVED					
UEENEEN025B	Coordinate and manage track protection	4	1		Relevant work place requirements in 'Work site protection' have been acquired.	S4
UEENEEN026B	Develop rail signalling maintenance programs	4	1		Relevant work place requirements in 'Work site	S4

National Code	Title	AQ F	Stran d	Point s	Prerequisite s & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualification s
					protection’ have been acquired.	
UEENEEN027B	Decommission electrical and electro-mechanical signalling from service	4	1		Relevant work place requirements in ‘Work site protection’ have been acquired.	S4
UEENEEN028B	Test and commission power signalling equipment	4	1		Relevant work place requirements in ‘Work site protection’ have been acquired.	S4

P – Restricted and specialist electrical work units

National Code	Title	AQ F	Stran d	Point s	Prerequisite s & Full Prerequisite Chain <i>(indicated by italicised text)</i> (All units have a prefix UEENEE)	Qualifications
UEENEEP001 B	Disconnect and reconnect fixed wired electrical equipment connected to a Low Voltage supply	3	4		Competencie s needed for hot waters servicing, pool servicing, mechanical maintenance , appliance servicing, emergency services and equipment repair.	UEE30510; UEE30607; UEE30707; UEE31210; UEE31307; UEE31810; UEE41310; UEE42210; UEE42310; UEE42410; UEE42510; UEE50310; UEE50610; UEE51010; UEE60710; UEE61410; UEE61510; S3; PSC
UEENEEP002 B	Attach cords and plugs to electrical equipment for connection to a single phase 250 Volt supply	2/3	2	40	None	UEE30510; UEE31307; UEE32010; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710;S2; S3; PSC
UEENEEP003 B	Attach cords and plugs to electrical equipment for connection to	2/3	1		P002B;	UEE30510; UEE31307; UEE41310; UEE42510;

National Code	Title	AQF	Stand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	1000 Va.c. or 1500 Vd.c. supply					UEE50310; UEE50610; UEE60710; S2; S3; PSC
UEENEEP004B	Disconnect and reconnect explosion-protected electrical equipment connected to Low Voltage supply	3	3		P001B;	S3; PSC
UEENEEP005B	Disconnect and reconnect 3.3 kV electric propulsion components of self-propelled earth moving vehicles	3	3		Competencies needed for mechanical maintenance of HV electric propulsion components off-road earth moving trucks.	S3; PSC
UEENEEP006B	Attach flexible cables and plugs to electrical equipment connected to a high voltage supply	2	2		P003B; <i>P002B</i>	S2; PSC

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEEP007B	Locate and rectify faults in electrical low voltage equipment following prescribed procedures	3	1		P001B;	UEE30510; UEE31307; UEE41310; UEE42510; UEE50310; UEE50610; UEE60710; S3; PSC
UEENEEP008B	Conduct in-service safety testing of electrical cord assemblies and cord connected equipment	2	1	20	None	UEE30910; S2; PSC
UEENEEP012A	Disconnect / reconnect composite appliances connected to low voltage installation wiring	3		60	Competencies needed for emergency services and equipment repair.	UEE32111; UEE32211; UEE42711; UEE42811; UEE42911UEE42911; UEE51211; UEE62511;
UEENEEP017A	Locate and rectify faults in low voltage composite appliances using set procedures	2		20	P012A	UEE32111; UEE32211; UEE42711; UEE42811; UEE42911UEE42911; UEE51211; UEE62511;
UEENEEP024A	Attach cords and plugs to electrical	2		20	E101A	UEE30910; UEE32111;

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
	equipment for connection to a single phase 230 Volt supply					UEE32211; UEE42711; UEE42811; UEE42911UEE42911; UEE51211; UEE62511;
UEENEEP025A	Attach cords, cables and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply	3		20	P025A	UEE32111; UEE32211; UEE42711; UEE42811; UEE42911UEE42911; UEE51211; UEE62511;

R – Research units

National Code	Title	AQF	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
UEENEER001	Contribute to the planning	5/6	6		None	UEE50810;

National Code	Title	AQ F	Strand	Points	Prerequisites & Full Prerequisite Chain (indicated by italicised text) (All units have a prefix UEENEE)	Qualifications
B	of a research project					S5; S6
UEENEER002 B	Contribute to the conduct of a research project	5/6	6		None	UEE50810; S5; S6
UEENEER003 B	Contribute to the development of a product/application/service	5/6	6		None	UEE50810; S5; S6
UEENEER004 B	Contribute to the trial of a product/application/service	5/6	6		None	UEE50810; S5; S6
UEENEER005 B	Contribute to intellectual property management	5/6	6		None	UEE50810; S5; S6
UEENEER006 B	Contribute to the commercialisation of a products/applications/services	5/6	6		None	UEE50810; S5; S6

1.2.10 Relationship of UEE07 Electrotechnology Training Package Version 4 to earlier Versions

2.10 Relationship of UEE07 Electrotechnology Training Package Version 4 to earlier Versions

What follows is a guide to assist RTOs in granting equivalent units when implementing this Training Package.

Table 1 – Relationship of UEE07 Electrotechnology Training Package CSUs Version 4 to UEE07 Electrotechnology Training Package CSUs Version 3.1

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
UEENEEE011C	Manage risk in electrotechnology activities	UEENEE011B	Manage risk in electrotechnology activities	E
UEENEEE080A	Apply industry and community standards to engineering activities		New Unit	
UEENEEE081A	Apply material science to solving electrotechnology engineering problems		New Unit	
UEENEEE082A	Apply physics to solving electrotechnology engineering problems		New Unit	
UEENEEE083A	Establish and follow a competency development plan in an electrotechnology engineering discipline		New Unit	
UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace		New Unit	
UEENEEE102A	Fabricate, assemble and dismantle utilities industry components		New Unit	
UEENEEE104A	Solve problems in d.c. circuits		New Unit	
UEENEEE105A	Fix and secure		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	electrotechnology equipment			
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications		New Unit	
UEENEEE125A	Provide engineering solutions for problems in complex multiple path circuits		New Unit	
UEENEEE126A	Provide solutions to basic engineering computational problems		New Unit	
UEENEEE137A	Document and apply measures to control OHS risks associated with electrotechnology work		New Unit	
UEENEEG006A	Solve problems in single and three phase low voltage machines		New Unit	
UEENEEG033A	Solve problems in single and three phase low voltage electrical apparatus and circuits		New Unit	
UEENEEG063A	Arrange circuits, control and protection for general electrical installations		New Unit	
UEENEEG076A	Install and replace low voltage current transformer metering		New Unit	
UEENEEG101A	Solve problems in electromagnetic devices		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	and related circuits			
UEENE102A	Solve problems in low voltage a.c. circuits		New Unit	
UEENE103A	Install low voltage wiring and accessories		New Unit	
UEENE104A	Install appliances, switchgear and associated accessories for low voltage electrical installations		New Unit	
UEENE105A	Verify compliance and functionality of low voltage general electrical installations		New Unit	
UEENE106A	Terminate cables, cords and accessories for low voltage circuits		New Unit	
UEENE107A	Select wiring systems and cables for low voltage general electrical installations		New Unit	
UEENE108A	Trouble-shoot and repair faults in low voltage electrical apparatus and circuits		New Unit	
UEENE109A	Develop and connect electrical control circuits		New Unit	
UEENE149A	Provide engineering solutions to problems in complex polyphase power circuits		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
UEENEEG171A	Install, set up and commission interval metering		New Unit	
UEENEEH091A	Diagnose and rectify faults in air navigation systems		New Unit	
UEENEEH092A	Develop engineering solutions for air surveillance apparatus and systems		New Unit	
UEENEEI038A	Provide solutions to ELV electro-pneumatic control systems and drives		New Unit	
UEENEEI040A	Plan the installation of integrated systems		New Unit	
UEENEEI041A	Develop integrated systems		New Unit	
UEENEEI042A	Develop an integrated system interface for access through a touch screen		New Unit	
UEENEEI043A	Develop access control of integrated systems using logic-based programming tools		New Unit	
UEENEEI044A	Develop interfaces for multiple access methods to monitor, schedule and control an integrated system		New Unit	
UEENEEJ102A	Prepare and connect		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	refrigerant tubing and fittings			
UEENEEJ103A	Establish the basic operating conditions of vapour compression systems		New Unit	
UEENEEJ104A	Establish the basic operating conditions of air conditioning systems		New Unit	
UEENEEJ105A	Position, assemble and start up single head split air conditioning and water heating heat pump systems		New Unit	
UEENEEJ106A	Install refrigerant pipe work, flow controls and accessories		New Unit	
UEENEEJ107A	Install air conditioning and refrigeration systems, major components and associated equipment		New Unit	
UEENEEJ108A	Recover, pressure test, evacuate, charge and leak test refrigerants		New Unit	
UEENEEJ109A	Verify functionality and compliance of refrigeration and air conditioning installations		New Unit	
UEENEEJ110A	Select refrigerant piping, accessories and associated controls		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
UEENEEJ111A	Diagnose and rectify faults in air conditioning and refrigeration systems and components		New Unit	
UEENEEJ112A	Diagnose and rectify faults in complex air conditioning/refrigeration systems	UEENEEJ012B	Diagnose and rectify faults in complex refrigeration/air conditioning systems	E
UEENEEJ113A	Commission air conditioning and refrigeration systems		New Unit	
UEENEEJ114A	Resolve problems in hydronic systems	UEENEEJ014B	Solve problems in hydronic systems	E
UEENEEJ115A	Resolve problems in beverage dispensers		New Unit	
UEENEEJ116A	Resolve problems in transport refrigeration systems	UEENEEJ016B	Solve problems in transport refrigeration systems	E
UEENEEJ117A	Resolve problems in ultra-low temperature refrigeration systems	UEENEEJ017B	Solve problems in ultra-low temperature refrigeration systems	E
UEENEEJ118A	Resolve problems in post mix refrigeration systems		New Unit	
UEENEEJ119A	Resolve problems in ice making systems		New Unit	
UEENEEJ121A	Monitor and adjust refrigeration energy		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	management systems			
UEENEEJ122A	Diagnose faults in complex HVAC /refrigeration control systems	UEENEEJ022B	Diagnose faults in complex refrigeration or HVAC control systems	E
UEENEEJ123A	Commission complex (HVAC) heating, ventilation and air conditioning systems	UEENEEJ023B	Commission complex heating, ventilation and air conditioning (HVAC) systems	E
UEENEEJ124A	Commission refrigeration/air conditioning hydronic systems	UEENEEJ024B	Commission hydronic systems for refrigeration and/or air conditioning	E
UEENEEJ125A	Commission complex refrigeration systems and equipment	UEENEEJ025B	Commission complex refrigeration systems	E
UEENEEJ126A	Commission complex refrigeration/air conditioning control systems	UEENEEJ026B	Commission complex control systems for refrigeration/air conditioning	E
UEENEEJ127A	Establish the thermodynamic parameters of refrigeration and air conditioning systems	UEENEEJ027B	Determine thermodynamic parameters of refrigeration and air conditioning systems	E
UEENEEJ128A	Produce HVAC/R system design drawings	UEENEEJ028B	Produce HVAC/R design drawings	E

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
UEENEEJ129A	Establish heat loads for commercial refrigeration and air conditioning applications	UEENEEJ029B	Determine the heat loads for commercial refrigeration and air conditioning applications	E
UEENEEJ130A	Produce HVAC/R control system diagrams	UEENEEJ030B	Produce HVAC/R control system design diagrams	E
UEENEEJ131A	Determine noise and vibration encountered in HVAC/R applications	UEENEEJ031B	Provide solutions to vibration problems in HVAC/R system design	E
UEENEEJ132A	Design commercial refrigeration systems and select components	UEENEEJ032B	Design commercial refrigeration systems	E
UEENEEJ133A	Design industrial refrigeration systems and select components	UEENEEJ033B	Design industrial refrigeration systems	E
UEENEEJ134A	Design heating, ventilation and air conditioning (HVAC) systems and select components	UEENEEJ034B	Design heating, ventilation and air conditioning (HVAC) systems	E
UEENEEJ135A	Design control systems for refrigeration or heating, ventilation and air conditioning systems	UEENEEJ035B	Design control systems for a heating, ventilation, air conditioning or refrigeration system	E
UEENEEJ136A	Evaluate and report on	UEENEEJ036B	Evaluate and	E

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	building services energy management systems		report on energy management	
UEENEEJ137A	Evaluate and report on the indoor air quality of buildings	UEENEEJ037B	Evaluate and report on air quality in buildings	E
UEENEEJ138A	Analyse vibration and noise in refrigeration and air conditioning systems	UEENEEJ038B	Analyse noise and vibration in refrigeration and air conditioning systems	E
UEENEEJ139A	Develop specifications and prepare drawings for HVAC/Refrigeration projects	UEENEEJ039B	Develop specifications and prepare drawings for HVAC/R projects	E
UEENEEJ141A	Design complex commercial refrigeration systems and select equipment	UEENEEJ041B	Design complex commercial refrigeration systems	E
UEENEEJ142A	Design complex industrial refrigeration systems and select equipment	UEENEEJ042B	Design complex industrial refrigeration systems	E
UEENEEJ143A	Design complex air conditioning systems and select equipment	UEENEEJ043B	Design complex air conditioning systems	E
UEENEEJ144A	Design mechanical ventilation/exhaust systems and select equipment	UEENEEJ044B	Design mechanical ventilation/exhaust systems	E
UEENEEJ145A	Design hydronic systems and select equipment	UEENEEJ045B	Design hydronic systems	E

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
UEENEEJ146A	Design complex control systems for refrigeration, heating ventilation or air conditioning systems	UEENEEJ046B	Design complex control systems for heating, ventilation, air conditioning or refrigeration systems	E
UEENEEJ147A	Audit energy use for commercial HVAC/Refrigeration systems	UEENEEJ047B	Audit energy use for commercial HVAC/R systems	E
UEENEEJ148A	Audit HVAC/R control systems for compliance with regulations and standards	UEENEEJ048B	Audit HVAC/R control systems for compliance with standards and regulations	E
UEENEEJ149A	Develop heat exchanger design specifications	UEENEEJ049B	Develop specifications for heat exchanger designs	E
UEENEEJ150A	Evaluate new and alternative technologies applicable to electrotechnology applications	UEENEEJ050B	Evaluate alternative and new technologies applicable to electrotechnology applications	E
UEENEEJ151A	Service small electrical appliances and power tools	UEENEEJ051B	Service small appliances and power tools	E
	Deleted	UEENEEJ052B	Carry out repairs to appliance refrigeration systems	
UEENEEJ153A	Find and rectify faults in		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	motors and associated controls in refrigeration and air conditioning systems			
UEENEEJ154A	Find and rectify faults in appliance control systems and devices	UEENEEJ054B	Find and rectify faults in appliance control devices and systems	E
UEENEEJ155A	Service refrigeration appliances	UEENEEJ055B	Service refrigerated appliances	E
UEENEEJ156A	Service clothes washing machines and dryers	UEENEEJ056B	Service clothes washers and dryers	E
UEENEEJ157A	Service electrical heating appliances	UEENEEJ057B	Service electric heating appliances	E
UEENEEJ158A	Service dishwasher machines	UEENEEJ058B	Service dish washing machines	E
UEENEEJ159A	Service gas heating appliances	UEENEEJ059B	Service gas appliances	E
UEENEEJ161A	Verify functionality and compliance of appliances	UEENEEJ061B	Verify compliance and functionality of appliances	E
UEENEEJ162A	Recover, pressure test, evacuate, charge and leak test refrigerants — appliances	UEENEEJ062B	Recover, pressure and leak test, evacuate and charge refrigerants – appliances	E
	Deleted	UEENEEJ063B	Analyse the psychrometric and thermodynamic performance of	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
			HVAC/R systems	
UEENEEJ164A	Analyse the operation of HVAC air and hydronic systems	UEENEEJ064B	Analyse the operation of HVAC/R systems	E
UEENEEJ165A	Evaluate thermodynamic and fluid parameters of refrigeration systems	UEENEEJ065B	Evaluate fluid and thermodynamic parameters of refrigeration systems	E
UEENEEJ166A	Resolve problems in dairy refrigeration systems	UEENEEJ066B	Solve problems in dairy refrigeration systems	E
UEENEEJ167A	Resolve problems in central plant air conditioning systems		New Unit	
UEENEEJ168A	Maintain microbial control of refrigeration and air conditioning systems	UEENEEJ068B	Maintain microbial control of air and water systems	E
UEENEEJ170A	Diagnose and rectify faults in air conditioning and refrigeration control systems		New Unit	
UEENEEJ171A	Resolve problems in refrigerated beverage vending cabinets	UEENEEJ071B	Solve problems in refrigerated beverage vending cabinets	E
UEENEEJ172A	Recover, pressure test, evacuate, charge and leak test refrigerants — split systems	UEENEEJ072B	Recover, pressure and leak test, evacuate and charge refrigerants – split air conditioning	E

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
			systems	
UEENEEJ173A	Service and repair microwave ovens	UEENEEJ073B	Service microwave ovens	E
UEENEEJ174A	Apply safety awareness and legal requirements for hydrocarbon refrigerants	UEENEEJ074A	Safety awareness and legal requirements for hydrocarbon refrigerants	E
UEENEEJ175A	Service and repair self contained hydrocarbon air conditioning and refrigeration systems	UEENEEJ075A	Service and repair self contained hydrocarbon refrigeration and air conditioning systems	E
UEENEEJ176A	Install and commission hydrocarbon refrigeration systems, components and associated equipment	UEENEEJ076B	Install and commission hydrocarbon refrigeration systems, major components and associated equipment	E
UEENEEJ177A	Design hydrocarbon refrigerated systems	UEENEEJ077A	Design hydrocarbon refrigeration systems	E
UEENEEJ178A	Apply safety awareness and legal requirements for ammonia refrigerant	UEENEEJ078A	Safety awareness in using ammonia as a refrigerant	E
UEENEEJ179A	Repair and service ammonia refrigeration systems	UEENEEJ079A	Service and repair ammonia refrigeration systems	E

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
UEENEEJ180A	Install and commission ammonia refrigeration systems, components and associated equipment	UEENEEJ080A	Install and commission ammonia refrigeration systems	E
UEENEEJ181A	Design ammonia refrigerated systems	UEENEEJ081A	Design ammonia refrigeration systems	E
UEENEEJ182A	Repair and service secondary refrigeration systems	UEENEEJ082A	Service and repair secondary refrigeration systems	E
UEENEEJ183A	Design secondary refrigerant systems	UEENEEJ083A	Design secondary refrigeration systems	E
UEENEEJ184A	Apply safety awareness and legal requirements for carbon dioxide refrigerant	UEENEEJ084A	Safety awareness in using carbon dioxide as a refrigerant	E
UEENEEJ185A	Repair and service carbon dioxide refrigeration systems	UEENEEJ085A	Service and repair carbon dioxide refrigeration systems	E
UEENEEJ186A	Install and commission carbon dioxide refrigeration systems, components and associated equipment	UEENEEJ086A	Install and commission carbon dioxide refrigeration systems	E
UEENEEJ187A	Design carbon dioxide refrigerated systems	UEENEEJ087A	Design carbon dioxide refrigeration systems	E
UEENEEJ188A	Repair and service self	UEENEEJ088A	Service and repair	E

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	contained carbon dioxide refrigeration and heat pump systems		self contained carbon dioxide refrigeration and heat pump systems	
UEENEEJ189A	Service room air conditioners	UEENEEJ089A	Room air conditioners servicing	E
UEENEEJ190A	Select basic commercial refrigeration system equipment, components and accessories	UEENEEJ090A	Select basic commercial refrigeration system equipment and components	E
UEENEEJ191A	Select residential air conditioning system equipment, components and accessories	UEENEEJ091A	Select residential air conditioning system equipment and components	E
UEENEEJ192A	Analyse the psychrometric performance of HVAC/R systems	UEENEEJ063B	Analyse the psychrometric and thermodynamic performance of HVAC/R systems	E
UEENEEJ193A	Analyse the thermodynamic performance of HVAC/R systems			
UEENEEJ194A	Solve problems in low voltage refrigeration circuits		New Unit	
UEENEEJ195A	Establish the basic operating conditions of vapour compression systems - appliances		New Unit	
UEENEEJ196A	Operate Ammonia		New Unit	

UEE07 Unit Code – V4	UEE07 Unit Title – V4	UEE07 Unit Code – V3.1	UEE07 Unit Title – V3.1	E = Equivalent N = Not Equivalent -
	Refrigeration Plant			
UEENEEN021A	Repair rail signalling cables		New Unit	
	Deleted	UEENEEN009B	Locate and rectify faults in electrical low voltage appliances up to 250V following prescribed procedures	
UEENEEN012A	Disconnect / reconnect composite appliances connected to low voltage installation wiring		New Unit	
UEENEEN017A	Locate and rectify faults in low voltage composite appliances using set procedures		New Unit	
UEENEEN024A	Attach cords and plugs to electrical equipment for connection to a single phase 230 Volt supply		New Unit	
UEENEEN025A	Attach cords, cables and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply		New Unit	

Rationalised Rail Signalling Competencies from TLI07 Transport and Logistics Training Package

The table below maps the rationalised Rail Signalling Competencies from TLI07 Transport and Logistics Training Package transferred to EE-Oz Coverage.

By agreement between the two industry sectors selected Rail Signalling units were deleted from TLI07 and transferred to EE-Oz through importation into UEE07 Electrotechnology Training Package. Under this agreement EE-Oz is required to map these units to equivalent competencies in The Rail Signalling discipline of UEE07

This mapping should be used to provide RPL and Credit Transfer to candidates seeking recognition of competencies gained under the TLI07 Training Package.

Equivalent unit in UEE07 – V4		Unit deleted from TLI07 Transport and Logistics Training Package		E = Equivalent N = Not Equivalent
Code	Title	Code	Title	
UEENEEN002B	Assemble and wire internal electrical signalling equipment	TLIB5907B	Assemble and wire internal electrical signalling equipment	E
UEENEEN003B	Install and maintain track circuit leads and bonds	TLIB6207B	Install and maintain track circuit leads and bonds	E
UEENEEN004B	Perform cable tests	TLIB5707B	Perform cable system test	E
UEENEEN005B	Install and maintain signalling power supplies	TLIB6607B	Install and maintain signalling power supplies	E
UEENEEN006B	Maintain remote control and non-vital interlocking control systems	TLIB5007B	Maintain remote control and non-vital interlocking control systems	E
UEENEEN007B	Maintain power signalling and protected level crossing equipment	TLIB5107B	Maintain power signalling and protected level crossing equipment	E
UEENEEN008B	Maintain on site power operated point-activating devices	TLIB5207B	Maintain on-site power operated point activating devices	E
UEENEEN009B	Maintain track circuit equipment	TLIB5407B	Install and maintain track circuit equipment	E

UEENEEN010B	Maintain electronic signalling and communication equipment	TLIB6307B	Maintain electronic signalling and communications systems	E
UEENEEN011B	Install and maintain power operated signalling equipment	TLIB6707B	Install and maintain power operated signalling equipment	E
UEENEEN012B	Maintain power signalling and protective relay interlocking systems	TLIB6907B	Maintain power signalling and protective relay interlocking systems	E
UEENEEN013B	Install and test computer based interlocking equipment	TLIS1107B	Install and test computer based and solid state interlocking equipment	E
UEENEEN014B	Maintain computer based and solid state interlocking systems	TLIB5507B	Maintain computer based and solid state interlocking equipment	E
UEENEEN015B	Conduct routine inspecting and testing of new signal cables and lines	TLIB5607B	Conduct route testing of new signal cables/line route	E
UEENEEN016B	Maintain electronic switched and microprocessor-based remote control systems	TLIB6407B	Maintain electronic switched and micro processor-based remote control systems	E
UEENEEN017B	Install and maintain transmission interface equipment	TLIB6507B	Install and maintain transmission interface equipment	E
UEENEEN028B	Test and commission power signalling equipment	TLIS1007B	Test and commission power signalling and protected level crossing equipment	E

Table 2 – Relationship of UEE07 Electrotechnology Training Package CSUs Version 3 to UEE07 Electrotechnology Training Package CSUs Version 2

Note:

1. RTOs shall ensure appropriate analysis of all the skills and knowledge specified in the respective competency standard units in this Training Package is undertaken with that of the version 2 Training Package (UEE07), in determining equivalence.
2. In granting an equivalence of an UEE07 – V2 unit for a UEE07 – V3 unit:
 - - the prerequisite units specified for the UEE07 – V2 unit shall be included
 - - the critical aspects of evidence of the UEE07 – V2 unit and its specified prerequisite units shall be at least equal to that of the UEE07 – V3 unit.
3. This table maps only the Qualifications which have changed between these versions.

Table 2 shows the relationship of UEE07 –V3 units to the version 2 Training Package UEE07.

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
UEENEEE019C	Solve problems in multiple path a.c. circuits	UEENEEE019B	Solve problems in multiple path a.c. circuits	E
UEENEEE024C	Compile and produce an electrotechnology report	UEENEEE024B	Compile and produce an electrotechnology report	E
UEENEEE048C	Carry out routine work activities in an electrotechnology environment	UEENEEE048B	Carry out routine work activities in an electrotechnology environment	E
UEENEEE079A	Identify and select components, accessories and materials for electrotechnology work activities	UEENEEE040B	Identify and select components/accessories/materials for electrotechnology work activities	E

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
UEENEEE084A	Write specifications for electrotechnology engineering projects		New Unit, Not previously covered	
UEENEEF016A	Lay and connect cabling for direct access to telecommunications services	UEENEEF001B	Lay and connect cabling for direct access to telecommunication services	E
UEENEEG072C	Investigate and report on electrical incidents	UEENEEG072B	Investigate and report on electrical incidents	E
UEENEEG075A	Develop compliance policies and plans to conduct a contracting business	UEENEEG014B	Develop plans and compliance policies to conduct a contracting business	E
UEENEEH072C	Find and repair faults in communication systems	UEENEEH072B	Find and repair faults in communication systems	E
UEENEEH090A	Provide solutions to air traffic control system problems		New Unit, Not previously covered	
UEENEEI007C	Install process instrumentation and control cabling and tubing	UEENEEI007B	Install process instrumentation and control cabling and tubing	E
UEENEEI008C	Install process control	UEENEEI008B	Install process control apparatus and associated	E

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
	apparatus and associated equipment		equipment	
UEENEEJ074 A	Apply safety awareness and legal requirements for hydrocarbon refrigerants		New Unit, Not previously covered	
UEENEEJ075 A	Service and repair self contained hydrocarbon refrigeration systems		New Unit, Not previously covered	
UEENEEJ076 A	Install and commission hydrocarbon refrigeration systems, major components and associated equipment		New Unit, Not previously covered	
UEENEEJ077 A	Design hydrocarbon refrigeration systems		New Unit, Not previously covered	
UEENEEJ078 A	Apply safety awareness in using ammonia as a refrigerant		New Unit, Not previously covered	
UEENEEJ079 A	Service and repair ammonia refrigeration systems		New Unit, Not previously covered	
UEENEEJ080	Install and		New Unit, Not previously	

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
A	commission ammonia refrigeration systems		covered	
UEENEEJ081 A	Design ammonia refrigeration systems		New Unit, Not previously covered	
UEENEEJ082 A	Service and repair secondary refrigeration systems		New Unit, Not previously covered	
UEENEEJ083 A	Design secondary refrigeration systems		New Unit, Not previously covered	
UEENEEJ084 A	Apply safety awareness for in using carbon dioxide as a refrigerant		New Unit, Not previously covered	
UEENEEJ085 A	Service and repair carbon dioxide refrigeration systems		New Unit, Not previously covered	
UEENEEJ086 A	Install and commission carbon dioxide refrigeration systems		New Unit, Not previously covered	
UEENEEJ087 A	Design complex carbon dioxide refrigeration systems		New Unit, Not previously covered	

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
UEENEEJ088 A	Service and repair self contained carbon dioxide refrigeration and heat pump systems		New Unit, Not previously covered	
UEENEEJ089 A	Service room air conditioners servicing	UEENEEJ060 B	Service room air conditioners	E
UEENEEJ089 A	Service room air conditioners	UEENEEJ060 B	Service room air conditioners	E
UEENEEJ090 A	Select basic commercial refrigeration system equipment and components		New Unit, Not previously covered	
UEENEEJ091 A	Select residential air conditioning system equipment and components		New Unit, Not previously covered	
UEENEEK01 6A	Maintain and monitor remote area generation facilities		New Unit, Not previously covered	
UEENEEK04 7A	Maintain and monitor remote area essential service operations		New Unit, Not previously covered	
UEENEEK04 9A	Verify compliance and functionality of	UEENEEK01 5B	Verify compliance and functionality of renewable energy installations	E

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
	a renewable energy installation			
UEENEEK05 0A	Assemble and set up photovoltaic apparatus in a domestic dwelling	UEENEEK02 4B	Assemble and set up photovoltaic apparatus in domestic dwellings	E
UEENEEK05 1A	Develop effective strategies for energy reduction in buildings	UEENEEK04 1B	Develop strategies for effective energy reduction in buildings	E
UEENEEM01 9A	Attend to breakdowns in hazardous areas — coal mining	UEENEEM00 2B	Attend to breakdowns in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM00 2B (Ex'd', Ex 'e', Ex 'i', Ex 'p', Ex 't')
UEENEEM02 0A	Attend to breakdowns in hazardous areas — gas atmospheres	UEENEEM00 2B	Attend to breakdowns in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM00 2B (Ex'd', Ex 'i', Ex 'e', Ex 'n')

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
UEENEEM021A	Attend to breakdowns in hazardous areas — dust atmospheres	UEENEEM002B	Attend to breakdowns in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM002B (Ex ‘i’, Ex ‘t’, Ex ‘p’)
UEENEEM022A	Attend to breakdowns in hazardous areas — pressurisation	UEENEEM002B	Attend to breakdowns in hazardous areas	E, provided endorsement Ex ‘p’ is met in UEENEEM002B
UEENEEM023A	Install explosion-protected equipment and wiring systems — coal mining	UEENEEM004B	Install explosion-protected equipment and wiring systems	E, provided the following endorsements specified in the range statement are met in UEENEEM004B (Ex’d’. Ex ‘e’, Ex ‘i’, Ex ‘p’, Ex ‘t’)
UEENEEM024A	Install explosion-protected equipment and wiring systems — gas atmospheres	UEENEEM004B	Install explosion-protected equipment and wiring systems	E, provided the following endorsements specified in the range statement are met in UEENEEM004B (Ex’d’, Ex ‘i’, Ex ‘e’, Ex ‘n’)
UEENEEM02	Install	UEENEEM00	Install explosion-protected	E, provided

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
5A	explosion-protected equipment and wiring systems — dust atmospheres	4B	equipment and wiring systems	the following endorsements specified in the range statement are met in UEENEEM004B (Ex ‘i’, Ex ‘t’, Ex ‘p’)
UEENEEM026A	Install explosion-protected equipment and wiring systems — pressurisation	UEENEEM004B	Install explosion-protected equipment and wiring systems	E, provided endorsement Ex ‘p’ is met in UEENEEM004B
UEENEEM027A	Maintain equipment in hazardous areas — coal mining	UEENEEM006B	Maintain equipment in hazardous areas	E, provided all endorsements specified in the range statement are met in UEENEEM006B
UEENEEM028A	Maintain equipment in hazardous areas — gas atmospheres	UEENEEM006B	Maintain equipment in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM004B (Ex ‘d’, Ex ‘i’, Ex ‘e’, Ex ‘n’)
UEENEEM029A	Maintain equipment in hazardous areas — dust	UEENEEM006B	Maintain equipment in hazardous areas	E, provided the following endorsements specified in

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
	atmospheres			the range statement are met in UEENEEM006B (Ex ‘i’, Ex ‘t’, Ex ‘p’)
UEENEEM030A	Maintain equipment in hazardous areas — pressurisation	UEENEEM006B	Maintain equipment in hazardous areas	E, provided endorsement Ex ‘p’ is met in UEENEEM006B
UEENEEM031A	Overhaul and repair of explosion-protected equipment — coal mining	UEENEEM007B	Overhaul and repair explosion-protected equipment	E, provided the following endorsements specified in the range statement are met in UEENEEM007B (Ex ‘d’. Ex ‘e’, Ex ‘i’, Ex ‘p’, Ex ‘t’)
UEENEEM032A	Overhaul and repair of explosion-protected equipment — flameproof enclosures	UEENEEM007B	Overhaul and repair explosion-protected equipment	E, provided all endorsements specified in the range statement are met in UEENEEM007B
UEENEEM033A	Overhaul and repair of explosion-protected equipment — gas atmospheres	UEENEEM007B	Overhaul and repair explosion-protected equipment	E, provided the following endorsements specified in the range statement are met in

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
				UEENEEM007B (Ex'd', Ex 'i', Ex 'e', Ex 'n')
UEENEEM034A	Overhaul and repair of explosion-protected equipment — dust atmospheres	UEENEEM007B	Overhaul and repair explosion-protected equipment	E, provided the following endorsements specified in the range statement are met in UEENEEM007B (Ex 'i', Ex 't', Ex 'p')
UEENEEM035A	Conduct a conformity assessment of explosion-protected equipment — coal mining	UEENEEM008B	Assess explosion-protected equipment for compliance with standards	No
UEENEEM036A	Conduct a conformity assessment of explosion-protected equipment — gas atmospheres	UEENEEM008B	Assess explosion-protected equipment for compliance with standards	No
UEENEEM037A	Conduct a conformity assessment of explosion-protected equipment — dust atmospheres	UEENEEM008B	Assess explosion-protected equipment for compliance with standards	No
UEENEEM038A	Conduct testing of hazardous areas installations —	UEENEEM009B	Test installations in hazardous areas	E, provided the following endorsements specified in

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
	coal mining			the range statement are met in UEE07 Unit 9B (Ex'd', Ex 'e', Ex 'i', Ex 'p', Ex 't')
UEENEEM03 9A	Conduct testing of hazardous areas installations — gas atmospheres	UEENEEM00 9B	Test installations in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEE07 Unit 9B (Ex'd', Ex 'i', Ex 'e', Ex 'n')
UEENEEM04 0A	Conduct testing of hazardous areas installations — dust atmospheres	UEENEEM00 9B	Test installations in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEE07 Unit 9B (Ex 'i', Ex 't', Ex 'p')
UEENEEM04 1A	Conduct testing of hazardous areas installations — pressurisation	UEENEEM00 9B	Test installations in hazardous areas	E, provided endorsement Ex 'p' is met in UEE07 Unit 9B
UEENEEM04 2A	Conduct visual inspection of hazardous areas installations	UEENEEM01 0B	Conduct close inspection of existing hazardous areas installations	E

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
UEENEEM04 3A	Conduct detailed inspection of hazardous areas installations — coal mining	UEENEEM01 1B	Conduct detailed inspection of hazardous areas installations	E, provided the following endorsements specified in the range statement are met in UEENEEM01 1B (Ex'd', Ex 'e', Ex 'i', Ex 'p', Ex 't')
UEENEEM04 4A	Conduct detailed inspection of hazardous areas installations — gas atmospheres	UEENEEM01 1B	Conduct detailed inspection of hazardous areas installations	E, provided the following endorsements specified in the range statement are met in UEENEEM01 1B (Ex'd', Ex 'i', Ex 'e', Ex 'n')
UEENEEM04 5A	Conduct detailed inspection of hazardous areas installations — dust atmospheres	UEENEEM01 1B	Conduct detailed inspection of hazardous areas installations	E, provided the following endorsements specified in the range statement are met in UEENEEM01 1B (Ex 'i', Ex 't', Ex 'p')
UEENEEM04 6A	Conduct detailed inspection of hazardous areas installations — pressurisation	UEENEEM01 1B	Conduct detailed inspection of hazardous areas installations	E, provided endorsement Ex 'p' is met in UEENEEM01 1B
UEENEEM04	Develop and	UEENEEM01	Develop and manage	E, provided

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
7A	manage maintenance programs for hazardous areas electrical equipment — coal mining	2B	maintenance programs for hazardous areas electrical equipment	the following endorsements specified in the range statement are met in UEENEEM01 2B (Ex'd', Ex 'e', Ex 'i', Ex 'p', Ex 't')
UEENEEM04 8A	Develop and manage maintenance programs for hazardous areas electrical equipment — gas atmospheres	UEENEEM01 2B	Develop and manage maintenance programs for hazardous areas electrical equipment	E, provided the following endorsements specified in the range statement are met in UEENEEM01 2B (Ex'd', Ex 'i', Ex 'e', Ex 'n')
UEENEEM04 9A	Develop and manage maintenance programs for hazardous areas electrical equipment — dust atmospheres	UEENEEM01 2B	Develop and manage maintenance programs for hazardous areas electrical equipment	E, provided the following endorsements specified in the range statement are met in UEENEEM01 2B (Ex 'i', Ex 't', Ex 'p')
UEENEEM05 0A	Develop and manage maintenance programs for hazardous areas electrical equipment —	UEENEEM01 2B	Develop and manage maintenance programs for hazardous areas electrical equipment	E, provided endorsement Ex 'p' is met in UEENEEM01 2B

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
	pressurisation			
UEENEEM051A	No unit available as modifications are regarded as manufacturing.	UEENEEM014B	Design and develop modifications to explosion-protected equipment	
UEENEEM052A	Classify hazardous areas — gas atmospheres	UEENEEM015B	Classify hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM015B (Ex'd', Ex 'i', Ex 'e', Ex 'n')
UEENEEM053A	Classify hazardous areas — dust atmospheres	UEENEEM015B	Classify hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM015B (Ex 'i', Ex 't', Ex 'p')
UEENEEM054A	Plan electrical installations for hazardous areas — gas atmospheres	UEENEEM016B	Design electrical installations in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM016B (Ex'd', Ex 'i', Ex 'e', Ex 'n')

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
UEENEEM05 5A	Plan electrical installations for hazardous areas — dust atmospheres	UEENEEM01 6B	Design electrical installations in hazardous areas	E, provided the following endorsements specified in the range statement are met in UEENEEM01 6B (Ex ‘i’, Ex ‘t’, Ex ‘p’)
UEENEEM05 6A	Plan electrical installations for hazardous areas — pressurisation	UEENEEM01 6B	Design electrical installations in hazardous areas	E, provided endorsement Ex ‘p’ is met in UEENEEM01 6B
UEENEEM05 7A	Design explosion-protected electrical systems and installations — gas atmospheres	UEENEEM01 7B	Design explosion-protected electrical systems	E, provided the following endorsements specified in the range statement are met in UEENEEM01 7B (Ex’d’, Ex ‘i’, Ex ‘e’, Ex ‘n’)
UEENEEM05 8A	Design explosion-protected electrical systems and installations — dust atmospheres	UEENEEM01 7B	Design explosion-protected electrical systems	E, provided the following endorsements specified in the range statement are met in UEENEEM01 7B (Ex ‘i’, Ex ‘t’, Ex ‘p’)
UEENEEM05	Design explosion-protected	UEENEEM01	Design explosion-protected	E, provided endorsement

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
9A	ted electrical systems and installations — pressurisation	7B	electrical systems	Ex ‘p’ is met in UEE07 7B
UEENEEM06 0A	Carry out overhaul and repair of explosion-protected equipment — coal mining		New Unit, Not previously covered	
UEENEEM06 1A	Carry out overhaul and repair of explosion-protected equipment — flameproof enclosures		New Unit, Not previously covered	
UEENEEM06 2A	Carry out overhaul and repair of explosion-protected equipment — gas atmospheres		New Unit, Not previously covered	
UEENEEM06 3A	Carry out overhaul and repair of explosion-protected equipment — dust atmospheres		New Unit, Not previously covered	
UEENEEM06 4A	Conduct audit of hazardous areas installations — coal mining		New Unit, Not previously covered	
UEENEEM06 5A	Conduct audit of hazardous areas		New Unit, Not previously covered	

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
	installations — gas atmospheres			
UEENEEM06 6A	Conduct audit of hazardous areas installations — dust atmospheres		New Unit, Not previously covered	
UEENEEM06 7A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — coal mining		New Unit, Not previously covered	
UEENEEM06 8A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — gas atmospheres		New Unit, Not previously covered	
UEENEEM06 9A	Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — dust atmospheres		New Unit, Not previously covered	
UEENEEM07 0A	Repair reeling, trailing and flexible cables		New Unit, Not previously covered	
UEENEEM07 1A	Test reeling, trailing and flexible cables		New Unit, Not previously covered	

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
UEENEEM07 2A	Inspect and fit plugs/couplers for reeling, trailing and flexible cables		New Unit, Not previously covered	
UEENEEM07 3A	Verify compliance of repaired reeling, trailing and flexible cables		New Unit, Not previously covered	
UEENEEM07 4A	Plan electrical installations in hazardous areas — Coal mining		New Unit, Not previously covered	
UEENEEM07 5A	Design explosion-protected electrical systems — <i>Coal mining</i>		New Unit, Not previously covered	
UEENEEM07 6A	Use and maintain the integrity of a portable gas detection device	UEENEEM00 3B	Use and maintain the integrity of portable gas detection devices	E
UEENEEM07 7A	Install and maintain the integrity of fixed gas detection equipment	UEENEEM00 5B	Install and maintain integrity of fixed gas detection equipment	E
UEENEEM07 8A	Manage compliance of hazardous areas	UEENEEM01 3B	Ensure the safety of hazardous areas	E
UEENEEM07 9A	Design of gas detection systems and	UEENEEM01 8B	Design gas detection systems	E

UEE07 Unit Code – V3	UEE07 Unit Title – V3	UEE07 Unit Code – V2	UEE07 Unit Title – V2	E = Equivalent N = Not Equivalent -
	installations			
UEENEEM080A	Report on the integrity of explosion-protected equipment in a hazardous area	UEENEEM001B	Report on the integrity of explosion-protected equipment in hazardous areas	E

Table 3 – Relationship of UEE07 Electrotechnology Training Package Version 2 Units to UEE07 Electrotechnology Training Package Version 1 Units

Table 3 shows the relationship of units modified or added in UEE07 Electrotechnology Training Package Version 2 to the previous UEE07 Training Package Version 1 for information on all other units refer to Table 4 below, which shows the relationship of units from UEE07 Training Package Version 1 to the former Training Package UEE06.

UEE07 Electrotechnology Training Package Version 2 Unit Code	Title	Relates to previous UEE07 Electrotechnology Training Package Version 1 unit Code	Nature of relationship to units in the former Training Package (UEE07 Version 1)	Equivalent — Full, part or none
	All Existing Qualifications in UEE07 Version 1	All existing qualifications in UEE07 version 1 remain unchanged	Refer to table mapping UEE07 Version 1 qualifications to UEE06 Version 1 for equivalences	
UEENEK025C	Solve basic problems in photovoltaic energy apparatus	UEENEK025B	Revised version	Full
UEENEK048A	Install and, configure and commission grid	New Unit	New Unit	New Unit

UEE07 Electrotechnology Training Package Version 2 Unit Code	Title	Relates to previous UEE07 Electrotechnology Training Package Version 1 unit Code	Nature of relationship to units in the former Training Package (UEE07 Version 1)	Equivalent — Full, part or none
	connected photovoltaic power systems			
UEENEEK035C	Design grid connected power supply systems	UEENEEK035B	Revised Version	Full
UEENEEG071C	Install and setup interval metering	UEENEEG071B	Revised Version	Full

Table 4 Relationship of UEE07 Electrotechnology Training Package Version 1 Units to UEE06 Electrotechnology Training Package

What follows is a guide to assist RTOs in granting equivalent units when implementing this Training Package.

Note:

1. RTOs shall ensure appropriate analysis of all the skills and knowledge specified in the respective competency standard units in this Training Package is undertaken with that of the former Training Package (UEE06), in determining equivalence.
2. In granting an equivalence of an UEE06 unit for a UEE07 unit:
 - the prerequisite units specified for the UEE06 unit shall be included
 - the critical aspects of evidence of the UEE06 unit and its specified prerequisite units shall be at least equal to that of the UEE07 unit.

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEA0 01B	Assemble electronic apparatus	UEENEEA0 01A	Assemble electronic apparatus	Part - Refer Note 1 (below).
UEENEEA0 02B	Select electronic components	UEENEEA0 02A	Select electronic components	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
				(below).
UEENEEA003B	Set up and check electronic component placement machines	UEENEEA003A	Set up and check electronic component placement machines	Part - Refer Note 1 (below).
UEENEEA004B	Rework electronic sub assemblies	UEENEEA004A	Rework electronic sub assemblies	Part - Refer Note 1 (below).
UEENEEA005B	Conduct functional and quality tests on assembled electronic apparatus	UEENEEA005A	Conduct functional and quality tests on assembled electronic apparatus	Part - Refer Note 1 (below).
UEENEEA006B	Apply lead-free soldering techniques	UEENEEA006A	Apply lead-free soldering techniques	Part - Refer Note 1 (below).
UEENEEA007A	RESERVED	UEENEEA007A	RESERVED	
UEENEEA008A	RESERVED	UEENEEA008A	RESERVED	
UEENEEA009A	RESERVED	UEENEEA009A	RESERVED	
UEENEEA010B	Assemble; mount and connect switchgear and control gear	UEENEEA010A	Assemble; mount and connect switchgear and control gear	Part - Refer Note 1 (below).
UEENEEA011A	RESERVED	UEENEEA011A	RESERVED	
UEENEEA012B	Make up and assemble bus bars	UEENEEA012A	Make up and assemble bus bars	Part - Refer Note 1 (below).
UEENEEA013B	Assemble and wire control panels	UEENEEA013A	Assemble and wire control panels	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEB001B	Operate and maintain an amateur radio communication station	UEENEEB001A	Operate and maintain an amateur radio communication station	Part - Refer Note 1 (below).
UEENEEC001B	Maintain documentation	UEENEEC001A	Maintain documentation	Part - Refer Note 1 (below).
UEENEEC002B	Source and purchase material/parts for installation or service jobs	UEENEEC002A	Source and purchase material/parts for installation or service jobs	Part - Refer Note 1 (below).
UEENEEC003B	Provide quotations for installation or service jobs	UEENEEC003A	Provide quotations for installation or service jobs	Part - Refer Note 1 (below).
UEENEEC004B	Prepare specifications for the supply of materials and equipment for electrotechnology projects	UEENEEC004A	Prepare specifications for the supply of materials and equipment for electrotechnology projects	Part - Refer Note 1 (below).
UEENEEC005B	Estimate electrotechnology projects	UEENEEC005A	Estimate electrotechnology projects	Part - Refer Note 1 (below).
UEENEEC006B	Prepare tender submissions for electrotechnology projects	UEENEEC006A	Prepare tender submissions for electrotechnology projects	Part - Refer Note 1 (below).
UEENEEC007B	Manage contract variations	UEENEEC007A	Manage contract variations	Part - Refer Note 1 (below).
UEENEEC008B	Receive and store materials and equipment for electrotechnology work	UEENEEC008A	Receive and store materials and equipment for electrotechnology work	Part - Refer Note 1 (below).
UEENEEC009B	Provide quotations for inspection and compliance audit	UEENEEC009A	Provide quotations for inspection and compliance audit	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	services		services	(below).
UEENEEO010B	Deliver a service to customers	UEENEEO010A	Deliver a service to customers	Part - Refer Note 1 (below).
UEENEEO011A	RESERVED	UEENEEO011A	RESERVED	
UEENEEO012B	Direct technical and non-technical enquiries to appropriate personnel	UEENEEO012A	Direct technical and non-technical enquiries to appropriate personnel	Part - Refer Note 1 (below).
UEENEEO013B	Participate in business equipment work and competency development activities	UEENEEO013A	Participate in business equipment work and competency development activities	Part - Refer Note 1 (below).
UEENEEO014B	Participate in computer equipment work and competency development activities	UEENEEO014A	Participate in computer equipment work and competency development activities	Part - Refer Note 1 (below).
UEENEEO015B	Participate in custom electronic installations work and competency development activities	UEENEEO015A	Participate in custom electronic installations work and competency development activities	Part - Refer Note 1 (below).
UEENEEO016B	Participate in voice and data communications work and competency development activities	UEENEEO016A	Participate in voice and data communications work and competency development activities	Part - Refer Note 1 (below).
UEENEEO017B	Participate in appliance servicing work and competency development activities	UEENEEO017A	Participate in appliance servicing work and competency development activities	Part - Refer Note 1 (below).
UEENEEO018B	Participate in electrical machine repair work and competency development activities	UEENEEO018A	Participate in electrical machine repair work and competency development activities	Part - Refer Note 1 (below).
UEENEEO0	Participate in switchgear	UEENEEO0	Participate in switchgear	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
19B	and control gear work and competency development activities	19A	and control gear work and competency development activities	Note 1 (below).
UEENEEC020B	Participate in electrical work and competency development activities	UEENEEC020A	Participate in electrical work and competency development activities	Part - Refer Note 1 (below).
UEENEEC021B	Participate in electronics and communications work and competency development activities	UEENEEC021A	Participate in electronics and communications work and competency development activities	Part - Refer Note 1 (below).
UEENEEC022B	Participate in fire protection control work and competency development activities	UEENEEC022A	Participate in fire protection control work and competency development activities	Part - Refer Note 1 (below).
UEENEEC023B	Participate in gaming electronic work and competency development activities	UEENEEC023A	Participate in gaming electronic work and competency development activities	Part - Refer Note 1 (below).
UEENEEC024B	Participate in instrumentation and control work and competency development activities	UEENEEC024A	Participate in instrumentation and control work and competency development activities	Part - Refer Note 1 (below).
UEENEEC025B	Participate in refrigeration and air conditioning work and competency development activities	UEENEEC025A	Participate in refrigeration and air conditioning work and competency development activities	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEC026B	Participate in security equipment work and competency development activities	UEENEEC026A	Participate in security equipment work and competency development activities	Part - Refer Note 1 (below).
UEENEEC0	Participate in rail communications and	UEENEEC0	Participate in rail communications and	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
27B	networks work and competency development activities	27A	networks work and competency development activities	(below).
UEENEEO028B	Participate in hazardous areas work and competency development activities	UEENEEO028A	Participate in hazardous areas work and competency development activities	Part - Refer Note 1 (below).
UEENEEO029B	Participate in explosion-protected equipment overhaul work and competency development activities	UEENEEO029A	Participate in explosion-protected equipment overhaul work and competency development activities	Part - Refer Note 1 (below).
UEENEEO001B	Use basic computer applications relevant to a workplace	UEENEEO001A	Use basic computer applications relevant to a workplace	Part - Refer Note 1 (below).
UEENEEO002B	Assemble, set up and test personal computers	UEENEEO002A	Assemble, set up and test personal computers	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEO003B	Evaluate and modify programs written in object oriented code	UEENEEO003A	Evaluate and modify programs written in object oriented code	Part - Refer Note 1 (below).
UEENEEO004B	Use engineering applications software	UEENEEO004A	Use engineering applications software	Part - Refer Note 1 (below).
UEENEEO005B	Enter and verify operating instructions in microprocessor equipped devices	UEENEEO005A	Enter and verify operating instructions in microprocessor equipped devices	Part - Refer Note 1 (below).
UEENEEO006A	RESERVED	UEENEEO006A	RESERVED	

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEED007B	Develop, enter and verify programs for programmable logic controllers using ladder instruction set	UEENEED007A	Develop, enter and verify programs for programmable logic controllers using ladder instruction set	Part - Refer Note 1 (below).
UEENEED008B	Develop, enter and verify programs in Supervisory Control and Data Acquisition systems	UEENEED008A	Develop, enter and verify programs in Supervisory Control and Data Acquisition systems	Part - Refer Note 1 (below).
UEENEED009B	Develop, enter and verify programs for industrial control systems using high level instructions	UEENEED009A	Develop, enter and verify programs for industrial control systems using high level instructions	Part - Refer Note 1 (below).
UEENEED010B	Set up and create content for a web server	UEENEED010A	Set up and create content for a web server	Part - Refer Note 1 (below).
UEENEED011B	Develop object oriented code	UEENEED011A	Develop object oriented code	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED012B	Support computer hardware and software	UEENEED012A	Support computer hardware and software	Part - Refer Note 1 (below).
UEENEED013B	Install and administer Unix based computers	UEENEED013A	Install and administer Unix based computers	Part - Refer Note 1 (below).
UEENEED014B	Design and manage enterprise networks	UEENEED014A	Design and manage enterprise networks	Part _ Refer Note 1 (below). Also, removal of

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
				all pre-requisites
UEENEED015B	Administer user networks	UEENEED015A	Administer user networks	Part - Refer Note 1 (below).
UEENEED016B	Develop network services	UEENEED016A	Develop network services	Part - Refer Note 1 (below). Also, removal of UEENEED015B pre-requisite
UEENEED017B	Install and configure Internetworking systems	UEENEED017A	Install and configure Internetworking systems	Part - Refer Note 1 (below).
UEENEED018B	Design and implement Internetworking systems	UEENEED018A	Design and implement Internetworking systems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED019B	Design and implement Internetworking systems — advanced routing	UEENEED019A	Design and implement Internetworking systems — advanced routing	Part - Refer Note 1 (below). Also, removal of all pre-requisite
UEENEED020B	Design and implement Internetworking systems — remote access	UEENEED020A	Design and implement Internetworking systems — remote access	Part - Refer Note 1 (below). Also, removal of all

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
				pre-requisites
UEENEED021B	Design and implement Internetworking systems — multi-layer switching	UEENEED021A	Design and implement Internetworking systems — multi-layer switching	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED022B	Design and implement Internetworking systems — security	UEENEED022A	Design and implement Internetworking systems — security	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED023B	Design and implement Internetworking systems — wireless LANs/WANs	UEENEED023A	Design and implement Internetworking systems — wireless LANs/WANs	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED024B	Integrate multiple computer operating systems on a client server network	UEENEED024A	Integrate multiple computer operating systems on a client server network	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED025B	Design and configure Human-Machine Interface networks	UEENEED025A	Design and configure Human-Machine Interface networks	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED0	Design a computer	UEENEED0	Design a computer	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
26B	based control system	26A	based control system	(below). Also, removal of all pre-requisites
UEENEED027B	Develop structured programs to control sub systems to access external devices	UEENEED027A	Develop structured programs to control sub systems to access external devices	Part - Refer Note 1 (below).
UEENEED028B	Develop and test basic specification code for micro-controller equipped devices	UEENEED028A	Develop and test basic specification code for micro-controller equipped devices	Part - Refer Note 1 (below).
UEENEED029B	Develop basic web pages for engineering applications	UEENEED029A	Develop basic web pages for engineering applications	Part - Refer Note 1 (below).
UEENEED030B	Select, install, configure and test multimedia devices	UEENEED030A	Select, install, configure and test multimedia devices	Part - Refer Note 1 (below).
UEENEED031B	Develop and validate basic integrated systems	UEENEED031A	Develop and validate basic integrated systems	Part - Refer Note 1 (below).
UEENEED032B	Design integrated systems	UEENEED032A	Design integrated systems	Part - Refer Note 1 (below).
UEENEED033B	Design complex integrated systems	UEENEED033A	Design complex integrated systems	Part - Refer Note 1 (below).
UEENEED034B	Configure and maintain industrial control system networks	UEENEED034A	Configure and maintain industrial control system networks	Part - Refer Note 1 (below). Also, removal of all pre-requisites

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEED035A	RESERVED	UEENEED035A	RESERVED	
UEENEED036A	RESERVED	UEENEED036A	RESERVED	
UEENEED037A	RESERVED	UEENEED037A	RESERVED	
UEENEED038A	RESERVED	UEENEED038A	RESERVED	
UEENEED039A	RESERVED	UEENEED039A	RESERVED	
UEENEED040A	RESERVED	UEENEED040A	RESERVED	
UEENEED041A	RESERVED	UEENEED041A	RESERVED	
UEENEED042A	RESERVED	UEENEED042A	RESERVED	
UEENEED043B	Install and configure a computer operating system and software	UEENEED043A	Install and configure a computer operating system and software	Part - Refer Note 1 (below).
UEENEED044B	Commission computer systems	UEENEED044A	Commission computer systems	Part - Refer Note 1 (below).
UEENEED045B	Modify-redesign of computer system	UEENEED045A	Modify-redesign of computer system	Part - Refer Note 1 (below).
UEENEED046B	Set up and configure basic local area network	UEENEED046A	Set up and configure basic local area network	Part - Refer Note 1 (below).
UEENEED047B	Manage computer projects	UEENEED047A	Manage computer projects	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEED048B	Plan computer systems projects	UEENEED048A	Plan computer systems projects	Part - Refer Note 1 (below).
UEENEED049A	RESERVED	UEENEED049A	RESERVED	
UEENEED050B	Develop control programs for micro-computer equipped devices	UEENEED050A	Develop control programs for micro-computer equipped devices	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED051B	Provide programming solution for engineering problems	UEENEED051A	Provide programming solution for engineering problems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED052B	Design embedded controller systems	UEENEED052A	Design embedded controller systems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEED053B	Set up and test biometric devices	UEENEED053A	Set up and test biometric devices	Part - Refer Note 1 (below).
UEENEED054B	Analyse and implement biometric techniques and applications	UEENEED054A	Analyse and implement biometric techniques and applications	Part - Refer Note 1 (below).
UEENEED055B	Develop and validate biometric systems installation instructions	UEENEED055A	Develop and validate biometric systems installation instructions	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEE001B	Apply OHS practices in the workplace	UEENEEE001A	Apply OHS practices in the workplace	Part - Refer Note 1 (below).
UEENEEE002B	Dismantle, assemble and fabricate electrotechnology components	UEENEEE002A	Dismantle, assemble and fabricate electrotechnology components	Part - Refer Note 1 (below).
UEENEEE003B	Solve problems in extra-low voltage single path circuits	UEENEEE003A	Solve problems in extra-low voltage single path circuits	Part - Refer Note 1 (below).
UEENEEE004B	Solve problems in multiple path d.c. circuits	UEENEEE004A	Solve problems in multiple path d.c. circuits	Part - Refer Note 1 (below).
UEENEEE005B	Fix and secure equipment	UEENEEE005A	Fix and secure equipment	Part - Refer Note 1 (below).
UEENEEE006B	Apply methods to maintain currency of industry developments	UEENEEE006A	Apply methods to maintain currency of industry developments	Part - Refer Note 1 (below).
UEENEEE007B	Use drawings, diagrams, schedules and manuals	UEENEEE007A	Use drawings, diagrams, schedules and manuals	Part - Refer Note 1 (below).
UEENEEE008B	Lay wiring/cabling and terminate accessories for extra-low voltage circuits	UEENEEE008A	Lay wiring/cabling and terminate accessories for extra-low voltage circuits	Part - Refer Note 1 (below).
UEENEEE009B	Comply with scheduled and preventative maintenance program processes	UEENEEE009A	Comply with scheduled and preventative maintenance program processes	Part - Refer Note 1 (below).
UEENEEE010B	Develop and implement maintenance programs	UEENEEE010A	Develop and implement maintenance programs	Part - Refer Note 1 (below).
UEENEEE0	Manage risk in	UEENEEE0	Manage risk in	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
11B	electrotechnology activities	11A	electrotechnology activities	Note 1 (below).
UEENEEE012B	Manage electrotechnology projects	UEENEEE012A	Manage electrotechnology projects	Part - Refer Note 1 (below).
UEENEEE013B	Plan electrotechnology projects	UEENEEE013A	Plan electrotechnology projects	Part - Refer Note 1 (below).
UEENEEE014B	Supervise and coordinate work activities	UEENEEE014A	Supervise and coordinate work activities	Part - Refer Note 1 (below).
UEENEEE015B	Develop design briefs for electrotechnology projects	UEENEEE015A	Develop design briefs for electrotechnology projects	Part - Refer Note 1 (below).
UEENEEE016B	Write specifications for electrotechnology projects	UEENEEE016A	Write specifications for electrotechnology projects	Part - Refer Note 1 (below).
UEENEEE017B	Implement and monitor OHS policies and procedures	UEENEEE017A	Implement and monitor OHS policies and procedures	Part - Refer Note 1 (below).
UEENEEE018B	Establish, maintain and evaluate OHS systems	UEENEEE018A	Establish, maintain and evaluate OHS systems	Part - Refer Note 1 (below).
UEENEEE019B	Solve problems in multiple path a.c. circuits	UEENEEE019A	Solve problems in multiple path a.c. circuits	Part - Refer Note 1 (below).
UEENEEE020B	Provide basic instruction in the use of electrotechnology apparatus	UEENEEE020A	Provide basic instruction in the use of electrotechnology apparatus	Part - Refer Note 1 (below).
UEENEEE021B	Plan an integrated cabling system	UEENEEE021A	Plan an integrated cabling system	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEE022B	Carry out preparatory electrotechnology work activities	UEENEEE022A	Carry out preparatory electrotechnology work activities	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEE023B	Solve basic problems in electronic and digital equipment	UEENEEE023A	Solve basic problems in electronic and digital equipment	Part - Refer Note 1 (below).
UEENEEE024C	Compile and produce an electrotechnology report	UEENEEE024A	Compile and produce an electrotechnology report	Part - Refer Note 1 (below).
UEENEEE025B	Solve problems in complex multiple path circuits	UEENEEE025A	Solve problems in complex multiple path circuits	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEE026B	Provide computational solutions to basic engineering problems	UEENEEE026A	Provide computational solutions to basic engineering problems	Part - Refer Note 1 (below).
UEENEEE027B	Use advanced computational processes to provide solutions to engineering problems	UEENEEE027A	Use advanced computational processes to provide solutions to engineering problems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEE028B	Develop engineering solutions to photonic problems	UEENEEE028A	Develop engineering solutions to photonic problems	Part - Refer Note 1 (below).
UEENEEE029B	Solve electrotechnical problems	UEENEEE029A	Solve electrotechnical problems	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEE030B	Provide solutions to and report on routine electrotechnology problems	UEENEEE030A	Provide solutions to and report on routine electrotechnology problems	Part - Refer Note 1 (below).
UEENEEE031A	RESERVED	UEENEEE031A	RESERVED	
UEENEEE032B	Document occupational hazards and risks in computer systems	UEENEEE032A	Document occupational hazards and risks in computer systems	Part - Refer Note 1 (below).
UEENEEE033B	Document occupational hazards and risks in electrical	UEENEEE033A	Document occupational hazards and risks in electrical	Part - Refer Note 1 (below).
UEENEEE034B	Document occupational hazards and risks in electronics	UEENEEE034A	Document occupational hazards and risks in electronics	Part - Refer Note 1 (below).
UEENEEE035B	Document occupational hazards and risks in instrumentation	UEENEEE035A	Document occupational hazards and risks in instrumentation	Part - Refer Note 1 (below).
UEENEEE036B	Document occupational hazards and risks in refrigeration and Air-conditioning	UEENEEE036A	Document occupational hazards and risks in refrigeration and Air-conditioning	Part - Refer Note 1 (below).
UEENEEE037B	Document occupational hazards and risks in electrotechnology	UEENEEE037A	Document occupational hazards and risks in electrotechnology	Part - Refer Note 1 (below).
UEENEEE038B	Participate in development and follow a personal competency development plan	UEENEEE038A	Participate in development and follow a personal competency development plan	Part - Refer Note 1 (below).
UEENEEE039A	RESERVED	UEENEEE039A	RESERVED	
UEENEEE040B	Identify and select components/accessories/materials for	UEENEEE040A	Identify and select components/accessories/materials for	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	electrotechnology work activities		electrotechnology work activities	(below).
UEENEEE041B	Use of routine equipment/plant/technologies in an electrotechnology environment	UEENEEE041A	Use of routine equipment/plant/technologies in an electrotechnology environment	Part - Refer Note 1 (below).
UEENEEE042B	Produce routine products for carrying out electrotechnology work activities	UEENEEE042A	Produce routine products for carrying out electrotechnology work activities	Part - Refer Note 1 (below).
UEENEEE043B	Produce routine tools/devices for carrying out electrotechnology work activities	UEENEEE043A	Produce routine tools/devices for carrying out electrotechnology work activities	Part - Refer Note 1 (below).
UEENEEE044B	Apply technologies and concepts to electrotechnology work activities	UEENEEE044A	Apply technologies and concepts to electrotechnology work activities	Part - Refer Note 1 (below).
UEENEEE045B	Apply computation when using equipment, materials and concepts in an electrotechnology environment	UEENEEE045A	Apply computation when using equipment, materials and concepts in an electrotechnology environment	Part - Refer Note 1 (below).
UEENEEE046B	Identify affects of energy on machinery and materials in an electrotechnology environment	UEENEEE046A	Identify affects of energy on machinery and materials in an electrotechnology environment	Part - Refer Note 1 (below).
UEENEEE047B	Identify building techniques, methods and materials used in electrotechnology work activities	UEENEEE047A	Identify building techniques, methods and materials used in electrotechnology work activities	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEE048C	Carry out routine work activities in an electrotechnology environment	UEENEEE048A	Carry out routine work activities in an electrotechnology environment	Part - Refer Note 1 (below).
UEENEEE049B	Contribute to the operation of support plant and equipment used in electricity supply	UEENEEE049A	Contribute to the operation of support plant and equipment used in electricity supply	Part - Refer Note 1 (below).
UEENEEE050B	Undertake computations in an electrotechnology environment	UEENEEE050A	Undertake computations in an electrotechnology environment	Part - Refer Note 1 (below).
UEENEEE051B	Transport apparatus and materials	UEENEEE051A	Transport apparatus and materials	Part - Refer Note 1 (below).
UEENEEE052A	RESERVED	UEENEEE052A	RESERVED	
UEENEEE053A	RESERVED	UEENEEE053A	RESERVED	
UEENEEE054A	RESERVED	UEENEEE054A	RESERVED	
UEENEEE055A	RESERVED	UEENEEE055A	RESERVED	
UEENEEE056A	RESERVED	UEENEEE056A	RESERVED	
UEENEEE057A	RESERVED	UEENEEE057A	RESERVED	
UEENEEE058A	RESERVED	UEENEEE058A	RESERVED	
UEENEEE059A	RESERVED	UEENEEE059A	RESERVED	

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEE060B	Provide solutions for uses of materials and thermodynamic effects	UEENEEE060A	Provide solutions for uses of materials and thermodynamic effects	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEE061B	Analyse static and dynamic parameters of equipment	UEENEEE061A	Analyse static and dynamic parameters of equipment	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEE062B	Select drive components for equipment design	UEENEEE062A	Select drive components for equipment design	Part - Refer Note 1 (below).
UEENEEE063B	Analyse materials for suitability in equipment	UEENEEE063A	Analyse materials for suitability in equipment	Part - Refer Note 1 (below).
UEENEEE064B	Design machine drives and production layout plans	UEENEEE064A	Design machine drives and production layout plans	Part - Refer Note 1 (below).
UEENEEE065A	RESERVED	UEENEEE065A	RESERVED	
UEENEEE066A	RESERVED	UEENEEE066A	RESERVED	
UEENEEE067A	RESERVED	UEENEEE067A	RESERVED	
UEENEEE068A	RESERVED	UEENEEE068A	RESERVED	
UEENEEE069A	RESERVED	UEENEEE069A	RESERVED	

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEE070B	Write specifications for computer systems engineering projects	UEENEEE070A	Write specifications for computer systems engineering projects	Part - Refer Note 1 (below).
UEENEEE071B	Write specifications for electrical engineering projects	UEENEEE071A	Write specifications for electrical engineering projects	Part - Refer Note 1 (below).
UEENEEE072B	Write specifications for electronics and communications engineering projects	UEENEEE072A	Write specifications for electronics and communications engineering projects	Part - Refer Note 1 (below).
UEENEEE073B	Write specifications for refrigeration and air conditioning engineering projects	UEENEEE073A	Write specifications for refrigeration and air conditioning engineering projects	Part - Refer Note 1 (below).
UEENEEE074B	Write specifications for renewable energy engineering projects	UEENEEE074A	Write specifications for renewable energy engineering projects	Part - Refer Note 1 (below).
UEENEEE075B	Write specifications for industrial electronics and control projects	UEENEEE075A	Write specifications for industrial electronics and control projects	Part - Refer Note 1 (below).
UEENEEE076A	RESERVED	UEENEEE076A	RESERVED	
UEENEEE077B	Write specifications for automated systems projects	UEENEEE077A	Write specifications for automated systems projects	Part - Refer Note 1 (below).
UEENEEE078B	Contribute to risk management in electrotechnology systems	UEENEEE078A	Contribute to risk management in electrotechnology systems	Part - Refer Note 1 (below).
UEENEFF001B	Lay and connect cabling for direct access to telecommunication services	UEENEFF001A	Lay and connect cabling for direct access to telecommunication services	Part - Refer Note 1 (below).
UEENEFF0	Lay and connect cables	UEENEFF0	Lay and connect cables	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
02B	for multiple access to telecommunication services	02A	for multiple access to telecommunication services	Note 1 (below).
UEENEEF0 03B	Install and maintain cabling for telecommunication services in lifts	UEENEEF0 03A	Install and maintain cabling for telecommunication services in lifts	Part - Refer Note 1 (below).
UEENEEF0 04B	Install and modify performance data communication structured cabling	UEENEEF0 04A	Install and modify performance data communication structured cabling	Part - Refer Note 1 (below).
UEENEEF0 05B	Install and modify performance data communication optical fibre cabling	UEENEEF0 05A	Install and modify performance data communication optical fibre cabling	Part - Refer Note 1 (below).
UEENEEF0 06B	Solve problems in data and voice communications circuits	UEENEEF0 06A	Solve problems in data and voice communications circuits	Part - Refer Note 1 (below).
UEENEEF0 07B	Set up the wireless capabilities of communications and data storage devices	UEENEEF0 07A	Set up the wireless capabilities of communications and data storage devices	Part - Refer Note 1 (below).
UEENEEF0 08B	Select and arrange equipment for wireless networks	UEENEEF0 08A	Select and arrange equipment for wireless networks	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEF0 09B	Install and connect voice and data communications equipment	UEENEEF0 09A	Install and connect voice and data communications equipment	Part - Refer Note 1 (below).
UEENEEF0 10B	Select and arrange equipment for local area	UEENEEF0 10A	Select and arrange equipment for local area	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	networks		networks	(below).
UEENEEF011B	Test, report and rectify faults in voice and data installations	UEENEEF011A	Test, report and rectify faults in voice and data installations	Part - Refer Note 1 (below).
UEENEEF012B	Install aerial communication cables	UEENEEF012A	Install aerial communication cables	Part - Refer Note 1 (below).
UEENEEF013B	Install below ground communication cables	UEENEEF013A	Install below ground communication cables	Part - Refer Note 1 (below).
UEENEEF014B	Set up and configure basic data communications systems	UEENEEF014A	Set up and configure basic data communications systems	Part - Refer Note 1 (below).
UEENEEF015B	Assemble and connect communication frames and cabinets	UEENEEF015A	Assemble and connect communication frames and cabinets	Part - Refer Note 1 (below).
UEENEEG001B	Solve problems in electromagnetic circuits	UEENEEG001A	Solve problems in electromagnetic circuits	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEG002B	Solve problems in single and three phase low voltage circuits	UEENEEG002A	Solve problems in single and three phase low voltage circuits	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEG003B	Install wiring and accessories for low voltage circuits	UEENEEG003A	Install wiring and accessories for low voltage circuits	Part - Refer Note 1 (below).
UEENEEG0	Install low voltage	UEENEEG0	Install low voltage	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
04B	electrical apparatus and associated equipment	04A	electrical apparatus and associated equipment	Note 1 (below).
UEENEEG005B	Verify compliance and functionality of general electrical installations	UEENEEG005A	Verify compliance and functionality of general electrical installations	Part - Refer Note 1 (below).
UEENEEG006A	RESERVED	UEENEEG006A	RESERVED	
UEENEEG007B	Select and arrange equipment for general electrical installations	UEENEEG007A	Select and arrange equipment for general electrical installations	Part - Refer Note 1 (below).
UEENEEG008B	Find and repair faults in electrical apparatus and circuits	UEENEEG008A	Find and repair faults in electrical apparatus and circuits	Part - Refer Note 1 (below).
UEENEEG009B	Develop and connect control circuits	UEENEEG009A	Develop and connect control circuits	Part - Refer Note 1 (below).
UEENEEG010B	Find and repair faults in d.c. electrical apparatus and circuits	UEENEEG010A	Find and repair faults in d.c. electrical apparatus and circuits	Part - Refer Note 1 (below).
UEENEEG011B	Carry out basic repairs to electrical apparatus	UEENEEG011A	Carry out basic repairs to electrical apparatus	Part - Refer Note 1 (below).
UEENEEG012B	Solve fundamental problems in electrical systems	UEENEEG012A	Solve fundamental problems in electrical systems	Part - Refer Note 1 (below).
UEENEEG013B	Install and maintain emergency systems.	UEENEEG013A	Install and maintain emergency systems.	Part - Refer Note 1 (below).
UEENEEG014B	Develop plans and compliance policies to conduct a contracting business	UEENEEG014A	Develop plans and compliance policies to conduct a contracting business	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEG015B	Find and rectify faults in energy supply network equipment	UEENEEG015A	Find and rectify faults in energy supply network equipment	Part - Refer Note 1 (below).
UEENEEG016B	Diagnose and rectify faults in lifts systems	UEENEEG016A	Diagnose and rectify faults in lifts systems	Part - Refer Note 1 (below).
UEENEEG017B	Install electrical power and control equipment for rail network signalling	UEENEEG017A	Install electrical power and control equipment for rail network signalling	Part - Refer Note 1 (below).
UEENEEG018B	Maintain operation of electrical mining equipment	UEENEEG018A	Maintain operation of electrical mining equipment	Part - Refer Note 1 (below).
UEENEEG019B	Maintain operation of electrical marine equipment	UEENEEG019A	Maintain operation of electrical marine equipment	Part - Refer Note 1 (below).
UEENEEG020B	Select and arrange equipment for special electrical installations	UEENEEG020A	Select and arrange equipment for special electrical installations	Part - Refer Note 1 (below).
UEENEEG021B	Verify compliance and functionality of special electrical installations	UEENEEG021A	Verify compliance and functionality of special electrical installations	Part - Refer Note 1 (below). Also, removal of pre-requisite UEEENEEG020B
UEENEEG022B	Conduct compliance inspection of single phase electrical installations	UEENEEG022A	Conduct compliance inspection of single phase electrical installations	Part - Refer Note 1 (below).
UEENEEG023B	Conduct compliance inspection of electrical installations with demand exceeding 100A	UEENEEG023A	Conduct compliance inspection of electrical installations with demand exceeding 100A	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	per phase		per phase	
UEENEEG0 24B	Conduct compliance inspection of special electrical installations	UEENEEG0 24A	Conduct compliance inspection of special electrical installations	Part - Refer Note 1 (below).
UEENEEG0 25B	Plan electrical installations with a LV demand up to 400A per phase	UEENEEG0 25A	Plan electrical installations with a LV demand up to 400A per phase	Part - Refer Note 1 (below).
UEENEEG0 26B	Install and maintain field power and distribution systems with a LV demand up to 200 A per phase	UEENEEG0 26A	Install and maintain field power and distribution systems with a LV demand up to 200 A per phase	Part - Refer Note 1 (below).
UEENEEG0 27B	Design electrical installations with a LV demand greater than 400 A per phase	UEENEEG0 27A	Design electrical installations with a LV demand greater than 400 A per phase	Part - Refer Note 1 (below).
UEENEEG0 28B	Plan switchboard and control panel layouts	UEENEEG0 28A	Plan switchboard and control panel layouts	Part - Refer Note 1 (below).
UEENEEG0 29B	Overhaul and repair major switchgear/controlgear	UEENEEG0 29A	Overhaul and repair major switchgear/controlgear	Part - Refer Note 1 (below).
UEENEEG0 30B	Design switchboards rated for high fault levels	UEENEEG0 30A	Design switchboards rated for high fault levels	Part - Refer Note 1 (below).
UEENEEG0 31B	Evaluate performance of electrical apparatus	UEENEEG0 31A	Evaluate performance of electrical apparatus	Part - Refer Note 1 (below).
UEENEEG0 32B	Carry out electrical field testing and report findings	UEENEEG0 32A	Carry out electrical field testing and report findings	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEG033A	RESERVED	UEENEEG033A	RESERVED	
UEENEEG034B	Perform high voltage field switching to a given schedule	UEENEEG034A	Perform high voltage field switching to a given schedule	Part - Refer Note 1 (below).
UEENEEG035B	Diagnose and rectify faults in a.c. motor drive systems	UEENEEG035A	Diagnose and rectify faults in a.c. motor drive systems	Part - Refer Note 1 (below).
UEENEEG036B	Diagnose and rectify faults in d.c. motor drive systems	UEENEEG036A	Diagnose and rectify faults in d.c. motor drive systems	Part - Refer Note 1 (below).
UEENEEG037B	Diagnose and rectify faults in energy supply apparatus	UEENEEG037A	Diagnose and rectify faults in energy supply apparatus	Part - Refer Note 1 (below).
UEENEEG038B	Diagnose and rectify faults in electrical energy distribution systems	UEENEEG038A	Diagnose and rectify faults in electrical energy distribution systems	Part - Refer Note 1 (below).
UEENEEG039B	Diagnose and rectify faults in distributed generation systems	UEENEEG039A	Diagnose and rectify faults in distributed generation systems	Part - Refer Note 1 (below).
UEENEEG040B	Develop engineering solutions for energy supply power transformer problems	UEENEEG040A	Develop engineering solutions for energy supply power transformer problems	Part - Refer Note 1 (below).
UEENEEG041B	Diagnose and rectify faults in servo drive systems	UEENEEG041A	Diagnose and rectify faults in servo drive systems	Part - Refer Note 1 (below).
UEENEEG042B	Diagnose and rectify faults in electrical energy supply transmission systems	UEENEEG042A	Diagnose and rectify faults in electrical energy supply transmission systems	Part - Refer Note 1 (below).
UEENEEG0	Develop engineering solution for synchronous	UEENEEG0	Develop engineering solution for synchronous	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
43B	machine problems	43A	machine problems	(below).
UEENEEG044B	Develop engineering solutions for d.c. machine problems	UEENEEG044A	Develop engineering solutions for d.c. machine problems	Part - Refer Note 1 (below).
UEENEEG045B	Develop engineering solutions for induction motor problems	UEENEEG045A	Develop engineering solutions for induction motor problems	Part - Refer Note 1 (below).
UEENEEG046B	Develop engineering solutions for energy supply system protection problems	UEENEEG046A	Develop engineering solutions for energy supply system protection problems	Part - Refer Note 1 (below).
UEENEEG047B	Provide computational solutions to power engineering problems	UEENEEG047A	Provide computational solutions to power engineering problems	Part - Refer Note 1 (below).
UEENEEG048B	Solve problems in complex multiple path power circuits	UEENEEG048A	Solve problems in complex multiple path power circuits	Part - Refer Note 1 (below).
UEENEEG049B	Solve problems in complex polyphase power circuits	UEENEEG049A	Solve problems in complex polyphase power circuits	Part - Refer Note 1 (below).
UEENEEG050B	Wind coils	UEENEEG050A	Wind coils	Part - Refer Note 1 (below).
UEENEEG051B	Place and connect coils	UEENEEG051A	Place and connect coils	Part - Refer Note 1 (below).
UEENEEG052B	Rewind single phase induction machines	UEENEEG052A	Rewind single phase induction machines	Part - Refer Note 1 (below).
UEENEEG053B	Rewind three phase induction machines rated for low voltage	UEENEEG053A	Rewind three phase induction machines rated for low voltage	Part - Refer Note 1 (below).
UEENEEG0	Rewind direct current	UEENEEG0	Rewind direct current	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
54B	machines rated for low voltage	54A	machines rated for low voltage	Note 1 (below).
UEENEEG0 55B	Rewind three phase induction machines rated for high voltage to 3.3 kV	UEENEEG0 55A	Rewind three phase induction machines rated for high voltage to 3.3 kV	Part - Refer Note 1 (below).
UEENEEG0 56B	Rewind three phase induction machines rated for high voltage above 3.3 kV	UEENEEG0 56A	Rewind three phase induction machines rated for high voltage above 3.3 kV	Part - Refer Note 1 (below).
UEENEEG0 57B	Conduct electrical tests on low voltage electrical machines	UEENEEG0 57A	Conduct electrical tests on low voltage electrical machines	Part - Refer Note 1 (below).
UEENEEG0 58B	Conduct electrical tests on high voltage electrical machines	UEENEEG0 58A	Conduct electrical tests on high voltage electrical machines	Part - Refer Note 1 (below).
UEENEEG0 59B	Conduct mechanical tests on electrical machines	UEENEEG0 59A	Conduct mechanical tests on electrical machines	Part - Refer Note 1 (below).
UEENEEG0 60B	Evaluate performance of electrical machines	UEENEEG0 60A	Evaluate performance of electrical machines	Part - Refer Note 1 (below).
UEENEEG0 61B	Design and develop modifications to electrical machines	UEENEEG0 61A	Design and develop modifications to electrical machines	Part - Refer Note 1 (below).
UEENEEG0 62B	Set up and place electrical apparatus and associated circuits into service	UEENEEG0 62A	Set up and place electrical apparatus and associated circuits into service	Part - Refer Note 1 (below).
UEENEEG0 63A	RESERVED	UEENEEG0 63A	RESERVED	
UEENEEG0 64B	Repair mechanical components of electrical machines	UEENEEG0 64A	Repair mechanical components of electrical machines	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEG065B	Maintain and service traction lifts	UEENEEG065A	Maintain and service traction lifts	Part - Refer Note 1 (below).
UEENEEG066B	Installation and maintenance of escalators, moving walks and tread ways	UEENEEG066A	Installation and maintenance of escalators, moving walks and tread ways	Part - Refer Note 1 (below).
UEENEEG067B	Align and install lift equipment	UEENEEG067A	Align and install lift equipment	Part - Refer Note 1 (below).
UEENEEG068B	Diagnose and rectify faults in complex lifts systems	UEENEEG068A	Diagnose and rectify faults in complex lifts systems	Part - Refer Note 1 (below).
UEENEEG069B	Manage electrical projects	UEENEEG069A	Manage electrical projects	Part - Refer Note 1 (below).
UEENEEG070B	Plan electrical projects	UEENEEG070A	Plan electrical projects	Part - Refer Note 1 (below).
UEENEEG071B	Install and set up interval metering	UEENEEG071A	Install and set up interval metering	Part - Refer Note 1 (below).
UEENEEG072B	Investigate and report on electrical incidents	UEENEEG072A	Investigate and report on electrical incidents	Part - Refer Note 1 (below).
UEENEEH001B	Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies	UEENEEH001A	Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH0 02B	Carry out basic repairs to electronic apparatus by replacement of components	UEENEEH0 02A	Carry out basic repairs to electronic apparatus by replacement of components	Part - Refer Note 1 (below). Also, removal of pre-requisites UEENEEE004B and UEENEEE007B
UEENEEH0 03B	Carry out routine repairs to business equipment	UEENEEH0 03A	Carry out routine repairs to business equipment	Part - Refer Note 1 (below).
UEENEEH0 04B	Set up and test residential audio/video equipment	UEENEEH0 04A	Set up and test residential audio/video equipment	Part - Refer Note 1 (below).
UEENEEH0 05B	Verify compliance and functionality of custom electronic installations	UEENEEH0 05A	Verify compliance and functionality of custom electronic installations	Part - Refer Note 1 (below).
UEENEEH0 06B	Assemble and set up fixed audio/video components and systems in buildings and premises	UEENEEH0 06A	Assemble and set up fixed audio/video components and systems in buildings and premises	Part - Refer Note 1 (below).
UEENEEH0 07B	Carry out repairs of predictable faults in general electronic apparatus	UEENEEH0 07A	Carry out repairs of predictable faults in general electronic apparatus	Part - Refer Note 1 (below).
UEENEEH0 08B	Assemble and erect reception antennae and signal distribution equipment	UEENEEH0 08A	Assemble and erect reception antennae and signal distribution equipment	Part - Refer Note 1 (below).
UEENEEH0 09B	Set up and test gaming/games equipment	UEENEEH0 09A	Set up and test gaming/games equipment	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH010B	Install commercial audio/video system components	UEENEEH010A	Install commercial audio/video system components	Part - Refer Note 1 (below).
UEENEEH011B	Solve problems in d.c. power supplies with single phase input	UEENEEH011A	Solve problems in d.c. power supplies with single phase input	Part - Refer Note 1 (below). Also, removal of pre-requisite UEENEEH001B.
UEENEEH012B	Solve problems in digital components of electronic apparatus	UEENEEH012A	Solve problems in digital components of electronic apparatus	Part - Refer Note 1 (below). Also, removal of pre-requisite UEENEEH001B and UEENEEH070B
UEENEEH013B	Solve problems in amplifier sections of electronic apparatus	UEENEEH013A	Solve problems in amplifier sections of electronic apparatus	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH014B	Solve problems in frequency dependent circuits	UEENEEH014A	Solve problems in frequency dependent circuits	Part - Refer Note 1 (below). Also, inclusion of 'or UEENEEH069B' in pre-requisite statement

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH015B	Solve problems in microprocessor based hardware and firmware	UEENEEH015A	Solve problems in microprocessor based hardware and firmware	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH016B	Find and repair faults in the microwave amplifier sections in electronic apparatus	UEENEEH016A	Find and repair faults in the microwave amplifier sections in electronic apparatus	Part - Refer Note 1 (below).
UEENEEH017B	Carry out repairs of predictable faults in audio and video replay/recording apparatus	UEENEEH017A	Carry out repairs of predictable faults in audio and video replay/recording apparatus	Part - Refer Note 1 (below).
UEENEEH018B	Find and repair faults in electronic apparatus	UEENEEH018A	Find and repair faults in electronic apparatus	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH019B	Carry out repairs of predictable faults in television receivers	UEENEEH019A	Carry out repairs of predictable faults in television receivers	Part - Refer Note 1 (below).
UEENEEH020B	Find and repair faults in gaming and games equipment	UEENEEH020A	Find and repair faults in gaming and games equipment	Part - Refer Note 1 (below).
UEENEEH021B	Find and repair faults in high volume office equipment	UEENEEH021A	Find and repair faults in high volume office equipment	Part - Refer Note 1 (below).
UEENEEH022B	Find and repair faults in remote control apparatus	UEENEEH022A	Find and repair faults in remote control apparatus	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH0 23B	Find and repair faults in microwave heating apparatus	UEENEEH0 23A	Find and repair faults in microwave heating apparatus	Part - Refer Note 1 (below).
UEENEEH0 24B	Carry out repairs of predictable faults in audio components	UEENEEH0 24A	Carry out repairs of predictable faults in audio components	Part - Refer Note 1 (below).
UEENEEH0 25B	Provide solutions to single phase electronic power control problems	UEENEEH0 25A	Provide solutions to single phase electronic power control problems	Part - Refer Note 1 (below).
UEENEEH0 26B	Provide solutions to polyphase electronic power control problems	UEENEEH0 26A	Provide solutions to polyphase electronic power control problems	Part - Refer Note 1 (below).
UEENEEH0 27B	Commission commercial radio frequency (RF) transmission and reception systems	UEENEEH0 27A	Commission commercial radio frequency (RF) transmission and reception systems	Part - Refer Note 1 (below).
UEENEEH0 28B	Install microwave and antennae and waveguides	UEENEEH0 28A	Install microwave and antennae and waveguides	Part - Refer Note 1 (below).
UEENEEH0 29B	Diagnose and rectify faults in navigation systems	UEENEEH0 29A	Diagnose and rectify faults in navigation systems	Part - Refer Note 1 (below).
UEENEEH0 30B	Diagnose and rectify faults in satellite-based surveillance and observation systems	UEENEEH0 30A	Diagnose and rectify faults in satellite-based surveillance and observation systems	Part - Refer Note 1 (below).
UEENEEH0 31B	Diagnose and rectify faults in radar apparatus and systems	UEENEEH0 31A	Diagnose and rectify faults in radar apparatus and systems	Part - Refer Note 1 (below).
UEENEEH0 32B	Diagnose and rectify faults in global positioning systems	UEENEEH0 32A	Diagnose and rectify faults in global positioning systems	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH033B	Diagnose and rectify faults in telecommunication apparatus and systems	UEENEEH033A	Diagnose and rectify faults in telecommunication apparatus and systems	Part - Refer Note 1 (below).
UEENEEH034B	Diagnose and rectify faults in electronic medical equipment	UEENEEH034A	Diagnose and rectify faults in electronic medical equipment	Part - Refer Note 1 (below).
UEENEEH035B	Design custom electronic installations	UEENEEH035A	Design custom electronic installations	Part - Refer Note 1 (below).
UEENEEH036B	Design commercial audio/video installations	UEENEEH036A	Design commercial audio/video installations	Part - Refer Note 1 (below).
UEENEEH037B	Program and commission commercial audio/video systems	UEENEEH037A	Program and commission commercial audio/video systems	Part - Refer Note 1 (below).
UEENEEH038B	Find and repair faults in complex power supplies	UEENEEH038A	Find and repair faults in complex power supplies	Part - Refer Note 1 (below).
UEENEEH039B	Solve problems in basic amplifier circuits	UEENEEH039A	Solve problems in basic amplifier circuits	Part - Refer Note 1 (below). Also, removal of pre-requisite UEENEEH070BA
UEENEEH040B	Diagnose and rectify faults in sonar apparatus and systems	UEENEEH040A	Diagnose and rectify faults in sonar apparatus and systems	Part - Refer Note 1 (below).
UEENEEH041B	Manage and implement electronic projects	UEENEEH041A	Manage and implement electronic projects	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH042B	Solve problems in oscillator sections of electronic apparatus	UEENEEH042A	Solve problems in oscillator sections of electronic apparatus	Part - Refer Note 1 (below). Also, removal of pre-requisite UEENEEE007B.
UEENEEH043B	Diagnose and rectify faults in digital subsystems of electronic controls	UEENEEH043A	Diagnose and rectify faults in digital subsystems of electronic controls	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH044B	Diagnose and rectify faults in analogue circuits and components in electronic control systems	UEENEEH044A	Diagnose and rectify faults in analogue circuits and components in electronic control systems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH045B	Develop solutions to analogue electronic problems	UEENEEH045A	Develop solutions to analogue electronic problems	Part - Refer Note 1 (below).
UEENEEH046B	Solve fundamental problems in electronic communications systems	UEENEEH046A	Solve fundamental problems in electronic communications systems	Part - Refer Note 1 (below).
UEENEEH047B	Assess compliance of electronic apparatus	UEENEEH047A	Assess compliance of electronic apparatus	Part - Refer Note 1 (below).
UEENEEH048B	Design and develop advanced digital systems	UEENEEH048A	Design and develop advanced digital systems	Part - Refer Note 1 (below). Also, removal of

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
				all pre-requisites
UEENEEH049B	Develop solutions to audio electronic problems	UEENEEH049A	Develop solutions to audio electronic problems	Part - Refer Note 1 (below).
UEENEEH050B	Assemble and set up basic wired and wireless security systems	UEENEEH050A	Assemble and set up basic wired and wireless security systems	Part - Refer Note 1 (below).
UEENEEH051B	Install large wired and wireless security systems	UEENEEH051A	Install large wired and wireless security systems	Part - Refer Note 1 (below).
UEENEEH052B	Enter instructions and test basic wired and wireless security systems	UEENEEH052A	Enter instructions and test basic wired and wireless security systems	Part - Refer Note 1 (below).
UEENEEH053B	Program and test large wired and wireless security systems	UEENEEH053A	Program and test large wired and wireless security systems	Part - Refer Note 1 (below).
UEENEEH054B	Program and commission commercial security alarm systems	UEENEEH054A	Program and commission commercial security alarm systems	Part - Refer Note 1 (below).
UEENEEH055B	Program and commission commercial security access control systems	UEENEEH055A	Program and commission commercial security access control systems	Part - Refer Note 1 (below).
UEENEEH056B	Program and commission commercial security closed circuit television (CCTV) systems	UEENEEH056A	Program and commission commercial security closed circuit television (CCTV) systems	Part - Refer Note 1 (below).
UEENEEH057B	Develop basic integrated security systems plan	UEENEEH057A	Develop basic integrated security systems plan	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH058B	Design integrated security systems for a single site	UEENEEH058A	Design integrated security systems for a single site	Part - Refer Note 1 (below).
UEENEEH059B	Design integrated complex security systems	UEENEEH059A	Design integrated complex security systems	Part - Refer Note 1 (below).
UEENEEH060B	Plan electronic projects	UEENEEH060A	Plan electronic projects	Part - Refer Note 1 (below).
UEENEEH061B	Position and terminate fire detection and warning system apparatus	UEENEEH061A	Position and terminate fire detection and warning system apparatus	Part - Refer Note 1 (below).
UEENEEH062B	Verify compliance and functionality of fire protection installations	UEENEEH062A	Verify compliance and functionality of fire protection installations	Part - Refer Note 1 (below).
UEENEEH063B	Enter and verify programs in preparation for commissioning fire protection systems	UEENEEH063A	Enter and verify programs in preparation for commissioning fire protection systems	Part - Refer Note 1 (below).
UEENEEH064B	Commission commercial fire protection systems	UEENEEH064A	Commission commercial fire protection systems	Part - Refer Note 1 (below).
UEENEEH065B	Find and repair faults in fire protection systems	UEENEEH065A	Find and repair faults in fire protection systems	Part - Refer Note 1 (below).
UEENEEH066B	Fault find Microcontroller based hardware	UEENEEH066A	Fault find Microcontroller based hardware	Part - Refer Note 1 (below).
UEENEEH067B	Commission electronics and communications systems	UEENEEH067A	Commission electronics and communications systems	Part - Refer Note 1 (below).
UEENEEH0	Modify-redesign of electronics and	UEENEEH0	Modify-redesign of electronics and	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
68B	communications system	68A	communications system	(below).
UEENEEH0 69B	Solve problems in electronic circuits	UEENEEH0 69A	Solve problems in electronic circuits	Part - Refer Note 1 (below).
UEENEEH0 70B	Terminate and connect components, conductors, wiring and cables for electronic circuits	UEENEEH0 70A	Terminate and connect components, conductors, wiring and cables for electronic circuits	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH0 71B	Find and repair faults in television receivers	UEENEEH0 71A	Find and repair faults in television receivers	Part - Refer Note 1 (below).
UEENEEH0 72B	Find and repair faults in the RF sections of electronic apparatus	UEENEEH0 72A	Find and repair faults in the RF sections of electronic apparatus	Part - Refer Note 1 (below). Also, removal of pre-requisites UEENEEH0 12B; UEENEEH0 13B and UEENEEH0 38B. Inclusion of pre-requisite UEENEEH0 46B
UEENEEH0 73B	Find and repair faults in professional audio reproduction components	UEENEEH0 73A	Find and repair faults in professional audio reproduction components	Part - Refer Note 1 (below).
UEENEEH0 74B	Find and repair faults in audio/video recording equipment	UEENEEH0 74A	Find and repair faults in audio/video recording equipment	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEH075B	Find and rectify faults and malfunctions in security system installations	UEENEEH075A	Find and rectify faults and malfunctions in security system installations	Part - Refer Note 1 (below).
UEENEEH076B	Diagnose and rectify faults in display circuits	UEENEEH076A	Diagnose and rectify faults in display circuits	Part - Refer Note 1 (below).
UEENEEH077B	Diagnose and rectify faults in recording and replay apparatus	UEENEEH077A	Diagnose and rectify faults in recording and replay apparatus	Part - Refer Note 1 (below).
UEENEEH078B	Diagnose and rectify faults in camera circuits	UEENEEH078A	Diagnose and rectify faults in camera circuits	Part - Refer Note 1 (below).
UEENEEH079B	Diagnose and rectify faults in digital television apparatus	UEENEEH079A	Diagnose and rectify faults in digital television apparatus	Part - Refer Note 1 (below).
UEENEEH080B	Diagnose and rectify faults in digital transmission systems	UEENEEH080A	Diagnose and rectify faults in digital transmission systems	Part - Refer Note 1 (below).
UEENEEH081B	Design printed circuit boards	UEENEEH081A	Design printed circuit boards	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH082B	Develop solutions to RF amplifiers problems	UEENEEH082A	Develop solutions to RF amplifiers problems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH083B	Analyse the performance of	UEENEEH083A	Analyse the performance of	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	wireless-based electronic systems		wireless-based electronic systems	(below). Also, removal of all pre-requisites
UEENEEH084B	Design DSP-based systems	UEENEEH084A	Design DSP-based systems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH085B	Design electronic data acquisition systems	UEENEEH085A	Design electronic data acquisition systems	Part - Refer Note 1 (below). Also, removal of all pre-requisites
UEENEEH086B	Commission microwave and satellite communication systems	UEENEEH086A	Commission microwave and satellite communication systems	Part - Refer Note 1 (below).
UEENEEH087B	Solve problems in musical equipment circuits	UEENEEH087A	Solve problems in musical equipment circuits	Part - Refer Note 1 (below).
UEENEEH088B	Design and develop electronics/computer systems project	UEENEEH088A	Design and develop electronics/computer systems project	Part - Refer Note 1 (below).
UEENEEI001B	Install and set up transducers and sensing devices	UEENEEI001A	Install and set up transducers and sensing devices	Part - Refer Note 1 (below).
UEENEEI002B	Solve problems in pressure measurement systems	UEENEEI002A	Solve problems in pressure measurement systems	Part - Refer Note 1 (below).
UEENEEI0	Solve problems in density/level	UEENEEI0	Solve problems in density/level	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
03B	measurement systems	03A	measurement systems	(below).
UEENEEI0 04B	Solve problems in flow measurement systems	UEENEEI0 04A	Solve problems in flow measurement systems	Part - Refer Note 1 (below).
UEENEEI0 05B	Solve problems in temperature measurement systems	UEENEEI0 05A	Solve problems in temperature measurement systems	Part - Refer Note 1 (below).
UEENEEI0 06B	Solve problems in process controllers, transmitters and converters	UEENEEI0 06A	Solve problems in process controllers, transmitters and converters	Part - Refer Note 1 (below).
UEENEEI0 07B	Install process instrumentation and control cabling and tubing	UEENEEI0 07A	Install process instrumentation and control cabling and tubing	Part - Refer Note 1 (below).
UEENEEI0 08B	Install process control apparatus and associated equipment	UEENEEI0 08A	Install process control apparatus and associated equipment	Part - Refer Note 1 (below).
UEENEEI0 09B	Set up process measuring and control instruments	UEENEEI0 09A	Set up process measuring and control instruments	Part - Refer Note 1 (below).
UEENEEI0 10B	Set up and adjust process control loops	UEENEEI0 10A	Set up and adjust process control loops	Part - Refer Note 1 (below).
UEENEEI0 11B	Find and rectify faults in process control valve and associated equipment	UEENEEI0 11A	Find and rectify faults in process control valve and associated equipment	Part - Refer Note 1 (below).
UEENEEI0 12B	Verify compliance and functionality of process control installations	UEENEEI0 12A	Verify compliance and functionality of process control installations	Part - Refer Note 1 (below).
UEENEEI0 13B	Select equipment for process control systems	UEENEEI0 13A	Select equipment for process control systems	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEI014B	Find and rectify faults in process control systems	UEENEEI014A	Find and rectify faults in process control systems	Part - Refer Note 1 (below).
UEENEEI015B	Find and rectify faults in medical equipment control systems	UEENEEI015A	Find and rectify faults in medical equipment control systems	Part - Refer Note 1 (below).
UEENEEI016A	RESERVED	UEENEEI016A	RESERVED	
UEENEEI017B	Calibrate and test measuring instruments	UEENEEI017A	Calibrate and test measuring instruments	Part - Refer Note 1 (below).
UEENEEI018A	RESERVED	UEENEEI018A	RESERVED	Part - Refer Note 1 (below).
UEENEEI019B	Set up field control devices	UEENEEI019A	Set up field control devices	Part - Refer Note 1 (below).
UEENEEI020B	Provide solutions to problems in basic industrial control systems	UEENEEI020A	Provide solutions to problems in basic industrial control systems	Part - Refer Note 1 (below).
UEENEEI021B	Find and repair faults in measuring and analysis systems	UEENEEI021A	Find and repair faults in measuring and analysis systems	Part - Refer Note 1 (below).
UEENEEI022B	Assist in commissioning process control systems	UEENEEI022A	Assist in commissioning process control systems	Part - Refer Note 1 (below).
UEENEEI023B	Design electronic control systems	UEENEEI023A	Design electronic control systems	Part - Refer Note 1 (below).
UEENEEI024A	RESERVED	UEENEEI024A	RESERVED	

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEI0 25B	Provide solutions to fluid circuit operations	UEENEEI0 25A	Provide solutions to fluid circuit operations	Part - Refer Note 1 (below).
UEENEEI0 26B	Provide solutions to pneumatic/hydraulic system operations	UEENEEI0 26A	Provide solutions to pneumatic/hydraulic system operations	Part - Refer Note 1 (below).
UEENEEI0 27B	Analyse complex electronic circuits controlling fluids	UEENEEI0 27A	Analyse complex electronic circuits controlling fluids	Part - Refer Note 1 (below).
UEENEEI0 28B	Set up controls on complex fluid systems	UEENEEI0 28A	Set up controls on complex fluid systems	Part - Refer Note 1 (below).
UEENEEI0 29B	Set up electronically controlled mechanically operated complex systems	UEENEEI0 29A	Set up electronically controlled mechanically operated complex systems	Part - Refer Note 1 (below).
UEENEEI0 30B	Set up electronically controlled robotically operated complex systems	UEENEEI0 30A	Set up electronically controlled robotically operated complex systems	Part - Refer Note 1 (below).
UEENEEI0 31A	RESERVED	UEENEEI0 31A	RESERVED	
UEENEEI0 32A	RESERVED	UEENEEI0 32A	RESERVED	
UEENEEI0 33B	RESERVED	UEENEEI0 33A	RESERVED	
UEENEEI0 34B	Manage control projects	UEENEEI0 33A	Manage control projects	Part - Refer Note 1 (below).
UEENEEI0 35B	Plan control projects	UEENEEI0 35A	Plan control projects	Part - Refer Note 1 (below).
UEENEEI0	Manage automated	UEENEEI0	Manage automated	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
36B	systems projects	36A	systems projects	Note 1 (below).
UEENEEI0 37B	Plan automated systems projects	UEENEEI0 37A	Plan automated systems projects	Part - Refer Note 1 (below).
UEENEEJ0 01A	RESERVED	UEENEEJ0 01A	RESERVED	
UEENEEJ0 02B	Prepare refrigerant tubing and fittings	UEENEEJ0 02A	Prepare refrigerant tubing and fittings	Part - Refer Note 1 (below).
UEENEEJ0 03B	Determine the basic operating conditions of vapour compression systems	UEENEEJ0 03A	Determine the basic operating conditions of vapour compression systems	Part - Refer Note 1 (below).
UEENEEJ0 04B	Determine the basic operating conditions of air conditioning systems	UEENEEJ0 04A	Determine the basic operating conditions of air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ0 05B	Position, assemble and start up split air conditioning systems	UEENEEJ0 05A	Position, assemble and start up split air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ0 06B	Install pipe work for refrigeration and air conditioning systems	UEENEEJ0 06A	Install pipe work for refrigeration and air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ0 07B	Install refrigeration and air conditioning systems, major components and associated equipment	UEENEEJ0 07A	Install refrigeration and air conditioning systems, major components and associated equipment	Part - Refer Note 1 (below).
UEENEEJ0 08B	Recover, pressure and leak test, evacuate and charge refrigerants	UEENEEJ0 08A	Recover, pressure and leak test, evacuate and charge refrigerants	Part - Refer Note 1 (below).
UEENEEJ0 09B	Verify compliance and functionality of refrigeration and air	UEENEEJ0 09A	Verify compliance and functionality of refrigeration and air	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	conditioning installations		conditioning installations	
UEENEEJ010B	Select refrigerant pipe/tube, accessories and associated controls	UEENEEJ010A	Select refrigerant pipe/tube, accessories and associated controls	Part - Refer Note 1 (below).
UEENEEJ011B	Diagnose and rectify faults in refrigeration and air conditioning systems and components	UEENEEJ011A	Diagnose and rectify faults in refrigeration and air conditioning systems and components	Part - Refer Note 1 (below).
UEENEEJ012B	Diagnose and rectify faults in complex refrigeration/air conditioning systems	UEENEEJ012A	Diagnose and rectify faults in complex refrigeration/air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ013B	Commission refrigeration and air conditioning systems	UEENEEJ013A	Commission refrigeration and air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ014B	Solve problems in hydronic systems	UEENEEJ014A	Solve problems in hydronic systems	Part - Refer Note 1 (below).
UEENEEJ015B	Solve problems in beverage dispensers	UEENEEJ015A	Solve problems in beverage dispensers	Part - Refer Note 1 (below).
UEENEEJ016B	Solve problems in transport refrigeration systems	UEENEEJ016A	Solve problems in transport refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ017B	Solve problems in ultra-low temperature refrigeration systems	UEENEEJ017A	Solve problems in ultra-low temperature refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ018B	Solve problems in post mix refrigeration systems	UEENEEJ018A	Solve problems in post mix refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ019B	Solve problems in ice making systems	UEENEEJ019A	Solve problems in ice making systems	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
				(below).
UEENEEJ020B	Solve problems in industrial refrigeration systems	UEENEEJ020A	Solve problems in industrial refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ021B	Monitor and adjust energy management systems on refrigeration systems	UEENEEJ021A	Monitor and adjust energy management systems on refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ022B	Diagnose faults in complex refrigeration or HVAC control systems	UEENEEJ022A	Diagnose faults in complex refrigeration or HVAC control systems	Part - Refer Note 1 (below).
UEENEEJ023B	Commission complex heating, ventilation and air conditioning (HVAC) systems	UEENEEJ023A	Commission complex heating, ventilation and air conditioning (HVAC) systems	Part - Refer Note 1 (below).
UEENEEJ024B	Commission hydronic systems for refrigeration and/or air conditioning	UEENEEJ024A	Commission hydronic systems for refrigeration and/or air conditioning	Part - Refer Note 1 (below).
UEENEEJ025B	Commission complex refrigeration systems	UEENEEJ025A	Commission complex refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ026B	Commission complex control systems for refrigeration/air conditioning systems	UEENEEJ026A	Commission complex control systems for refrigeration/air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ027B	Determine thermodynamic parameters of refrigeration and air conditioning systems	UEENEEJ027A	Determine thermodynamic parameters of refrigeration and air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ028B	Produce HVAC/R design drawings	UEENEEJ028A	Produce HVAC/R design drawings	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEJ0 29B	Determine the heat loads for commercial refrigeration and air conditioning applications	UEENEEJ0 29A	Determine the heat loads for commercial refrigeration and air conditioning applications	Part - Refer Note 1 (below).
UEENEEJ0 30B	Produce HVAC/R control system design diagrams	UEENEEJ0 30A	Produce HVAC/R control system design diagrams	Part - Refer Note 1 (below).
UEENEEJ0 31B	Provide solutions to vibration problems in HVAC/R system design	UEENEEJ0 31A	Provide solutions to vibration problems in HVAC/R system design	Part - Refer Note 1 (below).
UEENEEJ0 32B	Design commercial refrigeration systems	UEENEEJ0 32A	Design commercial refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ0 33B	Design industrial refrigeration systems	UEENEEJ0 33A	Design industrial refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ0 34B	Design heating, ventilation and air conditioning (HVAC) systems	UEENEEJ0 34A	Design heating, ventilation and air conditioning (HVAC) systems	Part - Refer Note 1 (below).
UEENEEJ0 35B	Design control systems for a heating, ventilation, air conditioning or refrigeration system	UEENEEJ0 35A	Design control systems for a heating, ventilation, air conditioning or refrigeration system	Part - Refer Note 1 (below).
UEENEEJ0 36B	Evaluate and report on energy management	UEENEEJ0 36A	Evaluate and report on energy management	Part - Refer Note 1 (below).
UEENEEJ0 37B	Evaluate and report on air quality in buildings	UEENEEJ0 37A	Evaluate and report on air quality in buildings	Part - Refer Note 1 (below).
UEENEEJ0 38B	Analyse noise and vibration in refrigeration and air conditioning	UEENEEJ0 38A	Analyse noise and vibration in refrigeration and air conditioning	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	systems		systems	(below).
UEENEEJ039B	Develop specifications and prepare drawings for HVAC/R projects	UEENEEJ039A	Develop specifications and prepare drawings for HVAC/R projects	Part - Refer Note 1 (below).
UEENEEJ040B	Manage refrigeration and air conditioning projects	UEENEEJ040A	Manage refrigeration and air conditioning projects	Part - Refer Note 1 (below).
UEENEEJ041B	Design complex commercial refrigeration systems	UEENEEJ041A	Design complex commercial refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ042B	Design complex industrial refrigeration systems	UEENEEJ042A	Design complex industrial refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ043B	Design complex air conditioning systems	UEENEEJ043A	Design complex air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ044B	Design mechanical ventilation/exhaust systems	UEENEEJ044A	Design mechanical ventilation/exhaust systems	Part - Refer Note 1 (below).
UEENEEJ045B	Design hydronic systems	UEENEEJ045A	Design hydronic systems	Part - Refer Note 1 (below).
UEENEEJ046B	Design complex control systems for a heating, ventilation, air conditioning or refrigeration system	UEENEEJ046A	Design complex control systems for a heating, ventilation, air conditioning or refrigeration system	Part - Refer Note 1 (below).
UEENEEJ047B	Audit energy use for commercial HVAC/R systems	UEENEEJ047A	Audit energy use for commercial HVAC/R systems	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEJ0 48B	Analyse HVAC control systems for compliance with standards and regulations	UEENEEJ0 48A	Analyse HVAC control systems for compliance with standards and regulations	Part - Refer Note 1 (below).
UEENEEJ0 49B	Develop specifications for heat exchanger designs	UEENEEJ0 49A	Develop specifications for heat exchanger designs	Part - Refer Note 1 (below).
UEENEEJ0 50B	Evaluate alternative and new technologies applicable to electrotechnology applications	UEENEEJ0 50A	Evaluate alternative and new technologies applicable to electrotechnology applications	Part - Refer Note 1 (below).
UEENEEJ0 51B	Service small appliances and power tools	UEENEEJ0 51A	Service small appliances and power tools	Part - Refer Note 1 (below).
UEENEEJ0 52B	Carry out repairs to appliance refrigeration systems	UEENEEJ0 52A	Carry out repairs to appliance refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ0 53B	Find and rectify faults in appliance motors and associated controls	UEENEEJ0 53A	Find and rectify faults in appliance motors and associated controls	Part - Refer Note 1 (below).
UEENEEJ0 54B	Find and rectify faults in appliance control devices and systems	UEENEEJ0 54A	Find and rectify faults in appliance control devices and systems	Part - Refer Note 1 (below). Also, removal of pre-requisite UEEENEEJ00 9B
UEENEEJ0 55B	Service refrigerated appliances	UEENEEJ0 55A	Service refrigerated appliances	Part - Refer Note 1 (below).
UEENEEJ0 56B	Service clothes washers and dryers	UEENEEJ0 56A	Service clothes washers and dryers	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEJ057B	Service electric heating appliances	UEENEEJ057A	Service electric heating appliances	Part - Refer Note 1 (below).
UEENEEJ058B	Service dish washing machines	UEENEEJ058A	Service dish washing machines	Part - Refer Note 1 (below).
UEENEEJ059B	Service gas appliances	UEENEEJ059A	Service gas appliances	Part - Refer Note 1 (below).
UEENEEJ060B	Service room air conditioners	UEENEEJ060A	Service room air conditioners	Part - Refer Note 1 (below).
UEENEEJ061B	Verify compliance and functionality of appliances	UEENEEJ061A	Verify compliance and functionality of appliances	Part - Refer Note 1 (below).
UEENEEJ062B	Recover, pressure and leak test, evacuate and charge refrigerants/appliances	UEENEEJ062A	Recover, pressure and leak test, evacuate and charge refrigerants/appliances	Part - Refer Note 1 (below).
UEENEEJ063B	Analyse the psychrometric and thermodynamic performance of HVAC/R systems	UEENEEJ063A	Analyse the psychrometric and thermodynamic performance of HVAC/R systems	Part - Refer Note 1 (below).
UEENEEJ064B	Analyse the operation of HVAC/R systems	UEENEEJ064A	Analyse the operation of HVAC/R systems	Part - Refer Note 1 (below).
UEENEEJ065B	Evaluate fluid and thermodynamic parameters of refrigeration systems	UEENEEJ065A	Evaluate fluid and thermodynamic parameters of refrigeration systems	Part - Refer Note 1 (below).
UEENEEJ066B	Solve problems in diary refrigeration systems	UEENEEJ066A	Solve problems in diary refrigeration systems	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEJ0 67B	Solve problems in central plant air conditioning systems	UEENEEJ0 67A	Solve problems in central plant air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ0 68B	Maintain microbial control of air and water systems	UEENEEJ0 68A	Maintain microbial control of air and water systems	Part - Refer Note 1 (below).
UEENEEJ0 69B	Plan refrigeration and air conditioning projects	UEENEEJ0 69A	Plan refrigeration and air conditioning projects	Part - Refer Note 1 (below).
UEENEEJ0 70B	Diagnose and rectify faults in refrigeration and air conditioning control systems	UEENEEJ0 70A	Diagnose and rectify faults in refrigeration and air conditioning control systems	Part - Refer Note 1 (below).
UEENEEJ0 71B	Solve problems in refrigerated beverage vending cabinets	UEENEEJ0 71A	Solve problems in refrigerated beverage vending cabinets	Part - Refer Note 1 (below).
UEENEEJ0 72B	Recover, pressure and leak test, evacuate and charge refrigerants – split air conditioning systems	UEENEEJ0 72A	Recover, pressure and leak test, evacuate and charge refrigerants – split air conditioning systems	Part - Refer Note 1 (below).
UEENEEJ0 73B	Service microwave ovens	UEENEEJ0 73A	Service microwave ovens	Part - Refer Note 1 (below).
UEENEEK0 01B	Maintain safety and tidiness of remote area power supply (RAPS) systems	UEENEEK0 01A	Maintain safety and tidiness of remote area power supply (RAPS) systems	Part - Refer Note 1 (below).
UEENEEK0 02B	Work safely with remote area power supply (RAPS) systems	UEENEEK0 02A	Work safely with remote area power supply (RAPS) systems	Part - Refer Note 1 (below).
UEENEEK0 03B	Conduct periodic maintenance of remote area power supply	UEENEEK0 03A	Conduct periodic maintenance of remote area power supply	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	(RAPS) battery banks		(RAPS) battery banks	
UEENEEK004B	Conduct periodic maintenance of remote area power supply (RAPS) generator sets	UEENEEK004A	Conduct periodic maintenance of remote area power supply (RAPS) generator sets	Part - Refer Note 1 (below).
UEENEEK005B	Conduct periodic maintenance of remote area power supply (RAPS) photo voltaic arrays	UEENEEK005A	Conduct periodic maintenance of remote area power supply (RAPS) photo voltaic arrays	Part - Refer Note 1 (below).
UEENEEK006B	Conduct periodic maintenance of remote area power supply (RAPS) wind generators	UEENEEK006A	Conduct periodic maintenance of remote area power supply (RAPS) wind generators	Part - Refer Note 1 (below).
UEENEEK007B	Conduct checks in the demand side use of remote area power supplies	UEENEEK007A	Conduct checks in the demand side use of remote area power supplies	Part - Refer Note 1 (below).
UEENEEK008B	Plan periodic maintenance schedules of remote area power supplies	UEENEEK008A	Plan periodic maintenance schedules of remote area power supplies	Part - Refer Note 1 (below).
UEENEEK009B	Attend to breakdowns in remote area power supplies	UEENEEK009A	Attend to breakdowns in remote area power supplies	Part - Refer Note 1 (below).
UEENEEK010B	Coordinate maintenance of renewable energy apparatus and systems	UEENEEK010A	Coordinate maintenance of renewable energy apparatus and systems	Part - Refer Note 1 (below).
UEENEEK011B	Assemble and connect remote area power supplies (RAPS)	UEENEEK011A	Assemble and connect remote area power supplies (RAPS)	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEK012B	Provide basic sustainable energy solutions for energy reduction in domestic premises	UEENEEK012A	Provide basic sustainable energy solutions for energy reduction in domestic premises	Part - Refer Note 1 (below).
UEENEEK013B	Apply sustainable energy practice in daily activities	UEENEEK013A	Apply sustainable energy practice in daily activities	Part - Refer Note 1 (below).
UEENEEK014B	Promote sustainable energy practice in the community	UEENEEK014A	Promote sustainable energy practice in the community	Part - Refer Note 1 (below).
UEENEEK015A	RESERVED	UEENEEK015A	RESERVED	Part - Refer Note 1 (below).
UEENEEK016A	RESERVED	UEENEEK016A	RESERVED	Part - Refer Note 1 (below).
UEENEEK017B	Maintain and repair facilities associated with remote area essential services operation	UEENEEK017A	Maintain and repair facilities associated with remote area essential services operation	Part - Refer Note 1 (below).
UEENEEK018B	Maintain operation of remote area water facilities	UEENEEK018A	Maintain operation of remote area water facilities	Part - Refer Note 1 (below).
UEENEEK019B	Maintain operation of remote area waste water facilities	UEENEEK019A	Maintain operation of remote area waste water facilities	Part - Refer Note 1 (below).
UEENEEK020B	Maintain operation of remote area power plant	UEENEEK020A	Maintain operation of remote area power plant	Part - Refer Note 1 (below).
UEENEEK021B	Manage renewable energy projects	UEENEEK021A	Manage renewable energy projects	Part - Refer Note 1 (below).
UEENEEK0	Plan renewable energy	UEENEEK0	Plan renewable energy	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
22B	projects	22A	projects	Note 1 (below).
UEENEEK0 23B	Carry out basic repairs to renewable energy apparatus by replacement of components	UEENEEK0 23A	Carry out basic repairs to renewable energy apparatus by replacement of components	Part - Refer Note 1 (below).
UEENEEK0 24B	Assemble and set up photovoltaic apparatus in domestic dwellings	UEENEEK0 24A	Assemble and set up photovoltaic apparatus in domestic dwellings	Part - Refer Note 1 (below).
UEENEEK0 25B	Solve basic problems in photovoltaic energy apparatus	UEENEEK0 25A	Solve basic problems in photovoltaic energy apparatus	Part - Refer Note 1 (below).
UEENEEK0 26B	Install and set up grid connected photovoltaic power systems	UEENEEK0 26A	Install and set up grid connected photovoltaic power systems	Part - Refer Note 1 (below).
UEENEEK0 27B	Diagnose faults in renewable energy control systems	UEENEEK0 27A	Diagnose faults in renewable energy control systems	Part - Refer Note 1 (below).
UEENEEK0 28B	Solve problems in stand-alone renewable energy systems	UEENEEK0 28A	Solve problems in stand-alone renewable energy systems	Part - Refer Note 1 (below).
UEENEEK0 29B	Design renewable energy heating systems	UEENEEK0 29A	Design renewable energy heating systems	Part - Refer Note 1 (below).
UEENEEK0 30B	Solve problems in wind energy conversion systems	UEENEEK0 30A	Solve problems in wind energy conversion systems	Part - Refer Note 1 (below).
UEENEEK0 31B	Design wind energy conversion systems rated to 10kW	UEENEEK0 31A	Design wind energy conversion systems rated to 10kW	Part - Refer Note 1 (below).
UEENEEK0 32B	Develop strategies to address sustainability issues	UEENEEK0 32A	Develop strategies to address sustainability issues	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEK033B	Design hybrid power systems	UEENEEK033A	Design hybrid power systems	Part - Refer Note 1 (below).
UEENEEK034B	Install stand-alone photovoltaic power systems	UEENEEK034A	Install stand-alone photovoltaic power systems	Part – Refer Note 1 (below).
UEENEEK035B	Design grid connected power supply systems	UEENEEK035A	Design grid connected power supply systems	Part - Refer Note 1 (below).
UEENEEK036A	Prepare grid connected photovoltaic power systems for LV connection	UEENEEK036A	Prepare grid connected photovoltaic power systems for LV connection	Part – Refer Note 1 (below).
UEENEEK037B	Install and set up micro-hydro systems	UEENEEK037A	Install and set up micro-hydro systems	Part - Refer Note 1 (below).
UEENEEK038B	Design micro-hydro systems	UEENEEK038A	Design micro-hydro systems	Part - Refer Note 1 (below).
UEENEEK039B	Design stand-alone renewable energy systems	UEENEEK039A	Design stand-alone renewable energy systems	Part - Refer Note 1 (below).
UEENEEK040B	Develop engineering solutions to renewable energy problems	UEENEEK040A	Develop engineering solutions to renewable energy problems	Part - Refer Note 1 (below).
UEENEEK041B	Develop strategies for effective energy reduction in buildings	UEENEEK041A	Develop strategies for effective energy reduction in buildings	Part - Refer Note 1 (below).
UEENEEK042A	Participate in environmentally sustainable work practices	NEW		
UEENEEK0	Install small wind energy conversion	NEW		

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
43A	systems for stand-alone applications			
UEENEEK044A	RESERVED	UEENEEK044A	RESERVED	Part - Refer Note 1 (below).
UEENEEK045A	Implement & monitor policies & procedures for environmentally sustainable electrotech work practice	NEW		
UEENEEK046A	Design energy management controls for electrical installations in buildings	NEW		
UEENEEM001B	Report on the integrity of explosion-protected equipment in hazardous areas	UEENEEM001A	Report on the integrity of explosion-protected equipment in hazardous areas	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM002B	Attend to breakdowns in hazardous areas	UEENEEM002A	Attend to breakdowns in hazardous areas	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM003B	Use and maintain the integrity of portable gas detection devices	UEENEEM003A	Use and maintain the integrity of portable gas detection devices	Part - Refer Note 1 (below). Also, amendment of pre-requisite

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
				statement
UEENEEM 004B	Install explosion-protected equipment and wiring systems	UEENEEM 004A	Install explosion-protected equipment and wiring systems	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 005B	Install and maintain integrity of fixed gas detection equipment	UEENEEM 005A	Install and maintain integrity of fixed gas detection equipment	Part - Refer Note 1 (below).
UEENEEM 006B	Maintain equipment in hazardous areas	UEENEEM 006A	Maintain equipment in hazardous areas	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 007B	Overhaul and repair explosion-protected equipment	UEENEEM 007A	Overhaul and repair explosion-protected equipment	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 008B	Assess explosion-protected equipment for compliance with standards	UEENEEM 008A	Assess explosion-protected equipment for compliance with standards	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM	Test installations in	UEENEEM	Test installations in	Part - Refer

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
009B	hazardous areas	009A	hazardous areas	Note 1.
UEENEEM 010B	Conduct close inspection of existing hazardous areas installations	UEENEEM 010A	Conduct close inspection of existing hazardous areas installations	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 011B	Conduct detailed inspection of hazardous areas installations	UEENEEM 011A	Conduct detailed inspection of hazardous areas installations	Part - Refer Note 1 (below).
UEENEEM 012B	Develop and manage maintenance programs for hazardous areas electrical equipment	UEENEEM 012A	Develop and manage maintenance programs for hazardous areas electrical equipment	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 013B	Ensure the safety of hazardous areas	UEENEEM 013A	Ensure the safety of hazardous areas	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 014B	Design and develop modifications to explosion-protected equipment	UEENEEM 014A	Design and develop modifications to explosion-protected equipment	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEM 015B	Classify hazardous areas	UEENEEM 015A	Classify hazardous areas	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 016B	Design electrical installations in hazardous areas	UEENEEM 016A	Design electrical installations in hazardous areas	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 017B	Design explosion-protected electrical systems	UEENEEM 017A	Design explosion-protected electrical systems	Part - Refer Note 1 (below). Also, amendment of pre-requisite statement
UEENEEM 018B	Design gas detection systems	UEENEEM 018A	Design gas detection systems	Part - Refer Note 1 (below).
UEENEEN0 01B	Service mechanical signalling equipment and infrastructure	UEENEEN0 01A	Service mechanical signalling equipment and infrastructure	Part - Refer Note 1 (below).
UEENEEN0 02B	Assemble and wire internal electrical signalling equipment	UEENEEN0 02A	Assemble and wire internal electrical signalling equipment	Part - Refer Note 1 (below).
UEENEEN0 03B	Install and maintain track circuit leads and bonds	UEENEEN0 03A	Install and maintain track circuit leads and bonds	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEN0 04B	Perform cable tests	UEENEEN0 04A	Perform cable tests	Part - Refer Note 1 (below).
UEENEEN0 05B	Install and maintain signalling power supplies	UEENEEN0 05A	Install and maintain signalling power supplies	Part - Refer Note 1 (below).
UEENEEN0 06B	Maintain remote control and non-vital interlocking control systems	UEENEEN0 06A	Maintain remote control and non-vital interlocking control systems	Part - Refer Note 1 (below).
UEENEEN0 07B	Maintain power signalling and protected level crossing equipment	UEENEEN0 07A	Maintain power signalling and protected level crossing equipment	Part - Refer Note 1 (below).
UEENEEN0 08B	Maintain on-site power operated point-activating devices	UEENEEN0 08A	Maintain on-site power operated point-activating devices	Part - Refer Note 1 (below).
UEENEEN0 09B	Maintain track circuits equipment	UEENEEN0 09A	Maintain track circuits equipment	Part - Refer Note 1 (below).
UEENEEN0 10B	Maintain electronic signalling and communication equipment	UEENEEN0 10A	Maintain electronic signalling and communication equipment	Part - Refer Note 1 (below).
UEENEEN0 11B	Install and maintain power operated signalling equipment	UEENEEN0 11A	Install and maintain power operated signalling equipment	Part - Refer Note 1 (below).
UEENEEN0 12B	Maintain power signalling and protective relay interlocking systems	UEENEEN0 12A	Maintain power signalling and protective relay interlocking systems	Part - Refer Note 1 (below).
UEENEEN0 13B	Install and test computer based interlocking equipment	UEENEEN0 13A	Install and test computer based interlocking equipment	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
UEENEEN014B	Maintain computer based and solid state interlocking equipment	UEENEEN014A	Maintain computer based and solid state interlocking equipment	Part - Refer Note 1 (below).
UEENEEN015B	Conduct routine inspecting and testing of new signal cables and lines	UEENEEN015A	Conduct routine inspecting and testing of new signal cables and lines	Part - Refer Note 1 (below).
UEENEEN016B	Maintain electronic switched and microprocessor-based remote control systems	UEENEEN016A	Maintain electronic switched and microprocessor-based remote control systems	Part - Refer Note 1 (below).
UEENEEN017B	Install and maintain transmission interface equipment	UEENEEN017A	Install and maintain transmission interface equipment	Part - Refer Note 1 (below).
UEENEEN018B	Find and repair cable system faults	UEENEEN018A	Find and repair cable system faults	Part - Refer Note 1 (below).
UEENEEN019B	Test equipment and isolate faults	UEENEEN019A	Test equipment and isolate faults	Part - Refer Note 1 (below).
UEENEEN020B	Install electrical power and control equipment for rail networks	UEENEEN020A	Install electrical power and control equipment for rail networks	Part - Refer Note 1 (below).
UEENEEN021A	RESERVED	UEENEEN021A	RESERVED	
UEENEEN022A	RESERVED	UEENEEN022A	RESERVED	
UEENEEN023A	RESERVED	UEENEEN023A	RESERVED	
UEENEEN024A	RESERVED	UEENEEN024A	RESERVED	
UEENEEN0	Coordinate and manage	UEENEEN0	Coordinate and manage	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
25B	track protection	25A	track protection	(below).
UEENEEN0 26B	Develop rail signalling maintenance programmes	UEENEEN0 26A	Develop rail signalling maintenance programmes	Part - Refer Note 1 (below).
UEENEEN0 27B	Decommission electrical and electro-mechanical signalling from service	UEENEEN0 27A	Decommission electrical and electro-mechanical signalling from service	Part - Refer Note 1 (below).
UEENEEN0 28B	Test and commission power signalling equipment	UEENEEN0 28A	Test and commission power signalling equipment	Part - Refer Note 1 (below).
UEENEEO0 01B	Disconnect and reconnect fixed wired electrical equipment connected to a low voltage supply	UEENEEO0 01A	Disconnect and reconnect fixed wired electrical equipment connected to a low voltage supply	Part - Refer Note 1 (below). Also, amendment of EKAS alignments
UEENEEO0 02B	Attach cords and plugs to electrical equipment for connection to a single phase 250 volt supply	UEENEEO0 02A	Attach cords and plugs to electrical equipment for connection to a single phase 250 volt supply	Part - Refer Note 1 (below).
UEENEEO0 03B	Attach cords and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply	UEENEEO0 03A	Attach cords and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply	Part - Refer Note 1 (below).
UEENEEO0 04B	Disconnect and reconnect explosion-protected electrical equipment connected to low voltage supply	UEENEEO0 04A	Disconnect and reconnect explosion-protected electrical equipment connected to low voltage supply	Part - Refer Note 1 (below).
UEENEEO0 05B	Disconnect and reconnect 3.3 kV	UEENEEO0 05A	Disconnect and reconnect 3.3 kV	Part - Refer Note 1

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	electric propulsion components of self-propelled earth moving vehicles		electric propulsion components of self-propelled earth moving vehicles	(below).
UEENEEO06B	Attach flexible cables and plugs to electrical equipment connected to a high voltage supply	UEENEEO06A	Attach flexible cables and plugs to electrical equipment connected to a high voltage supply	Part - Refer Note 1 (below).
UEENEEO07B	Locate and rectify faults in electrical low voltage equipment following prescribed procedures	UEENEEO07A	Locate and rectify faults in electrical low voltage equipment following prescribed procedures	Part - Refer Note 1 (below).
UEENEEO08B	Conduct in-service safety testing of electrical cord assemblies and cord connected equipment	UEENEEO08A	Conduct in-service safety testing of electrical cord assemblies and cord connected equipment	Part - Refer Note 1 (below).
UEENEEO09B	Locate and rectify faults in electrical low voltage appliances up to 250V following prescribed procedures	UEENEEO09A	Locate and rectify faults in electrical low voltage appliances up to 250V following prescribed procedures	Part - Refer Note 1 (below).
UEENEEO01B	Contribute to the planning of a research project	UEENEEO01A	Contribute to the planning of a research project	Part - Refer Note 1 (below).
UEENEEO02B	Contribute to the conduct of a research project	UEENEEO02A	Contribute to the conduct of a research project	Part - Refer Note 1 (below).
UEENEEO03B	Contribute to the development of a product/application/service	UEENEEO03A	Contribute to the development of a product/application/service	Part - Refer Note 1 (below).
UEENEEO04B	Contribute to the trial of a product/application/service	UEENEEO04A	Contribute to the trial of a product/application/service	Part - Refer Note 1 (below).

UEE07 Unit Code	UEE07 Unit Title	UEE06 Unit Code	UEE06 Unit Title (previous Training Package)	Equivalence - Full, Part, No
	ice		ice	
UEENEER005B	Contribute to intellectual property management	UEENEER005A	Contribute to intellectual property management	Part - Refer Note 1 (below).
UEENEER006B	Contribute to the commercialisation of a product/application/service	UEENEER006A	Contribute to the commercialisation of a product/application/service	Part - Refer Note 1 (below).

Note:

1. All units have been amended as follows:

- Removal of all spaces within unit codes
- Addition of '1.1 Descriptor' as a new title
- Relocation of '3.1 License to practise' to position 1.2
- Relocation of the sub-heading '2.1 Competencies' from the left hand column to the right hand column
- Relocation of the sub-heading '2.2 Literacy and Numeracy skills' from the left hand column to the right hand column
- Inclusion of the statement *"For the full prerequisite chain details for this unit please refer to Table 2 in Volume 1, Part 2"* in 2.1 Competencies
- Removal of all guidance text from 2) Prerequisite Unit(s), with the exception of the 'M' Hazardous Areas units
- Inclusion of '3) Employability Skills' and the statement *"The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements."* as a whole new section
- Revision of the numbering of all subsequent sections to accommodate the inclusion of the Employability Skills section at 3)
- Inclusion of the statement *"All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies"* as a new paragraph in '7) Required Skills and Knowledge'
- Changing of the number '7' in paragraph *"Solve problems in complex polyphase power circuits as described in 7) and including:"* in section 9.2 of the unit to 8.
- Complete removal of the 'Key Competencies' and 'Skills Enabling Employment' sections.

1.2.11 Imported Competency Standard Units

2.11 Imported Competency Standard Units

The Table below shows the imported competency standard units in the Electricity Supply Industry – Transmission, Distribution and Rail Sector Training Package.

Table 4 – List of Imported Competency Standard Units

Code	Title	Origin
BSBINM501A	Manage an information or knowledge management system	Innovation and Business Services. ISC
BSBSMB405A	Monitor and manage small business operations	Innovation and Business Services. ISC
BSBWOR502B	Ensure team effectiveness	Innovation and Business Services. ISC
BSBINN502A	Build and sustain an innovative work environment	Innovation and Business Services. ISC
BSBITU306A	Design and produce business documents	Innovation and Business Services. ISC
BSBMGT502B	Manage people performance	Innovation and Business Services. ISC
BSBMGT516C	Facilitate continuous improvement	Innovation and Business Services. ISC
ICTTEN2207A	Install and configure a home or small office network	Innovation and Business Services. ISC
ICTTEN2208A	Install and configure a small to medium business network	Innovation and Business Services. ISC
ICTTEN2209A	Build and maintain a secure network	Innovation and Business Services. ISC
ICTTEN4210A	Implement and troubleshoot enterprise routers and switches	Innovation and Business Services. ISC
ICTTEN4211A	Design, install and configure an internetwork	Innovation and Business Services. ISC
ICTTEN4212A	Apply advanced routing protocols to network design	Innovation and Business Services. ISC

Code	Title	Origin
ICTTEN4213A	Configure and troubleshoot advanced network switching	Innovation and Business Services. ISC
ICTTEN4214A	Install and maintain a wide area network	Innovation and Business Services. ISC
ICTTEN3056A	Install telecommunications network equipment	IT Skills Hub Pty Ltd – IBSA
ICTTEN5083A	Locate, diagnose and rectify complex faults	IT Skills Hub Pty Ltd – IBSA
ICTTEN4085A	Monitor, analyse and action telecommunications network alarms	IT Skills Hub Pty Ltd – IBSA
ICTTEN4081A	Locate, diagnose and rectify faults	IT Skills Hub Pty Ltd – IBSA
ICTTEN3089A	Repair and replace telecommunications network hardware	IT Skills Hub Pty Ltd – IBSA
MEM05007C	Perform manual heating and thermal cutting	Manufacturing ISC
MEM05012C	Perform routine manual metal arc welding	Manufacturing ISC
MEM16006A	Organise and communicate information	Manufacturing ISC
MEM16008A	Interact with computing technology	Manufacturing ISC
MEM30001A	Use computer aided drafting systems to produce basic engineering drawings	Manufacturing ISC
MEM30002A	Produce basic engineering graphics	Manufacturing ISC
MEM30003A	Produce detailed engineering drawings	Manufacturing ISC
MEM30004A	Use CAD to create and display 3D models	Manufacturing ISC

Code	Title	Origin
MSACMS200A	Apply competitive manufacturing practices	Manufacturing Skills Australia
MSACMT220A	Apply quick changeover procedures	Manufacturing Skills Australia
MSACMT221A	Apply Just in Time (JIT) procedures	Manufacturing Skills Australia
MSACMT240A	Apply 5S procedures in a manufacturing environment	Manufacturing Skills Australia
MSACMT280A	Undertake root cause analysis	Manufacturing Skills Australia
MSACMT281A	Contribute to the application of a proactive maintenance strategy	Manufacturing Skills Australia
NWP209B	Use maps, plans, drawings and specifications	Government Skills Australia
NWP218B	Perform and record sampling	Government Skills Australia
NWP226B	Prepare and restore work site	Government Skills Australia
NWP227B	Control vegetation on a site	Government Skills Australia
NWP229B	Repair minor structures	Government Skills Australia
NWP243B	Operate bore fields and groundwater source systems	Government Skills Australia
NWP245B	Maintain tanks and water storage assets	Government Skills Australia
NWP247A	Maintain catchment and surrounding areas	Government Skills Australia
NWP253B	Install and repair water services	Government Skills Australia
NWP255B	Maintain and repair wastewater collection assets	Government Skills Australia
NWP256B	Monitor and report water	Government Skills Australia

Code	Title	Origin
	distribution systems	
NWP257B	Maintain and repair wastewater collection systems	Government Skills Australia
NWP259B	Operate, monitor and maintain pump stations	Government Skills Australia
NWP260A	Monitor and report water treatment processes	Government Skills Australia
NWP261A	Operate and maintain water treatment plant and equipment	Government Skills Australia
NWP262A	Monitor and report wastewater treatment processes	Government Skills Australia
NWP263A	Monitor and report wastewater treatment plant and Equipment	Government Skills Australia
NWP268B	Monitor, operate and report chlorine disinfection systems	Government Skills Australia
PMBQUAL390A	Solve problems using 'quality tools'	Manufacturing Skills Australia
RIIRAI601A	Establish and maintain the site infrastructure and fixed plant systems	Resources and Infrastructure
RIIRAI609A	Establish and maintain electrical installations, reticulation and protection system	Resources and Infrastructure
TLIB3407B	Maintain poles and associated hardware	Transport and Logistics
TLIB4007B	Inspect poles and associated hardware	Transport and Logistics
TLIB4807B	Carry out off-site repair, overhaul and assembly of mechanical signalling equipment	Transport and Logistics
TLIB5007B	Maintain remote control and non-vital interlocking control systems	Transport and Logistics

Code	Title	Origin
TLIB5107B	Maintain power signalling and protected level crossing equipment	Transport and Logistics
TLIB5207B	Maintain on-site power operated point activating devices	Transport and Logistics
TLIB5307B	Maintain mechanical signalling locking and interlocking devices	Transport and Logistics
TLIB5407B	Install and maintain track circuit equipment	Transport and Logistics
TLIB5507B	Maintain computer based and solid state interlocking equipment	Transport and Logistics
TLIB5607B	Conduct route testing of new signal cables/line route	Transport and Logistics
TLIB5707B	Perform cable system test	Transport and Logistics
TLIB5807B	Maintain aerial signal/telecommunications lines and cables	Transport and Logistics
TLIB5907B	Assemble and wire internal electrical signalling equipment	Transport and Logistics
TLIB6207B	Install and maintain track circuit leads and bonds	Transport and Logistics
TLIB6307B	Maintain electronic signalling and communications systems	Transport and Logistics
TLIB6407B	Maintain electronic switched and micro processor-based remote control systems	Transport and Logistics
TLIB6507B	Install and maintain transmission interface equipment	Transport and Logistics

Code	Title	Origin
TLIB6607B	Install and maintain signalling power supplies	Transport and Logistics
TLIB6707B	Install and maintain power operated signalling equipment	Transport and Logistics
TLIB6807B	Repair power operated signalling equipment in a workshop	Transport and Logistics
TLIB6907B	Maintain power signalling and protective relay interlocking systems	Transport and Logistics
TLID3507C	Operate a boom type elevating work platform	Transport and Logistics
TLILIC508A	Licence to operate a boom-type elevating work platform (boom length 11 meters or moer)	Transport and Logistics
TLIS507B	Install mechanical infrastructure for signalling	Transport and Logistics
TLIS807B	Decommission electrical and electromechanical signalling infrastructure equipment from service	Transport and Logistics
TLIS907B	Install mechanical signalling locking and interlocking devices	Transport and Logistics
TLIS1007B	Test and commission power signalling and protected level crossing equipment	Transport and Logistics
TLIS1107B	Install and test computer based and solid state interlocking equipment	Transport and Logistics
TLIX1107B	Install overhead wiring structure	Transport and Logistics
TLIX1607B	Erect and mount structures and	Transport and Logistics

Code	Title	Origin
	housings for signalling equipment	
UEPOPS234A	Perform routine oxyacetylene (fuel gas) welding (OAW)	EE-Oz Training Standards
UEPOPS235A	Perform routine manual arc welding	EE-Oz Training Standards
UEPOPS236A	Perform manual heating, thermal cutting and gouging	EE-Oz Training Standards
UETTDRI04B	Perform high voltage field switching operation to a given schedule	EE-Oz Training Standards

1.3.00 Assessment Guidelines

Volume 1 Part 3

Assessment Guidelines

1.3.01 Introduction

3.1 Introduction

These Assessment Guidelines provide the endorsed framework for assessment of the units of competency in this Training Package. They are designed to ensure that assessment is consistent with the current Australian Quality Training Framework *Australian Quality Training Framework (AQTF) Essential Standards for Initial and Continuing Registration*. Assessments against the competency standard units in this Training Package must be carried out in accordance with these Assessment Guidelines.

Note:

- Using this guideline to support any assessment strategy or process does not remove the responsibility of employers and employees to ensure appropriate 'duty of care' arrangements are maintained under relevant occupational health and safety legislation, and any other prevailing legislation, regulation, standard or code. RTOs should recognise this in their assessment processes and provide requisite advice.

2. In the assessment process it should be acknowledged that State/Territory regulatory requirements and/or Codes of Practice may vary. Therefore there may be a requirement for the demonstration of a greater range of items to those specified in respective Competency Standard Units. RTOs should incorporate this in their assessment processes and practices.

1.3.02 Assessment System Overview

3.2 Assessment System Overview

This section provides an overview of the requirements for assessment when using this Training Package, including a summary of the AQTF requirements; licensing/registration requirements; and assessment pathways. By way of supporting, and reinforcing, both the concept of competency and the competency standard unit, the Electrotechnology Industry embraces the following principles:

- Wherever practicable, summative (or final) assessment is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment.
- All persons may claim formal recognition for an assessment of an individual competency standard unit or a group of units.
- All persons have the right to have relevant competencies recognised through the most expeditious assessment system and method.

Quality assessment underpins the credibility of the vocational education and training sector. The Assessment Guidelines of a Training Package are an important tool in supporting quality assessment.

Assessment within the National Skills Framework is the process of collecting evidence and making judgements about whether competency has been achieved to confirm whether an individual can perform to the standards expected in the workplace, as expressed in the relevant endorsed unit of competency.

Assessment must be carried out in accordance with the:

- benchmarks for assessment
- specific industry requirements [where industry specific requirements are adequately covered by the Training Package Assessment Guidelines Mandatory Text, this dot point should be deleted]
- principles of assessment
- rules of evidence
- assessment requirements set out in the AQTF

1.3.03 Assessment Principles within the Electrotechnology Industry

3.3 Assessment Principles within the Electrotechnology Industry

Assessment Judgments

Attributing Competency

The deeming of competency shall be based on evidence that is sufficient, valid, current and authentic, so that a quality, low risk judgment can be made based on these assessment guidelines.

Competencies shall be deemed on evidence showing that the person is able to undertake the responsibilities for all safety measures, care of technology, plant and equipment, use of standards, manuals and procedures, and care of the environment, directly related to the work function for which such competencies are required.

Note:

1. Where the consequences of incorrectly deeming a person competent carries a risk of injury to persons, commerce, or damage to property and/or the environment, the level of evidence required for sufficiency is higher than where there is little risk. The risk of attributing competence to an individual should, therefore, form a critical part of the assessment process and methodology. All prerequisites and/or co-requisites must have been achieved.
2. The decision to attribute competence differs from training effort and delivery. The decision to attribute competence is based on evidence being present for an assessor to properly make that decision, including the prerequisite conditions. Learners can undertake training in competency standard units even when they may not have acquired any of the prerequisite competency standard units. The learners cannot be attributed any competency standard unit until they have acquired the prerequisites and met all of the conditions of the unit.
3. For more detailed information refer to Section 3.9 Guide to Assessment Methods and Items.

Principles of Assessment

All assessments carried out by RTOs are required to demonstrate compliance with the principles of assessment:

- Validity
- Reliability
- Flexibility
- Fairness
- Sufficiency

These principles must be addressed in the:

- design, establishment and management of the assessment system for this Training Package
- development of assessment tools, and
- the conduct of assessment.

Validity

Assessment is valid when the process is sound and assesses what it claims to assess. Validity requires that:

- a) assessment against the units of competency must cover the broad range of skills and knowledge that are essential to competent performance
- b) assessment of knowledge and skills must be integrated with their practical application
- c) judgement of competence must be based on sufficient evidence (that is, evidence gathered on a number of occasions and in a range of contexts using different assessment methods). The specific evidence requirements of each unit of competency provide advice on sufficiency

Reliability

Reliability refers to the degree to which evidence presented for assessment is consistently interpreted and results in consistent assessment outcomes. Reliability requires the assessor to have the required competencies in assessment and relevant vocational competencies (or to assess in conjunction with someone who has the vocational competencies). It can only be achieved when assessors share a common interpretation of the assessment requirements of the unit(s) being assessed.

Flexibility

To be flexible, assessment should reflect the candidate's needs; provide for recognition of competencies no matter how, where or when they have been acquired; draw on a range of methods appropriate to the context, competency and the candidate; and support continuous competency development.

Fairness

Fairness in assessment requires consideration of the individual candidate's needs and characteristics, and any reasonable adjustments that need to be applied to take account of them. It requires clear communication between the assessor and the candidate to ensure that the candidate is fully informed about, understands and is able to participate in, the assessment process, and agrees that the process is appropriate. It also includes an opportunity for the person being assessed to challenge the result of the assessment and to be reassessed if necessary.

Sufficiency

Sufficiency relates to the quality and quantity of evidence assessed. It requires collection of enough appropriate evidence to ensure that all aspects of competency have been satisfied and that competency can be demonstrated repeatedly. Supplementary sources of evidence may be necessary. The specific evidence requirements of each unit of competency provide advice on sufficiency. Sufficiency is also one of the rules of evidence.

Current

In assessment, currency relates to the age of the evidence presented by a candidate to demonstrate that they are still competent. Competency requires demonstration of current performance, so the evidence collected must be from either the present or the very recent past.

The principle to be applied in the Electrotechnology Industry when determining currency of evidence is that claims are to be fully substantiated through both direct and indirect assessment processes.

Assessment processes ensure the candidate is current in terms of knowledge of the technology and/or processes and in the recency of application of the knowledge and skills.

Regulatory Context of Assessment

The determination of competency is to be based on evidence of having consistently performed autonomously and to requirements across a representative range of specified equipment, processes and activities for the scope of work and/or endorsement for which competency is being sought. Evidence from a number of sources is acceptable, including formal assessment.

With respect to the essential knowledge and associated skills (EKAS) component of each competency standard unit, assessment activities shall be in accordance with the approach required by the regulatory environment. This may include the use of industry supported essential knowledge and associated skills knowledge and skills specifications intended to ensure the depth and breadth of learning results in appropriate retention of the skills and knowledge and to enhance transferability.

Percentile-based graded assessment and reporting may be required by some jurisdictions in the regulatory environment. Where this is a requirement it will apply to the EKAS component and not the competency standard unit as a whole. RTOs should ensure that assessment is consistent with licensing/registration requirements. The latest information on licensing/registration requirements may be obtained by contacting the relevant Regulator or visiting the Electrical Regulatory Authorities Council (ERAC) website <http://www.erac.gov.au/>

It is preferred that assessing competency occurs in the workplace; however it can be undertaken in a simulated work environment approved for that purpose.

Rules of Evidence

The rules of evidence guide the collection of evidence that address the principles of validity and reliability, guiding the collection of evidence to ensure that it is valid, sufficient, current and authentic.

Valid

Valid evidence must relate directly to the requirements of the unit of competency. In ensuring evidence is valid, assessors must ensure that the evidence collected supports demonstration of the outcomes and performance requirements of the unit of competency together with the knowledge and skills necessary for competent performance. Valid evidence must encapsulate the breadth and depth of the unit of competency, which will necessitate using a number of different assessment methods.

Sufficient

Sufficiency relates to the quality and quantity of evidence assessed. It requires collection of enough appropriate evidence to ensure that all aspects of competency have been satisfied and that competency can be demonstrated repeatedly. Supplementary sources of evidence may be necessary. The specific evidence requirements of each unit of competency provide advice on sufficiency.

Sufficiency of Evidence

In all instances competency is to be attributed on evidence sufficient to show that a person has the necessary skills required for the scope of work. These include:

Task skills – performing individual tasks

Task management skills – managing a number of different tasks

Contingency management skills – responding to irregularities and breakdowns in routines

Job/role environment skills – dealing with the responsibilities and expectations of the work environment including working with others.

Evidence must demonstrate that an individual can perform competently across the specified range of activities and has the essential knowledge, understanding and associated skills underpinning the competency.

Current

In assessment, currency relates to the age of the evidence presented by a candidate to demonstrate that they are still competent. Competency requires demonstration of current performance, so the evidence collected must be from either the present or the very recent past.

Currency of Evidence

Evidence must be relevant to what is outlined in current competency standard units.

Note: The deeming of competence at a point in time does not mean that competence exists for all time; competency must be maintained by use and/or retraining. Refer also to Section 3.9 ‘Guide to Assessment Methods and Items’ for more detailed information on currency.

Recent changes in technology are unlikely to be properly supported by evidence pre-dating the changes. Similarly, if the individual claiming competency has not performed/applied the competency for extensive periods of time, documentary evidence would not be sufficient.

Authentic

To accept evidence as authentic, an assessor must be assured that the evidence presented for assessment is the candidate's own work

Authenticity

Evidence is to be genuine and related to the person being assessed and no one else.

By way of supporting and reinforcing both the concept of competency and the competency standard units as the currency for Vocational Education **and** Training (VET) system, the Electrotechnology Industry embraces the following:

- Assessment (summative or final) is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment.
- Simulation must be in accord with any prevailing industry policy. It is recognised that in some circumstances, assessment may occur outside the workplace; however this should only occur where necessary and must be in accord with industry and regulatory policy. In relation to this Training Package the Industry Skills Council for ElectroComms and EnergyUtilities, EE-Oz Training Standards, has developed an Industry Simulation Policy. This can be accessed from the EE-Oz Training Standards website at: www.ee-oz.com.au.
- All **persons** may claim formal recognition for an assessment of an individual competency standard unit or a group of units.
- All **persons** have the right to have relevant competencies recognised through the most expeditious assessment system and method.
- Under-**represented** groups are not biased from participation and access.

Assessment Requirements of the Australian Quality Training Framework

Assessment leading to nationally recognised AQF qualifications and Statements of Attainment in the vocational education and training sector must meet the requirements of the AQTF as expressed in the AQTF 2010 Essential Standards for Registration.

The AQTF 2010 Essential Standards for Initial and Continuing Registration can be downloaded from <www.training.com.au>.

The following points summarise the assessment requirements.

Registration of Training Organisations

Assessment must be conducted by or on behalf of a Registered Training Organisation (RTO) formally registered by a State/Territory registering/course accrediting body in accordance with the AQTF. The RTO must have the specific competency standard units and/or AQF qualifications on its scope of registration.

The RTO is responsible for all aspects of assessment. The assessment must cover the critical aspects of evidence (assessment) detailed in each unit. In addressing these critical aspects, and maintaining reasonable consistency, the assessment is to ensure that:

- the individual satisfies the requirements in terms of underpinning/essential knowledge and associated skills so that their ability to transfer the competency to differing circumstances may reasonably be inferred
- the individual is competent to safely perform all the practical applications required.

The RTO is also responsible for issuing formal recognition in the form of National Qualifications or Statements of Attainment and, where regulatory requirements apply, providing the required additional information, and, where applicable and preferred by industry, entering relevant information into an individual *Industry Skills Passport* or other industry approved instrument. In discharging these responsibilities the RTO will:

- issue the National Qualification based on individuals having been assessed as competent for the qualification and all the competency standard units which constitute the qualification, **and/or**
- issue formal recognition (Statements of Attainment) in respect of individual or sets of competency standard units for which candidates have been assessed and found competent, **and/or**
- where required for regulated or industry purposes, issue additional formal information as specified by the industry and relevant regulator.

Consistent with the criteria established by State Training Authorities, RTOs are responsible for the implementation of the quality assurance arrangements included in these guidelines.

Quality Training and Assessment

Each RTO must provide quality training and assessment across all its operations. See the AQTF 2010 Essential Standards for Initial and Continuing Registration, Standard 1.

Assessor Competency Requirements

Each person involved in training and assessment must be competent for the functions they perform. See the AQTF 2010 Essential Standards for Initial and Continuing Registration, Standard 1 for assessor (and trainer) competency requirements. See also the AQTF 2010 Users' Guide to the Essential Standards for Registration – Appendix 2.

Assessment Requirements

The RTO assessments, including RPL, must meet the requirements of the relevant endorsed Training Package. See the AQTF 2010 *Essential Standards for Initial and Continuing Registration*.

Assessment Strategies

Each RTO must have strategies for training and assessment that meet the requirements of the relevant Training Package or accredited course and are developed in consultation with industry stakeholders. See the AQTF 2010 *Essential Standards for Initial and Continuing Registration*.

National Recognition

Each RTO must recognise the AQF qualifications and Statements of Attainment issued by any other RTO. See the AQTF 2010 *Essential Standards for Initial and Continuing Registration*, RTOs may contact the EE-Oz Training Standards as the declared National Industry Skills Council for the ElectroComms and EnergyUtilities Industry, for assistance with national recognition.

Access and Equity and Client Outcomes

Each RTO must adhere to the principles of access and equity and maximise outcomes for its clients. See AQTF 2010 *Essential Standards for Initial and Continuing Registration*.

Monitoring Assessments

Training and/or assessment provided on behalf of the RTO must be monitored to ensure that it is in accordance with all aspects of the AQTF 2010 Essential Standards for Initial and Continuing Registration.

Recording Assessment Outcomes

Each RTO must manage records to ensure their accuracy and integrity. See the AQTF 2010 Essential Standards for Initial and Continuing Registration.

Partnership Arrangements

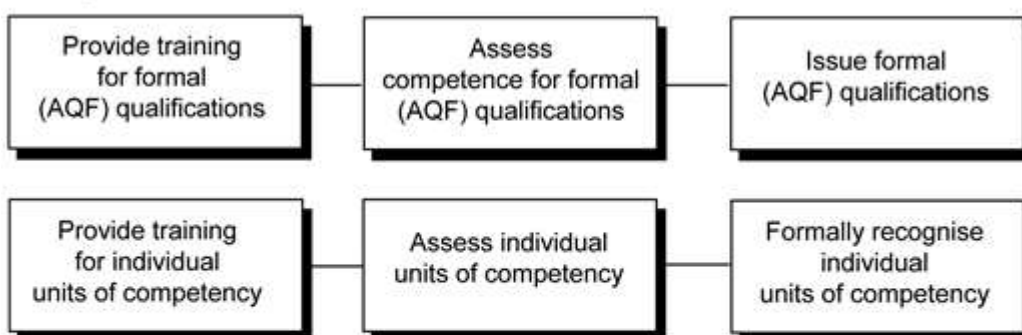
An RTO must have, and comply with, written agreements with each organisation providing training and/or assessment on its behalf.

RTOs operating in partnership with other organisations are responsible for the quality of the partnering organisation services and service outcomes. Under the AQTF, RTOs may enter into partnerships with external and/or non-registered third party organisations, such as schools, industry organisations and enterprises, for delivery and assessment within the RTOs scope of registration.

External and/or non-registered third party organisations do not have to be Registered Training Organisations; however, the agreement must specify how each party to the agreement will discharge its responsibilities for compliance with all aspects of the Standards for Registered Training Organisations.

Roles for Registered Training Organisations

Training and assessment:



Assessment only:



Where the RTO establishes a partnership arrangement it must have a formal agreement with the organisation that provides the training and/or assessment services. This agreement must specify how all parties will discharge their responsibilities for ensuring the quality of the training and/or assessment conducted on its behalf, including the qualification requirements of those to be involved in delivery and assessment. The RTO has full responsibility for the quality and outcomes of any training or assessment conducted on its behalf, and must maintain a register of all such agreements.

Issuing AQF Qualifications and Statements of Attainment

Each RTO must issue AQF qualifications and Statements of Attainment that meet the requirements of the AQF Implementation Handbook and the endorsed Training Packages within the scope of its registration. An AQF qualification is issued once the full requirements for a qualification, as specified in the nationally endorsed Training Package are met. A Statement of Attainment is issued where the individual has completed one or more units of competency from nationally recognised qualification(s)/course(s). See the AQTF and the current edition of the AQF Implementation Handbook - available on the AQFC website www.aqf.edu.au.

Licensing/Registration Requirements

This section provides information on licensing/registration requirements for this Training Package, with the following important disclaimer.

Licensing and registration requirements that apply to specific industries, and vocational education and training, vary between each State and Territory, and can regularly change. The developers of this Training Package consider that the licensing/registration requirements described in this section apply to RTOs, assessors or candidates with respect to this Training Package. While reasonable care has been taken in its preparation, the developers of this Training Package and the Department cannot guarantee that the list is definitive or accurate at the time of reading; the information in this section is provided in good faith on that basis.

Statutory/Regulatory requirements may apply at the qualification, Skill Set or individual unit level. Where a component has a regulatory requirement it is identified in the following sections:

- Competency Standard – Unit Descriptor 1.2) License to practice
- Identified Skill Set – Target Group
- Qualification – Scope

Contact the relevant State or Territory Department(s) to check if the licensing/registration requirements described below still apply, and to check if there are any others with which you must comply. For further information contact:

Current information on national and jurisdictional licensing requirements can be obtained from:

<http://www.licensinglinenews.com/> or the relevant authority in their jurisdiction

State Electrical Regulatory Bodies		
Jurisdiction	Organisation	Website
Australian Capital Territory	ACT Planning and Land Authority	www.actpla.act.gov.au
New South Wales	Office of Fair Trading	www.fairtrading.nsw.gov.au
Northern Territory	Electrical Workers and Contractors Licensing Board	www.electricallicensing.nt.gov.au
Queensland	Department of Employment and Industrial Relations	www.deir.qld.gov.au
South Australia	Office of Consumer and Business Affairs	www.ocba.sa.gov.au
Tasmania	Workplace Standards Tasmania	www.wst.tas.gov.au
Victoria	Energy Safe Victoria	www.esv.vic.gov.au
Western Australia	Department of Consumer and Employment Protection	www.energysafety.wa.gov.au

Statutory Authorities		
Jurisdiction	Organisation	Website
Australia	australia.gov.au	www.australia.gov.au/306
Australian Capital Territory	ACT Legislation Register	www.legislation.act.gov.au
New South Wales	Parliamentary Counsel's Office	www.legislation.nsw.gov.au

Northern Territory	Department of the Chief Minister	www.nt.gov.au/dcm/legislation/current.html
Queensland	Office of the Queensland Parliamentary Counsel	www.legislation.qld.gov.au/oqpchome.htm
South Australia	Parliament of South Australia	www.legislation.sa.gov.au
Tasmania	Tasmanian Legislation	www.thelaw.tas.gov.au/index.w3p
Victoria	Victorian Legislation and Parliamentary Documents	www.legislation.vic.gov.au
Western Australia	State Law Publisher	www.slp.wa.gov.au

Requirements for Assessors

In order to conduct assessment for statutory licensing or other industry registration requirements, assessors must meet the requirements established by regulatory agencies and respective nominees, in addition to the AQTF requirements. Assessors are to liaise with relevant agencies to ensure all requirements are met.

Where regulatory requirements are stated in the relevant sections of a Qualification, Unit or Skill Set, trainers and assessors shall have a current, equivalent licence, registration or permit to work for the jurisdiction in which the training and/or assessment takes place.

Please refer to the bodies listed above for details of jurisdictional regulatory requirements.

Requirements for RTOs

Selected competency standard units and qualifications in this Training Package provide the basis for a range of statutory licensing and industry registration arrangements. To satisfy these licensing and registration arrangements, RTOs are to keep abreast of developments and any additional requirements detailed by those bodies and their nominees. RTOs and their assessors are therefore required to liaise with the Training Package developer and relevant agencies to ensure requirements are known and met.

Requirements for Candidates

Individuals being assessed under statutory licensing and industry registration systems may be required to comply with training and experience requirements additional to any minimum requirements identified in this Training Package. RTOs are to formally advise individuals of these additional requirements prior to the delivery of the Training Package outcomes.

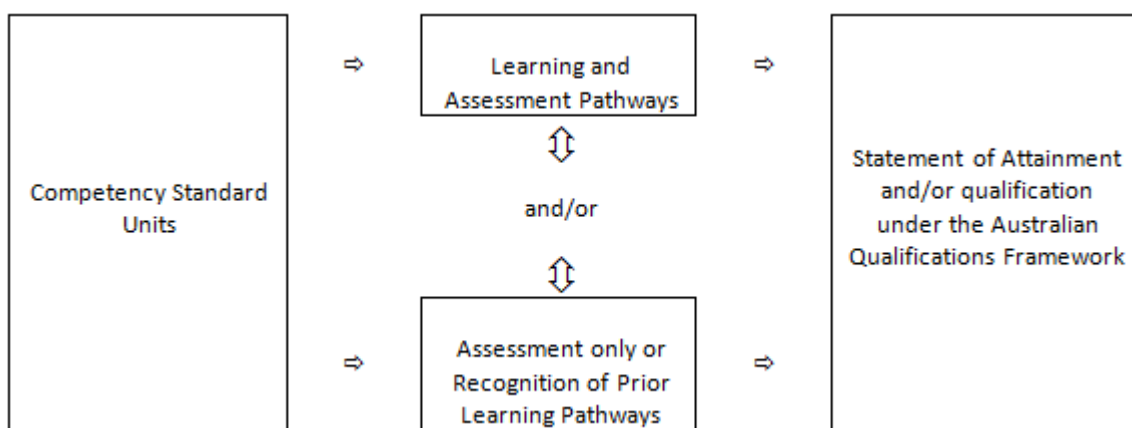
1.3.04 Pathways

3.4 Pathways

The competencies in this Training Package may be attained in a number of ways including through:

- formal or informal education and training
- experiences in the workplace
- general life experience and/or
- any combination of the above.

Assessment under Training Packages leading to an AQF qualification or Statement of Attainment may follow a learning and assessment pathway, an assessment-only or recognition pathway or a combination of the two as illustrated below.



Each of these assessment pathways leads to full recognition of competencies held – the critical issue is that the candidate is competent, not how the competency was acquired.

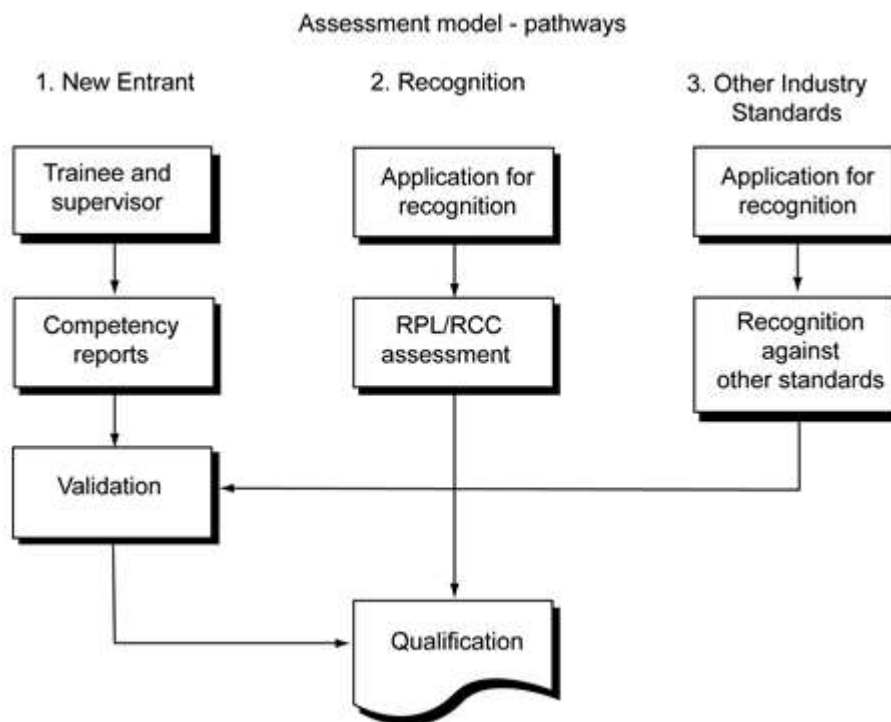
Assessment, by any pathway, must comply with the assessment requirements set out in the Assessment Guidelines of the Training Package and the AQTF.

Within the general Training Package Pathways framework three distinct Assessment Pathways have been identified for use within the Electrotechnology Industry.

Pathway 1: New entrant competency development

Pathway 2: Recognition of currently held competencies or prior learning and workplace experience

Pathway 3: Recognition of other currently held competencies (other industry standards)



Although not exclusive, the three pathways provide typical recognition processes for individual competency standard units or groups of units that make up Qualifications or Statements of Attainment.

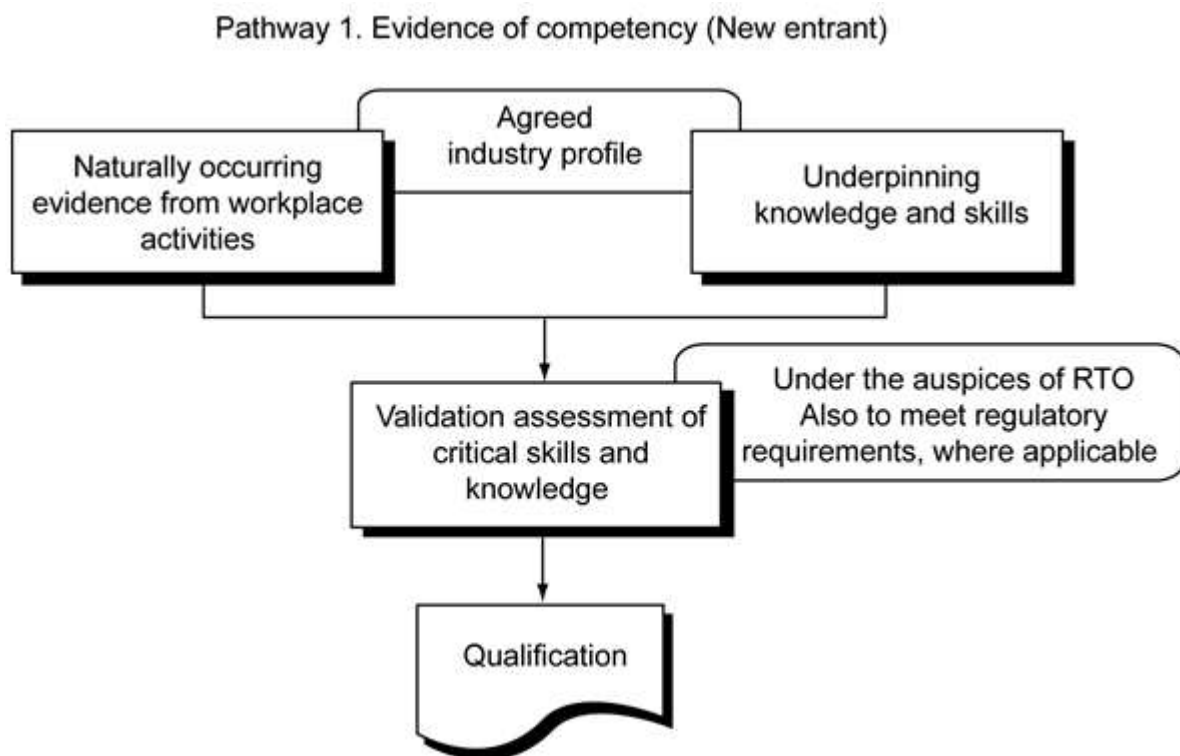
Pathway 1: New Entrant Competency Development

This pathway is for individuals who are undertaking an industry-preferred competency development plan. The users of this pathway may be:

- contracted employment based employees who are generally Australian Apprentices and who undertake an approved training program that supports a competency development plan, **or**
- those who undertake an approved structured training program in an institutional environment to achieve competency outcomes.

Evidence of Competency

In Pathway 1 evidence required to determine competence for the issuance of the qualification or Statement of Attainment is to be in accordance with the later section **3.4 Assessment principles within the Electrotechnology Industry**. The evidence however, must be sufficient in quality, quantity and type and be gathered in an on-going basis in a timely and accurate manner from several sources, such as, workplace and educational experiences based on the approved industry training program and related competency development plan in which individuals are involved.



Pathway 2: Recognition of prior learning/current competencies (RPL/RCC)

This pathway is for those who may have acquired skills and knowledge in relevant competency standard units outside formally recognised processes. The users of this pathway will include applicants from overseas and also applicants who have developed skills in allied industries but who have no formal recognition in respect of industry standards or qualifications. In using this pathway RTOs should also identify if any equivalence mapping document exists as per Pathway 3.

An existing national mechanism for recognition as a tradesperson exists under the *Tradesmen's Rights Regulation Act*, which is administered by *Trades Recognition Australia (TRA)* – part of the *Commonwealth Department of Industrial Relations*. TRA grants recognition for the purposes of migration but further analysis of the applicant's knowledge and skills is often needed before competency can be attributed.

The TRA process mainly operates to provide formal recognition of the knowledge and skills migrants possess as a result of structured training and/or work experience in overseas countries. However, it is also an important mechanism for the assessment and recognition of the competencies of those who may not have had access to the industry-preferred new entrant model of competency development for trade vocations in Australia. For further information on these requirements visit:

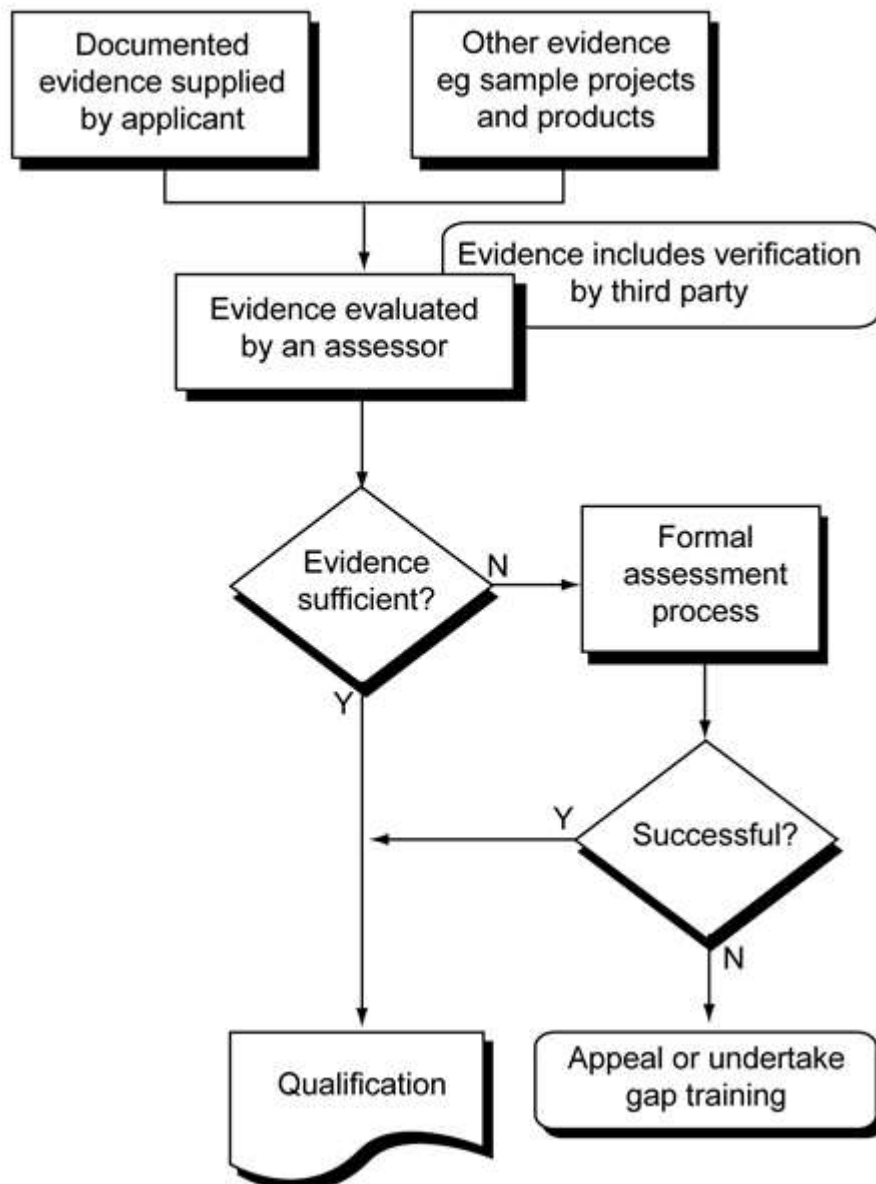
<http://www.workplace.gov.au/workplace/Category/SchemesInitiatives/TRA/TRA-TradeClassificationsAssessed.htm>

Evidence of Competency

In Pathway 2 many types of evidence can be used to determine competency for the issuance of qualifications or Statements of Attainment. The evidence may come from records of previous relevant work experience. This type of evidence will need endorsement by a supervisor/mentor skilled in the units for which recognition is sought. Evidence may consist of portfolios such as projects or products completed for other purposes, or from non-registered training programs or ad hoc prior experience, or from overseas programs of a similar nature.

Industry would expect this evidence to be assessed by the RTO (or its nominee – a qualified industry assessor). The result will be that the applicant is judged competent for the competency standard unit(s) or gaps are identified and noted. Where a gap is identified, the applicant can either accept the judgement and pursue gap training or elect to appeal the decision. Evidence used in the appeal process may include a personal portfolio, relevant work history, interview, comments by peers or employers, and challenge tests.

Pathway 2. Recognition (RPL/RCC)

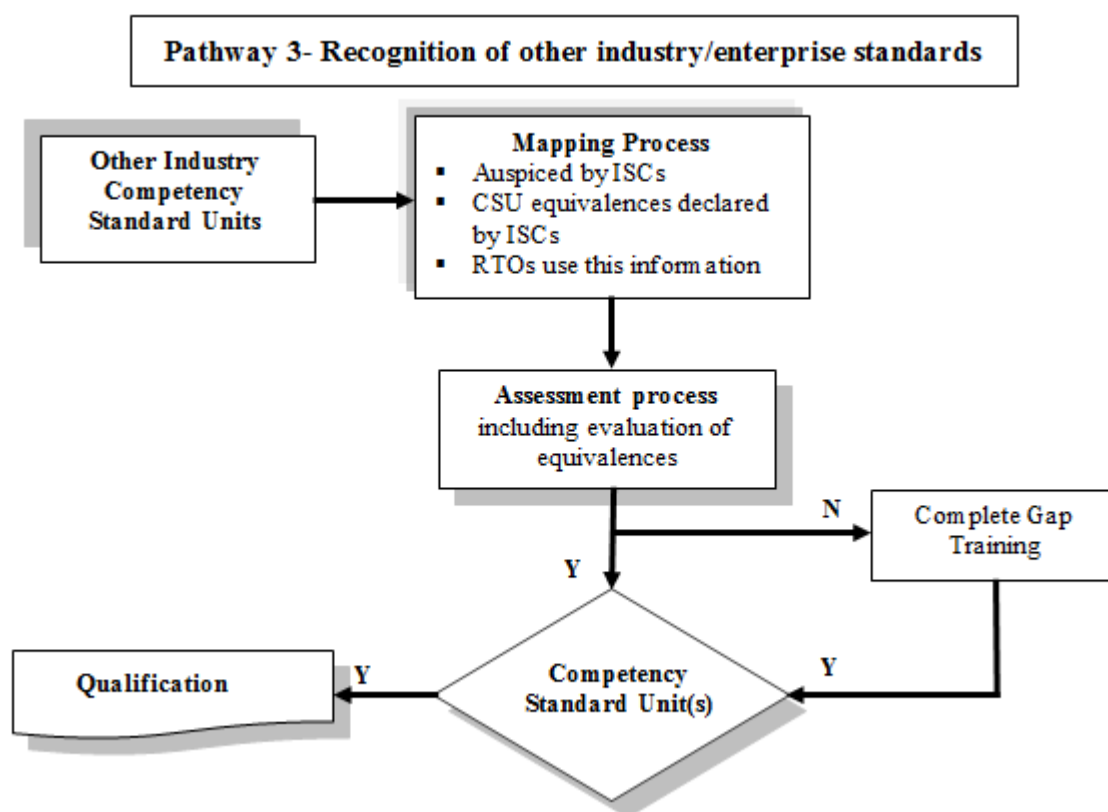


Pathway 3: Recognition of Other Industry/Enterprise Standards

This pathway is for individuals who have developed skills based on other nationally recognised industry or enterprise competency standards and who have received formal recognition in competency standard unit(s) from these areas. Recognition of equivalence of competency standard units between industries is through an agreed and formal mapping process. Equivalence of outcomes is declared by Industry Skills Councils for the relevant Training Packages. The recognition of units, as part of any mapping arrangements is the responsibility of the parties maintaining those competency standards. RTOs should investigate whether any mapping agreements are in place by contacting the relevant Industry Skills Councils.

Evidence of Competency

The applicant is required to supply details of the unit(s) held, their currency, and the unit(s) sought. This includes submitting any assessment reports to the RTO for a determination. This evidence will be reviewed against the mapping advice obtained by the RTO (or their nominee) and a judgement made. The result will be that the applicant is deemed competent for the unit(s) and a Statement of Attainment issued, or gaps are identified, advised and noted. Where a gap has been identified the applicant can consider the judgement and either pursue gap training or appeal the decision. Evidence used in the appeal process is based on the individual's records of achievement relative to the competency standard units for which recognition is sought.



Learning and Assessment Pathways

New Entrants

Usually, learning and assessment are integrated, with assessment evidence being collected and feedback provided to the candidate at any time throughout the learning and assessment process.

Learning and assessment pathways may include structured programs in a variety of contexts using a range of strategies to meet different learner needs. Structured learning and assessment programs could be group-based, work-based, project-based, self-paced, action learning-based; conducted by distance or e-learning; and/or involve practice and experience in the workplace.

Learning and assessment pathways to suit Australian Apprenticeships have a mix of formal training and structured workplace experience with formative assessment activities through which candidates can acquire and demonstrate skills and knowledge from the relevant units of competency.

The pathway must take into account:

- irregular work activity
- work availability as it effects access to the range of activities required to be covered
- structured formative assessment activities which demonstrate to the candidate and assessor the current strengths and weaknesses of the candidate
- summative assessments for the purpose of deeming competence

The model that best accommodates a new entrant with no prior experience is one that recognises that learning is best facilitated in a structured educational program with directed workplace activities followed by recurring practice of these activities. That is, the model is based on a combination of on-the-job and off-the-job learning experiences aligned to competency standard unit requirements. It recognises that learning occurs in an active way and should involve appropriate learning strategies. The model provides coherence and integration between respective components. It also represents a:

- most effective and efficient means of effecting quality education and training
- means of assessing if learning has occurred and competence has been attained.

Competency standard units are specifications of work performance but they do not specify how training or assessment activities are to be carried out. Given the nature of the information contained within the competency standard units (content and its interrelationships) there is the potential for a variety of interpretations to occur when RTOs are designing training programs.

To improve opportunities for consistency in interpretation the industry preferred approach is to support the use of appropriate learning and assessment strategies. To this end it has developed a Guideline Training and Assessment Model detailing the preferred approach. A copy of the model is available from EE-Oz Training Standards.

Credit Pathways

Credit is the value assigned for the recognition of equivalence in content between different types of learning and/or qualifications which reduces the volume of learning required to achieve a qualification.

Credit arrangements must be offered by all RTOs that offer Training Package qualifications. Each RTO must have a systematic institutional approach with clear, accessible and transparent policies and procedures.

Competencies already held by individuals can be formally assessed against the competency standard units in this Training Package and should be recognised regardless of how, when or where they were achieved.

Recognition of Prior Learning

Recognition of Prior Learning (RPL) is an assessment process which determines the credit outcomes of an individual application for credit.

The availability of Recognition of Prior Learning (RPL) provides all potential learners with access to credit opportunities.

The recognition of prior learning pathway is appropriate for candidates who have previously attained skills and knowledge and who, when enrolling in qualifications, seek to shorten the duration of their training and either continue or commence working. This may include the following groups of people:

- existing workers;
- individuals with overseas qualifications;
- recent migrants with established work histories;
- people returning to the workplace; and
- people with disabilities or injuries requiring a change in career.

As with all assessment, RPL assessment should be undertaken by academic or teaching staff with expertise in the subject, content of skills area, as well as knowledge of and expertise in RPL assessment policies and procedures.

Assessment methods used for RPL should provide a range of ways for individuals to demonstrate that they have met the required outcomes and can be granted credit. These might include:

- questioning (oral or written)
- consideration of a portfolio and review of contents
- consideration of third party reports and/or other documentation such as documentation such as articles, reports, project material, papers, testimonials or other products prepared by the RPL applicant that relate to the learning outcomes of the relevant qualification component

- mapping of learning outcomes from prior formal or non-formal learning to the relevant qualification components
- observation of performance, and
- participation in structured assessment activities the individual would normally be required to undertake if they were enrolled in the qualification component/s.

In a Recognition of Prior Learning (RPL) pathway, the candidate provides current, quality evidence of their competency against the relevant unit of competency. This process may be directed by the candidate and verified by the assessor. Where the outcomes of this process indicate that the candidate is competent, structured training is not required. The RPL requirements of the AQTF must be met.

As with all assessment, the assessor must be confident that the evidence indicates that the candidate is currently competent against the endorsed unit of competency. This evidence may take a variety of forms and might include certification, references from past employers, testimonials from clients, work samples and/or observation of the candidate. The onus is on candidates to provide sufficient evidence to satisfy assessors that they currently hold the relevant competencies. In judging evidence, the assessor must ensure that the evidence of prior learning is:

- authentic (the candidate's own work);
- valid (directly related to the current version of the relevant endorsed unit of competency);
- reliable (shows that the candidate consistently meets the endorsed unit of competency);
- current (reflects the candidate's current capacity to perform the aspect of the work covered by the endorsed unit of competency); and
- sufficient (covers the full range of elements in the relevant unit of competency and addresses the four dimensions of competency, namely task skills, task management skills, contingency management skills, and job/role environment skills).

Credit Transfer

Credit transfer is a process which provides learners with agreed and consistent credit outcomes based on equivalences in content between matched qualifications.

This process involves education institutions:

mapping, comparing and evaluating the extent to which the defined learning outcomes and assessment requirements of the individual components of one qualification are equivalent to the learning outcomes and assessment requirements of the individual components of another qualification

making an educational judgment of the credit outcomes to be assigned between the matched components of the two qualifications setting out the agreed credit outcomes in a documented arrangement or agreement, and publicising the arrangement/agreement and credit available.

Assessment-only Pathway or Recognition of Prior Learning Pathway

In some circumstances an assessment-only (skills recognition) pathway will be warranted. The candidate provides current, quality evidence against the relevant unit of competency.

In an assessment-only or Recognition of Prior Learning (RPL) pathway, the candidate provides current, quality evidence of their competency. This process may be directed by the candidate and verified by the assessor, such as in the compilation of portfolios; or directed by the assessor, such as through observation of workplace performance and skills application, and oral and/or written assessment. Where the outcomes of this process indicate that the candidate is competent, structured training is not required. The RPL requirements of the AQTF must be met (Standard 1).

As with all assessment, the assessor must be confident that the evidence indicates that the candidate is currently competent against the endorsed competency standard unit(s). This evidence may take a variety of forms and might include certification, Industry Skills Council equivalence mapping declarations, references from past employers, testimonials from clients and work samples. The onus is on candidates to provide sufficient evidence to satisfy assessors that they currently hold the relevant competencies. In judging evidence, the assessor must ensure that the evidence is:

- authentic (the candidate's own work)
- valid (directly related to the current version of the relevant endorsed Competency Standard Unit)
- reliable (a range of test instruments will provide the same result for a given candidate)
- current (reflect the candidate's current capacity to perform the aspect of the work covered by the endorsed competency standard unit), and
- sufficient (covers the full range of Elements and Performance Criteria in the relevant competency standard unit and addresses the four dimensions of competency, namely task skills, task management skills, con tangency management skills, and job/role environment skills).

An assessment-only or recognition of prior learning pathway is likely to be most appropriate for:

- candidates participating/enrolling in qualifications who want recognition for prior learning of current competencies
- existing workers
- individuals with overseas qualifications
- recent migrants with established work histories
- people returning to the workplace
- people with disabilities or injuries requiring a change in career
- people with existing competencies from allied industry Training Packages.

Note: The pathways listed above are only suggested and should not be used to limit a greater range of candidates seeking assessment.

Combination of 'Training and Assessment' and 'Assessment-only' Pathways

Credit may be awarded on the basis of a combination of credit transfer plus an individual RPL assessment for additional learning. Once credit has been awarded on the basis of RPL, subsequent credit transfer based on these learning outcomes should not include revisiting the RPL assessment but should be based on credit transfer or articulation or other arrangements between providers.

Where candidates for assessment have gained competencies through work and life experience and gaps in their competence are identified, or where they require training in new areas, a combination of approaches may be appropriate.

In such situations, the candidate may undertake an initial assessment to determine their current competence. Once current competence is identified, a structured training and assessment program ensures that the candidate acquires the required additional competencies identified as gaps. These would be achieved through a 'training and assessment pathway'.

1.3.05 Assessment Processes in the Electrotechnology Industry

3.5 Assessment Processes in the Electrotechnology Industry

Within the Electrotechnology Industry **sampling**, **profiling** and **portfolio** are recognised as the three main methods of collecting evidence to assist the assessment processes and, while they are not mandatory, they have become accepted and the preferred industry practice. These guidelines do not provide an extensive technical description of each of these methods; however, it is important to recognise the impact each will have on the management of assessment practices. An overview of each is provided below along with sample templates to assist RTOs in planning, managing and administering training and assessment delivery.

1. Sampling

Sampling requires that evidence of competence be derived from a sample of performances. Application skills are normally assessed by practical measures and knowledge underpinning performance is typically assessed in learning environments such as classrooms, by conventional written or oral questioning.

2. Profiling

Profiling requires the progressive recording of many samples through structured documentation. Progressive monitoring of evidence over an extended period of time is used to guide future experience and making judgements about the developing competency profile of the candidate/learner. The focus of evidence collection is set against the Elements, Range Statement and critical aspects detailed in the competency standard units and are further refined by the level of supervision experienced. The evidence collection process is staged against known and pre-defined work performance outcomes as specified in the competency standard units.

Profiling will assist in obtaining a series of periodical audit assessments and/or a final holistic assessment event when necessary. Technical educational achievements may be incorporated in the profiling model to augment information gathered directly from the workplace.

Profiling using an ElectroComms and Energy Utilities ISC approved system is the industry model for the collection of workplace performance evidence for those undertaking licenced qualifications.

3. Portfolio

The Portfolio approach is best suited to assessment conducted as Recognition of Prior Learning (RPL) and is to be in accord with the current AQTF Standards for RTOs or its replacement/equivalent. It requires the collection or build-up of indirect evidence as to an individual's competence.

The portfolio of evidence could include Statements of Attainment issued by other RTOs (Mutual Recognition AQTF Standard), suitably focused references and testimonials, formal project appraisals, work records and any other evidence which is current and relevant to the competencies sought.

Opportunities for Combined Approaches

The assessment approaches/processes described above may be implemented in combination. The assessment process selected will be acceptable to the industry if:

- the outcome is valid
- the approach supports industry-wide consistency
- the requirements of the competency standard units are satisfied in accordance with the industry expectations
- costs are acceptable to the industry.

1.3.06 Assessor Requirements

3.6 Assessor Requirements

This section identifies the specific requirements on the vocational competence and experience for assessors, to ensure that they meet the needs of industry and their obligations under AQTF, and clarifies how others may contribute to the assessment process where one person alone does not hold all the required competencies.

In such situations, the trainer/assessor candidate may undertake an initial assessment to determine their current competency. Once current competency is identified, a structured learning and assessment program ensures that the candidate acquires the required additional competencies identified as gaps.

The integrity of the Electrotechnology Industry assessment processes is centred on the need for all assessments to be conducted under the direction or the authority of an RTO using qualified assessors who may function with or within the RTO.

The responsibility for some activities may be delegated. For example, in a long term profiling process the qualified assessor may establish the system and identify the evidence to be captured by an industry approved system. Although the evidence is gathered by others the assessor will examine the evidence and make judgments.

Whatever forms of evidence and evidence gathering are used the RTO has full responsibility for the judgements in deeming competence.

Assessor Competencies

The AQTF specifies mandatory competency requirements for assessors. For information, Element 1.4 from the AQTF 2007 Essential Standards for Registration follows:

1.4 Training and assessment are conducted by trainers and assessors who:

- a) have the necessary training and assessment competencies as determined by the National Quality Council or its successors, and
- b) have the relevant vocational competencies at least to the level being delivered or assessed, and
- c) can demonstrate current industry skills directly relevant to the training/assessment being undertaken, and
- d) continue to develop their Vocational Education and Training (VET) knowledge and skills as well as their industry currency and trainer/assessor competence.

* See AQTF 2010 *Users' Guide to the Essential Standards for Registration* – Appendix 2

In this Training Package, assessments against the competencies will be carried out in accordance with the endorsed guidelines. The guidelines include the necessary qualifications for those conducting assessments and provide for those situations where more than one person may contribute to the assessment as occurs when the required technical and assessment competencies are not held by any one person.

Assessors are to be competent in the competencies which they are to assess or are to be assisted by an appropriate subject matter expert who is currently competent in the unit being assessed. This includes language literacy and numeracy (LLN), cultural diversity and under-represented groups, environmental and industrial safety and occupational health and safety (OHS).

Assessors (and their subject matter expert) must know current industry practices for the job or the role against which the performance is being assessed, and must practise the necessary interpersonal skills required in the assessment process.

All persons required to *plan, assess, develop or validate* assessment related matters must be currently competent against the competency standard(s) contained in the Training and Assessment Training Package, and comply with the AQTF Standards for RTOs and comply with the relevant industry vocational competencies.

Using Qualified Assessors

All assessment is to be under the authority of a formally qualified assessor. Within this constraint, the RTO may employ any or all of the following:

- a workplace assessor who is currently competent against the assessor competency standards contained within the Training and Assessment Training Package and the relevant industry vocational competencies.

- a workplace assessor who is currently competent against the assessor competency standards contained within the Training and Assessment Training Package and who has ready access to another person who is competent in, and can advise the assessor on the relevant vocational competencies to at least the level being assessed.
- an assessment panel that includes at least one person who is currently competent against the assessor competency standards contained within the Training and Assessment Training Package as well as at least one person who is competent in the relevant vocational competencies to at least the level being assessed.
- an external assessor who is currently competent against the assessor standards contained within the Training and Assessment Training Package but with the assessment evidence being collected, by a workplace supervisor who has the relevant vocational competencies to at least the level being assessed and is using industry endorsed assessment procedures.
- a workplace supervisor, with the relevant vocational competencies to at least the level being assessed, who uses industry endorsed assessment procedures with the outcome being validated by an externally qualified assessor who is currently competent against the assessor standards contained within the Training and Assessment Training Package.

In relation to the new entrant pathway industry would expect that in all instances the RTO will retain the responsibility of managing the competency development training program and related plan, the ultimate attributing of competence against competency standard units using qualified assessors, and the issuing of qualifications, and/or Statements of Attainment. It will also include providing any additional information that may be required for licensing requirements and specified by regulators or industry.

The process should be undertaken in accordance with the recognition processes defined by relevant training authorities.

Assessor Competencies

The AQTF specifies mandatory competency requirements for assessors. For information, see the AQTF *Essential Standards for Initial and Continuing Registration*. follows:

"1.4 Training and assessments is delivered by trainers and assessors who:

- a) have the necessary training and assessment competencies as determined by the National Quality Council or its successors*
- b) have the relevant vocational competencies at least to the level being delivered or assessed and*
- c) can demonstrate current industry skills directly relevant to the training/assessment being undertaken, and*
- d) continue developing their Vocational Education and Training knowledge and skills as well as their industry currency and trainers/assessor competence."*

The Determination of the National Quality Council 18 December 2009 regarding Training and Assessment competencies to be held by Trainers and Assessors appendix 3 to the AQTF *User Guide for Initial Registration* specifies mandatory competency requirements for Trainers and Assessors:

Trainers must:

- i) hold the Certificate IV in Training and Assessment (TAA40104) from the Training and Assessment Training Package; or
 - ii) be able to demonstrate equivalent competencies; or
 - iii) hold the Certificate IV in Assessment and Workplace Training from the superseded Training Package for Assessment and Workplace Training (BSZ98), or
 - iv) be able to demonstrate that prior to 23 November 2005 they had been assessed as holding equivalent competencies to the Certificate IV in Assessment and Workplace Training from the Training Package for Assessment and Workplace Training (BSZ98); or
 - v) work under the direct supervision* of a person who has the competencies specified in (i) or (ii) or (iii) or (iv) above; and
- be able to demonstrate vocational competencies at least to the level of those being delivered.

Note: Direct supervision is achieved when a person delivering training on behalf of the RTO has regular guidance, support and direction from a person designated by the RTO who has the trainer competencies in (i), (ii), (iii) or (iv) above and who monitors and is accountable for the training delivery. It is not necessary for the supervising person to be present during all training delivery.

All assessors who are engaged in assessing against this Training Package must be engaged by an RTO, or be acting under the registration of an RTO (for example, an assessor working in an enterprise, or as a consultant, that has a partnership arrangement with the RTO).

Assessors must:

- i) hold the following three competencies from the Training and Assessment Training Package (TAA04):
 - (a) TAAASS401A Plan and organise assessment
 - (b) TAAASS402A Assess competence
 - (c) TAAASS404A Participate in assessment validation; or
- ii) be able to demonstrate equivalent competencies to all three units of competency

listed in (i); or

iii) hold the following competencies from the superseded Training Package for Assessment and

Workplace Training (BSZ98):

BSZ401A Plan assessment,

BSZ402A Conduct assessment, and

BSZ403A Review assessment; or

iv) be able to demonstrate that prior to 23 November 2005 they had been assessed as holding equivalent competencies to all three units of competency listed in (iii) above.

Note: If a person does not have the assessment competencies as defined in (i) (ii), (iii) or (iv) above and the relevant vocational competencies at least to the level being assessed, one person with all the assessment competencies listed in (i) (ii), (iii) or (iv) above and one or more persons who have the relevant vocational competencies at least to the level being assessed may work together to conduct the assessments.

Vocational competency

Vocational competency is defined as broad industry knowledge and experience, usually combined with a relevant industry qualification. A person who has vocational competency will be familiar with the content of the vocation and will have relevant current experience in the industry. Vocational competency must be considered on an industry-by-industry basis and with reference to the guidance provided in the Assessment Guidelines of the relevant Training Package.

Training Packages include advice specific to the industry related to the vocational competencies of assessors. This may include advice on relevant industry qualifications and experience required for assessing against the Training Package or for specific qualifications within the package. The Training Package will also provide specific industry advice outlining what it sees as acceptable forms of evidence to demonstrate the maintenance of currency of vocational competency.

This Training Package provides a range of options for meeting these assessor requirements. Assessments can be undertaken in a variety of workplace and enterprise contexts by individual assessors; partnerships involving assessors and technical experts; and teams of assessors.

The options below show how the requirement to use qualified assessors can be met.

Assessors, Technical Experts and Workplace Supervisors

Single assessor – Single arrangement

Where an individual assessor conducts the assessment, the assessor is required to:

- hold formal recognition of competence in the relevant units in the Training Package for Training and Assessment
- be deemed competent and, where possible, hold formal recognition of competence in the specific competency standard units in this Training Package, at least to the level being assessed.

In addition, it is recommended by the industry that the assessor can:

- demonstrate current knowledge of the Electrotechnology Industry, industry practices, and the job or role against which performance is being assessed
- demonstrate current knowledge and skill in assessing against this Training Package in a range of contexts
- demonstrate the necessary interpersonal and communication skills required in the assessment process
- continue to meet the requirements of the industry
- ensure assessment is consistent with the Australian Quality Training Framework Standards for Registered Training Organisations
- promote confidence in the system and the assessment outcomes on the part of industry, employers, enterprises, unions, employees, trainees, assessors and trainers
- ensure assessment processes and outcomes are valid, reliable, fair and flexible
- support RTOs in effectively carrying out their responsibilities
- participate in professional development
- have relevant work experience
- participate in professional/industry networks and assessor programs
- have recent planning and review of assessment activities
- participate in assessment validation processes
- have recent assessment and/or workplace training activities.

Partnership arrangements

Option 1 – Working with a Technical Expert

An assessor works with a technical expert to conduct the assessment. The assessor is required to hold formal recognition of competence in the relevant units in the Training Package for Training and Assessment.

In addition, it is recommended that the assessor is able to:

- demonstrate current knowledge and skill in assessing against this Training Package which contains the vocational standards for industry in a range of contexts
- demonstrate capability to assess with a technical expert

- demonstrate the interpersonal and communication skills required in the assessment process.

A technical expert is someone who is deemed currently competent and, where possible, holds formal recognition of competence in the specific competency standard units from this Training Package, at least to the level being assessed.

In addition, it is recommended that the technical expert is able to:

- demonstrate current knowledge of the industry, industry practices, and the job or role against which performance is being assessed
- communicate and liaise with the assessor throughout the assessment process.

Option 2 – Working with a Workplace Supervisor

An assessor works with workplace supervisor in collecting evidence for valid assessment.

An assessor is required to:

- hold formal recognition of competence in training and assessment in the relevant units in the Training and Assessment Training Package
- make the assessment decision.

In addition, it is recommended that the assessor is able to:

- demonstrate current knowledge and skill in assessing against this Training Package in a range of contexts
- demonstrate a capability to assess using a workplace supervisor as a valid and reliable source of evidence collaboration
- demonstrate interpersonal and communication skills required in the assessment process
- communicate and liaise, where appropriate, with the workplace supervisor throughout the assessment process.

A workplace supervisor is someone who is deemed currently competent and, where possible, holds formal recognition of competence in the specific competency standard units from this Training Package, at least to the level being assessed.

In addition, it is recommended that the workplace supervisor is able to:

- demonstrate current knowledge of the industry, industry practices, and the job or role against which performance is being assessed
- communicate and liaise, where appropriate, with the assessor throughout the assessment process
- use agreed practices to gather and record evidence for the assessor to use in making a valid judgement on competency.

Team/Panel Assessment

The members of an assessment team/panel have assessment and industry experience and expertise and they work together to conduct the assessment. This involves collecting evidence and making judgements about competency. The members of the team must include at least one person who:

- holds formal recognition of competence in training and assessment in the relevant units in the Training and Assessment Training Package
- is deemed competent and, where possible, holds formal recognition of competence in the specific competency standard units under assessment, at least to the level being assessed; and if not technically competent uses team/panel members with current technical competence in requisite units.

In addition, it is recommended that members of the team/panel involved in the assessment are able to demonstrate:

- current knowledge of the industry, industry practices, and the job or role against which performance is being assessed
- current knowledge and skill in assessing against this Training Package in a range of contexts
- the interpersonal and communication skills required in the assessment process and to liaise with other team/panel members throughout the assessment process.

Assessments against the competencies in the Training Package will be carried out in accordance with these endorsed guidelines. The guidelines include the necessary qualifications for those conducting assessments and provide for those situations where more than one person may contribute to the assessment and where the required technical and assessment competencies may not be held by any one person.

1.3.07 Designing Assessment Tools

3.7 Designing Assessment Tools

This section provides an overview on the use and development of assessment tools.

Use of Assessment Tools

Assessment tools provide a means of collecting the evidence that assessors use in making judgements about whether candidates have achieved competency.

There is no set format or process for the design, production or development of assessment tools. Assessors may use prepared assessment tools, such as those specifically developed to support this Training Package – Training and Assessment Advice Manual for the Electrotechnology Training Package, available from EE-Oz Training Standards. Visit the website: (www.ee-oz.com.au). Alternatively they may develop their own assessment materials to meet the needs of their clients by utilising pre-developed training and assessment instruments included in Section 3.8 Electrotechnology Industry Guidelines for designing assessment materials.

Using Prepared Assessment Tools

If using prepared assessment tools, assessors should ensure that these tools are benchmarked or mapped against the current version of the relevant competency standard unit(s) and any industry-preferred model, and supported by the industry. This can be done by checking that the materials are listed on the National Training Information Service (<http://www.ntis.gov.au>) or EE-Oz Training Standards (www.ee-oz.com.au). Materials on the list have been noted by the National Quality Council (NQC), as meeting the quality criteria for Training Packages support materials.

Developing Assessment Tools

When developing their own assessment tools, assessors must ensure that the tools:

- are benchmarked against the relevant unit or units of competency;
- are reviewed as part of the validation of assessment strategies required under the AQTF; and
- meet the assessment requirements expressed in the AQTF 2010 Essential Standards for Initial and Continuing Registration.

A key reference for assessors developing assessment tools is TAE10 Training and Education Training Package.

Language, Literacy and Numeracy

The design of assessment tools must reflect the language, literacy and numeracy competencies required for the performance of a task in the workplace and not exceed these expectations

1.3.08 Assessment Methods

3.8 Assessment Methods

Assessment methods must be appropriate to the situation. Learners can be encouraged to use these methods for self-assessment. Combinations of these methods will be required for most situations, e.g. observations and oral questioning.

The recommended assessment methods for collecting evidence required to determine the candidate's competency are:

- oral questioning
- structured observation of work
- indirect supporting evidence (supervisor's reports)

It is recommended that assessors use open questions in conjunction with direct observations to assess the candidate's ability to:

- apply relevant knowledge to the particular task
- perform the required tasks safely and efficiently
- handle unforeseen contingencies and circumstances
- recognise and solve problems associated with the whole job (which may not necessarily occur during the assessment).

Supervisor's reports or verified calculations should be used to confirm that workplace job activities have been completed on time and meet the required specifications. This is particularly relevant when the assessor may not be present for the total duration of the workplace job activity and/or the learner/candidate works as part of a team.

For more information see Section 3.10 Guide to assessment methods and items.

Direct observation. Observe the learner carrying out their usual practical tasks in the workplace. This may be accompanied by questions. Direct observation is probably the easiest and most convenient method of assessment.

Third party reports. Information is provided by the immediate supervisor or other appropriate person(s). An external assessor may not have the opportunity to make multiple observations of a candidate over a period of time, unlike an internal (in-house) assessor. The external assessor may obtain third party reports to supplement an assessment.

Demonstration and questioning. If there is no opportunity to observe this competency in the standard work environment, the assessor may ask the candidate to provide a practical demonstration. The assessor can see both the process and the finished product.

Pen and paper tests and essays. These are used to measure the extent of knowledge and/or problem-solving capability. They can complement practical demonstration.

Oral tests. These can be an adjunct to practical demonstration and pen and paper tests.

Projects. These are usually unsupervised. The assessor uses the final product and supervisor reports as a basis for judgement.

Simulation. This may involve an off-site practical test. The actual tasks and conditions are similar to real life situations and are in accord with prevailing industry policy enunciated by the Industry Skills Council. A Simulation Policy has been developed and can be obtained at www.ee-oz.com.

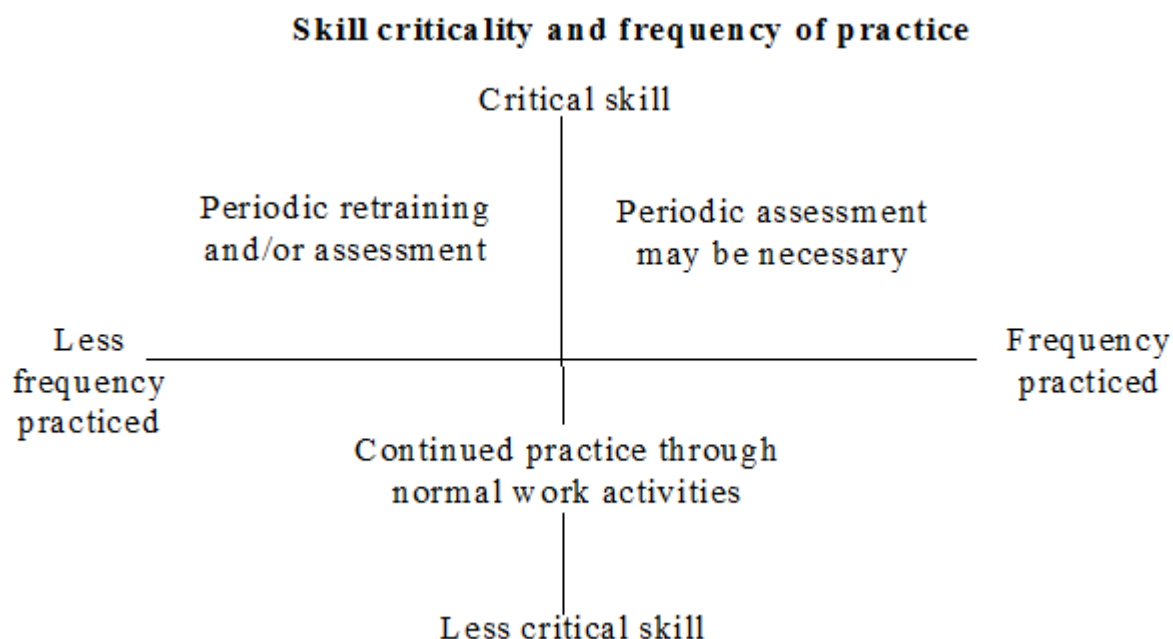
Portfolios. These are used for assessing skills achieved in the past. They can include work samples.

Profiling. Information is gathered over time from a structured profiled data entry card, log book or electronic system.

Selecting assessment methods is influenced by factors such as: the extent of the assessment, the most effective locations, access to physical resources and safety measures required. Sources of evidence need to be as comprehensive as possible in order to minimise error in judgment. Activities associated with normal everyday work contribute to the 'richness' of the evidence data.

When choosing an assessment method and developing assessment instruments, assessors must take into consideration that some knowledge and some skills are more critical to safety and operational requirements than others and some skills are practised more/less frequently.

These considerations can be summarised as follows:



Assessment methods and instruments used should satisfy the conditions associated with sufficiency, currency, authenticity, validity, reliability, and be holistic in nature.

The following *Table – Guide to Assessment Methods and Instruments* provides a summary of assessment methods in common use and the situations in which they may apply.

Table – Guide to Assessment Methods and Instruments

Assessment method	Appropriate instruments	Valid purposes or use	Conditions and numbers	Time constraints	Repeat assessments possible
Written objective tests	True/false Multiple choice Matching Completion	Confirming essential factual knowledge, principles Assessing deduction, transfer of knowledge Complementing other methods	Controlled classroom High level supervision Large numbers	Moderate	Many
Written	Calculations	Assessing use of	Test	Moderate	Many

Assessment method	Appropriate instruments	Valid purposes or use	Conditions and numbers	Time constraints	Repeat assessments possible
responses, short and extended answers	Definitions, explanations Essays	information Application of knowledge General ideas and solutions Research, organization and expression of concepts or ideas	condition as above or Minimal supervision, and assistance		
Oral test/ technical interview	Set question Scenarios	Assessing depth and breadth of knowledge Application of knowledge Relative to experience	Interview condition One to one	Moderate	Many
On job or workplace assessment	Observation, checklist Product assessment Questioning to complement observations	Identifying mastery or competence of practical task, technical skill or interpersonal skill in real or simulated setting Identifying gaps in education and training	Normal working conditions Moderate level supervision One to one Avoid expensive or hazardous situations	High	Nil to many depending on assessment of product or process
Practical/ Exercises	Stimulated work exercises Structured practical exercises Fault finding exercises	Checking mastery or competence of a practical task, technical skill, or subset of performance in a simulated work setting	Controlled laboratory or field setting High level supervision	Low	Several
Practical projects	Research task or investigation	Assessing integration and application of a	Access to laboratory, workshop or	Low	Several

Assessment method	Appropriate instruments	Valid purposes or use	Conditions and numbers	Time constraints	Repeat assessments possible
	Product or process development Individual learning contract	number of work related skills to solve a given problem Assessing individual approaches, innovation, creativity Assessing interaction with others	workplace Little supervision		
Assignments	Resource life Case studied Poster presentation Reports of video or speaker presentations Reports of laboratory/field work, excursions Individual learning contracts Writing simple manuals or procedures	Confirming competence to research, analyse and synthesise information Assessment of application of knowledge, skills and attitudes where practical testing is not feasible Assessment of communication skills	Moderate of level control Non-test conditions Little supervision	Low	Several
Personal appraisal	Checklists or criteria which enable peer or self assessment	Establishing readiness for summative assessments Assessment of an individual's performance within a team effort	Non-test conditions Little supervision Small numbers	Low	Many

Assessment method	Appropriate instruments	Valid purposes or use	Conditions and numbers	Time constraints	Repeat assessments possible
Verbal assessment	Oral exposition or lecture Seminar, presentation and group discussion Oral/aural tests Interviews	Confirming understanding of principles underpinning performance Supplement to other assessment methods Verification of learner's submitted work.	Moderate level of control High level of supervision One to one	Low	Several
Profiling¹	Structured manual or computer-based log.	Tracks competency development against the industry standard profile specified by CSUs. Identifies when remedial action is required during development period.	² Real work conditions under workplace supervision. Off-job assessment events Any number	Low / Medium	On going

¹ A valid profile is based on periodic collection of relevant data over the duration of a competency development training program.

² A complete profile is constructed from all required evidence of competency, however where a profile of only workplace performance is used it must be supplemented with other methods such as those outlined in this table.

1.3.09 Conducting Assessment

3.9 Conducting Assessment

This section details the mandatory assessment requirements and provided information on equity in assessment, including reasonable adjustment.

Mandatory Assessment Requirements

Assessments must meet the criteria set out in the AQTF 2010 Essential Standards for Initial and Continuing Registration.

For information, the mandatory assessment requirements from Standard 1 from the AQTF 2010 *Essential Standards for Initial and Continuing Registration* are as follows:

- "1.
5 *Assessment, including Recognition of Prior Learning(RPL):*
- a) *meets the requirements of the relevant Training Package or accredited course,*
 - b) *is conducted in accordance with the principles of assessment and the rules of evidence, and*
 - c) *meets workplace and, where relevant, regulatory requirements.*

Assessments must meet, at a minimum, the criteria set out in Standard 8 from the *Standards for Registered Training Organisations* which is reproduced below.

8 **RTO Assessments**

The RTOs assessments meet the requirements of the endorsed components of Training Package and the outcomes specified in accredited courses within the scope of its registration.

8.1 The RTO must ensure that assessments, regardless of whether through a training and assessment pathway or an assessment-only pathway:

- i comply with the Assessment Guidelines included in the applicable nationally endorsed Training Package or the assessment requirements specified in accredited courses;
- ii lead to the issuing of a Statement of Attainment or qualification under the AQF when a person is assessed as competent against nationally endorsed Competency Standard Units in the applicable Training Package or any additional information related to knowledge and skills specifications (e.g. modules) prescribed in the applicable accredited course;
- iii comply with the principles of validity, reliability, fairness and flexibility;
- iv provide for applicants to be informed of the context and purpose of the

assessment and the assessment process;

- v where relevant, focus on the application of knowledge and skill to the standard of performance required in the workplace and cover all aspects of workplace performance, including task skills, task management skills, contingency management skills and job role environment skills, and include transferable knowledge and skills to new situations and environments;
- vi involve the evaluation of sufficient evidence to enable judgements to be made about whether competency has been attained;
- vii identify issues related to techniques, OHS, language and literacy, cultural diversity, under-represented groups, key competencies and skills enabling employment.
- viii provide for feedback to the applicant about the outcomes of the assessment process and guidance on future options;
- ix are equitable for all persons, taking account of cultural and linguistic needs; and
- x provide for reassessment on appeal.

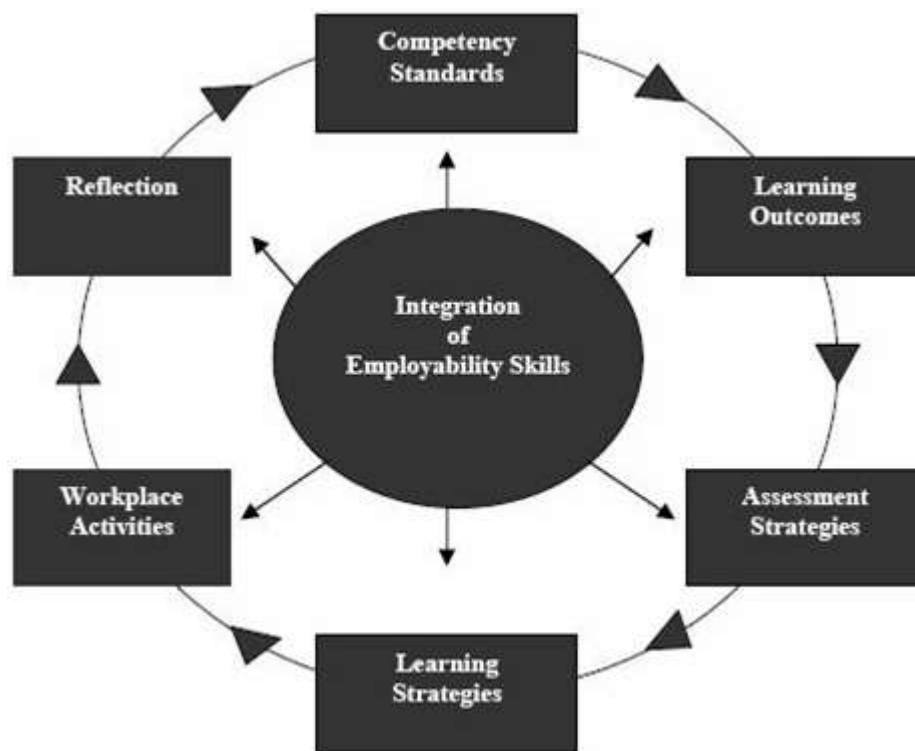
8.2 a The RTO must ensure that RPL is offered to all applicants on enrolment.

b The RTO must have a RPL process that:

- i is structured to minimise the time and cost to applicants; and
- ii provides adequate information and support to enable applicants to gather reliable evidence to support their claim for recognition of competencies currently held, regardless of how, when or where the learning occurred.

Assessment of Employability Skills

Employability Skills are integral to workplace competency. As such they must be considered in the design, customisation, delivery and assessment of vocational education and training programs in an integrated and holistic way, as represented diagrammatically below.



Employability Skills are embedded and explicit within each unit of competency. Training providers must use Employability Skills information in order to design valid and reliable training and assessment strategies. This analysis could include:

- reviewing units of competency to locate relevant Employability Skills and determine how they are applied within the unit
- analysing the Employability Skills Summary for the qualification in which the unit or units are packaged to help clarify relevant industry and workplace contexts and the application of Employability Skills at that qualification outcome
- designing training and assessment to address Employability Skills requirements.

For more information on Employability Skills in the ElectroComms and Energy Utilities Training Packages go to the EE-Oz website at www.ee-oz.com.au

Access and Equity

An individual's access to the assessment process should not be adversely affected by restrictions placed on the location or context of assessment beyond the requirements specified in this Training Package: training and assessment must be bias-free.

Under the rules for their development, Training Packages must reflect and cater for the increasing diversity of Australia's VET clients and Australia's current and future workforce. The flexibilities offered by Training Packages should enhance opportunities and potential outcomes for all people so that we can all benefit from a wider national skills base and a shared contribution to Australia's economic development and social and cultural life.

Reasonable Adjustments

It is important that education providers take meaningful, transparent and reasonable steps to consult, consider and implement reasonable adjustments for students with disability.

Under the *Disability Standards for Education 2005*, education providers must make reasonable adjustments for people with disability to the maximum extent that those adjustments do not cause that provider unjustifiable hardship. While ‘reasonable adjustment’ and ‘unjustifiable hardship’ are different concepts and involve different considerations, they both seek to strike a balance between the interests of education providers and the interests of students with and without disability.

An adjustment is any measure or action that a student requires because of their disability, and which has the effect of assisting the student to access and participate in education and training on the same basis as students without a disability. An adjustment is reasonable if it achieves this purpose while taking into account factors such as the nature of the student’s disability, the views of the student, the potential effect of the adjustment on the student and others who might be affected, and the costs and benefits of making the adjustment.

An education provider is also entitled to maintain the academic integrity of a course or program and to consider the requirements or components that are inherent or essential to its nature when assessing whether an adjustment is reasonable. There may be more than one adjustment that is reasonable in a given set of circumstances; education providers are required to make adjustments that are reasonable and that do not cause them unjustifiable hardship.

The Training Package Guidelines provides more information on reasonable adjustment, including examples of adjustments. Go to <http://www.deewr.gov.au/tpdh/Pages/home.aspx>

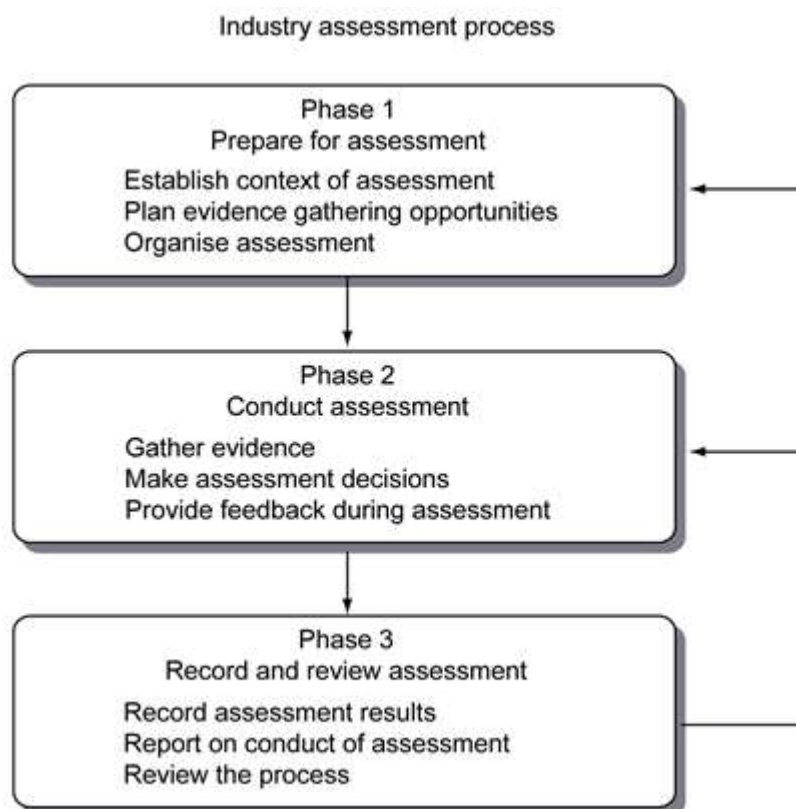
Industry-preferred assessment process

The following describes the industry-preferred process for conducting assessments against the competency standard unit(s) in this Training Package. This process applies to all assessments conducted for the purposes of national recognition.

- Assessment within the Electrotechnology Industry must be carried out by a qualified assessor trained in the conduct of assessment.
- Assessment should be planned, arranged and organised well in advance of the event/process.
- The candidate should be involved in the planning and preparation so that their readiness and availability is assured and their advice on evidence collection opportunities may be considered.
- The environment within which assessment is to occur is acceptable to the parties and conducive to the assessment process.
- The assessor’s actions throughout the process are firm, fair, friendly and unambiguous.
- Specific rulings on safety breaches are explained up-front and acted upon in accordance with the assessment materials.
- The assessment process should contain no surprises for any party.
- Feedback is provided as required throughout the assessment process.

- Post assessment activities including recording, reporting, counselling etc. are finalised promptly.
- Candidates are more likely to accept the outcomes of an assessment process in which:
- they consider they were treated fairly, consistently and with dignity
- they were given the full opportunity to demonstrate their capabilities
- the reasons for the assessment decisions were appropriate, logical and constructively explained
- the assessment judgements are conveyed in a sensitive and constructive manner.

Below is an overview for assessment within the Electrotechnology Industry. It outlines the process involved in conducting assessment in both the institutional and workplace context, and consists of three major components that each assessor will need to do.



Phase 1 Prepare for assessment

The assessor:

- establishes the context and purpose of the assessment
- identifies the relevant competency standard unit(s) and assessment guidelines from this Training Package including the relevant performance measures applying to assessment
- identifies any NTQC-noted support materials that have been developed to facilitate the assessment process
- analyses the competency standards and identifies the evidence requirements

- identifies potential evidence collection methods
- identifies issues related to techniques, OHS, language and literacy, cultural diversity, under-represented groups, key competencies and skills enabling employment.

Prepare the candidate

The assessor meets with the candidate to:

- discuss and confirm the purpose of assessment with the candidate and where appropriate, the employer
- explain the context and purpose of the assessment and the assessment process
- explain the competency standards to be assessed and the evidence to be collected and ensure the candidate has access to the relevant competency standards and any other relevant information
- explain and obtain agreement to the assessment procedure
- advise on self-assessment, including processes and criteria
- outline the assessment procedure, the preparation the candidate should undertake, and answer any questions.
- assess the needs of the candidate and where applicable negotiate reasonable adjustment when assessing people with disabilities; reasonable adjustment must not compromise the integrity of the competencies
- seek feedback regarding the candidate's understanding of the competency standard unit(s), evidence requirements and assessment process
- determine if the candidate is ready for assessment and, in consultation with the candidate, decide on the time and place of the assessment
- develop an assessment plan
- discuss the Electrotechnology Industry and enterprise assessment policy with the candidate, how the competencies to be assessed fit in with the industry training policy and the preferred framework or enterprise arrangements for training and assessment. The assessor should also discuss what the candidate has done to acquire the knowledge and skills.

Plan and prepare evidence-gathering process

Practical assessment is preferably conducted on-site. However, if on-site practical assessment is not possible then off-site assessment at a mutually agreeable site could be appropriate. It can be a part of the current work or a simulated task.

The assessor must:

- establish a plan for gathering sufficient quality evidence about the candidate's performance in order to make the assessment decision (and involve industry representatives in the development of plans for the validation of assessment)
- identify opportunities to gather evidence of competence which occurs as part of the workplace activities
- ensure the planned approach to gathering evidence will provide sufficient, reliable, valid and fair evidence of competence
-

- source or develop assessment materials to assist in the evidence gathering process
- choose the techniques that will be used to assess the candidate's knowledge and skill
- organise equipment or resources required to support the evidence gathering process
- check that the assessment environment allows for fair, valid and reliable assessment and that it is safe and accessible
- inform other relevant people of assessment plans
- coordinate and brief other personnel involved in the evidence gathering process
- identify the need to gather additional evidence which may not occur as part of workplace activities
- consider issues related to techniques, OHS, language and literacy, cultural diversity, under-represented groups, key competencies and skills enabling employment.

Phase 2 Conduct the assessment

Collect the evidence and make assessment decisions

The assessor must:

- establish and oversee the evidence gathering process to ensure its validity, reliability, fairness, flexibility and consistency.
- collect appropriate evidence and assess this against the Elements, Performance Criteria, Range Statement and Evidence Guide in the relevant competency standard unit(s)
- evaluate evidence in terms of the four dimensions of competency – task skills, task management skills, contingency management skills and job/role environment skills
- incorporate allowable adjustments to the assessment procedure without compromising the integrity of the competencies
- evaluate the evidence in terms of validity, consistency, currency, equity, authenticity and sufficiency
- gather evidence related to techniques, OHS, language and literacy, cultural diversity, under-represented groups, key competencies and skills enabling employment
- consult and work with other staff, assessment panel members or technical experts involved in the assessment process
- document the evidence gathered in accordance with the assessment procedure and record details of evidence collected
- make a judgement about the candidate's competency based on the evidence and the relevant competency standard unit(s) and the criteria specified in the assessment procedure.

Provide feedback on the assessment

The assessor must provide advice to the candidate about the outcomes of the assessment process.

This includes providing the candidate with:

- clear and constructive feedback on the assessment decision
- information on ways of overcoming any identified gaps in competency revealed by the assessment

- the opportunity to discuss the assessment process and outcome
- information on reassessment and the appeals process.

Phase 3 Record and review assessment

Record and report results

The assessor must:

- record the assessment outcome according to the policies and procedures of the RTO
- maintain records of the assessment procedure, evidence collected and the outcome according to the policies and procedures of the RTO
- maintain the confidentiality of the assessment outcome
- organise the issuing of qualifications and/or Statements of Attainment according to the policies and procedures of the RTO.

Review assessment process

- On completion of the assessment process, the assessor must:
 - review the assessment process
 - report on the positive and negative features of the assessment to those responsible for the assessment procedures
 - if necessary, suggest to appropriate personnel in the RTO ways of improving the assessment procedures.

Participate in the reassessment and appeals process

The assessor must:

- provide feedback and counsel the candidate, if required, regarding the assessment outcome or process, including guidance on further options
- provide the candidate with information on the reassessment and the appeals process
- report any disputed assessment decision to the appropriate personnel in the RTO
- participate in the reassessment or appeal according to the policies and procedures of the RTO.

Review and maintenance of the assessment system

EE-Oz Training Standards as the developer and custodian of this Training Package is responsible for the ongoing monitoring and review of these Assessment Guidelines. This process will be incorporated in the general review and maintenance of this Training Package.

1.3.10 Guidelines for Designing Assessment Materials

3.10 Guidelines for Designing Assessment Materials

Assessment materials are developed, designed and implemented by appropriately authorised and competent assessors. The materials may range from relatively straight forward questions/answers and task tests to quite elaborate simulations for assessing concepts and values. Assessment materials should facilitate the process of assessment by:

- detailing the personnel and material preparations required to support the **assessment** process
- establishing and/or confirming the circumstances under which the assessment is to take place
- detailing the evidence to be collected and the method(s) to be used to do this
- providing for the systematic review/analysis of the evidence on which logical and supportable judgments are made
- providing the means for recording the process and the judgments as required and in accordance with any regulatory and/or industry preferred arrangement
- providing a basis for post-assessment
- providing **counselling** and guidance for the candidate
- identifying specialist technical advice related to such things as OHS, LLN, **environmental** and equity matters.

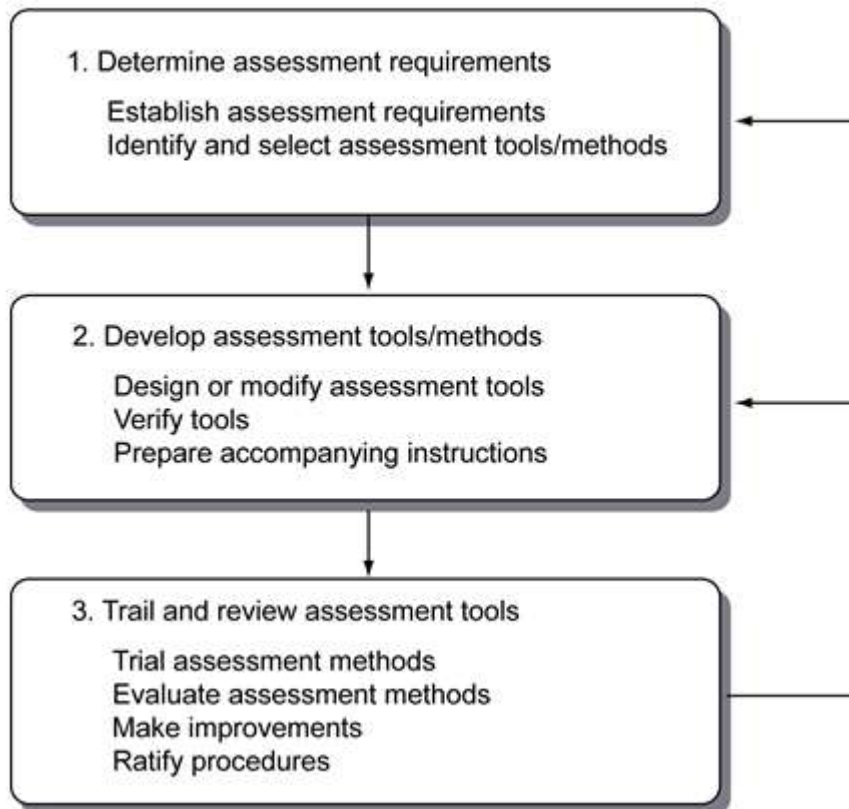
Assessment Material Design Process

The three Phases in the process of designing assessment materials are:

- **Determine assessment requirements. This includes identifying appropriate assessment tools and methods**
- **Develop assessment tools and methods. This involves designing and/or modifying tools, and preparing instructions**

- **Trial and review assessment tools. This includes ratifying procedures and making improvements.**

Process for designing assessment materials



1 Determine assessment requirements

1.1 Identify assessment requirements. In the development of tools and methods of assessment, the assessor will need to determine the range of methods appropriate to the assessment context and the characteristics of the person being assessed. The assessor may use the following questions when designing the assessment method:

- Is the data **gathering** process sufficient, timely, valid and reliable to ensure the decision about competence relates to the overall requirements of the unit?
- Do you always need to assess real work?
- How is the **critical** evidence specified?
- How many **assessment** tasks are required to collect the critical evidence of competency?
- Which **assessment** tasks will provide a broad coverage of the Range Statement?
- Are there any skills that the candidate should have or can develop before they are assessed for the unit?

1.2 Identify and select assessment tools/methods. The assessor must identify and select the assessment methods consistent with Electrotechnology Industry assessment guidelines and procedures.

2 Develop assessment tools/methods

2.1 Design or modify assessment tools. The assessor must design or modify existing assessment tools so that their format, language, literacy and numeracy requirements are appropriate to the characteristics of the assessment context and the person being assessed.

2.2 Verify tools. The assessor must verify the assessment tools, which maintain validity but are easy to administer, and allow sufficient flexibility to meet the range of possible assessment contexts.

2.3 Prepare accompanying instructions. The assessment system/process must be comprehensively and clearly documented so that the stages of assessment and their constituent parts may be observed and evaluated. The assessment materials must relate directly to the competency standard unit or group of units making up a qualification and address the totality of competency in a realistic, holistic and effective way.

3 Trial and review assessment tools

3.1 Trial and validate assessment tools. The assessor must trial and validates the assessment methods with a representative group of people similar to those who will ultimately be assessed. Once trials are conducted the assessor must seek responses from all parties and compile and analyse these responses.

3.2 Evaluate assessment methods. The assessor must evaluate the assessment methods and tools for clarity, reliability, validity, fairness and cost-effectiveness.

3.4 Make improvements. The assessor must modify the assessment tools based on the responses to the trials.

3.5 Ratify procedures. The assessor must ratify, with relevant people in the industry, procedures related to evidence requirements, assessment methods and assessment tools, and the processes used in developing them.

Assessment Material Requirements

Essential requirements to be met by assessment materials include the following:

Assessment of competency standard units. Assessment must directly address the competency standard unit or group of units making up a qualification or Skill Sets and, within this, satisfy the *critical aspects of evidence*, including the related Performance Criteria, Range Statement and essential knowledge and associated skills.

Assessment of practical applications. Summative assessment of practical applications should, whenever possible and practicable, be conducted in a real work environment or in a realistically simulated work environment. Removal of the summative assessment from the real work environment should occur only to the extent necessitated by circumstances such as safety, noise, excessive cost and disruption to equipment operation, and access to the required work.

Learning outcomes or other curricula documents. Outcomes are not to be the primary focus of summative assessment unless their direct relationship to the competency standard unit(s) is formally approved by industry and recorded.

Assessment of essential theory. Summative assessment of the theory (essential knowledge and associated skills) underpinning competent performance is to be sufficiently rigorous and searching to ensure that individuals comprehend why they are doing something, the options they may use to achieve the required goal, and the fact that they can recall and/or locate and, interpret and transfer this information in varying contexts if it is needed at some other time. Typically, the specific level of depth and breadth the individual is required to achieve is contained in industry and RTO sponsored essential knowledge and associated skills knowledge and skills specifications that are aligned to respective competency standard units.

Assessment of under-represented groups or learners with low language, literacy or numeracy skills. Assessment systems must be able to be used for under-represented groups or in cases where learners have low language, literacy and/or numeracy skills. Reasonable adjustment strategies for these groups should be included in any assessment materials used by RTOs (which should be consistent with the quality assurance requirements of State Training Authorities for registration).

Assessment instruments to support training and assessment material design

See Appendix B *Sample assessment instruments to support training and assessment material design* for information on assessment material design, training and assessment activities and sample assessment materials.

1.3.11 Maintenance of Assessment Guidelines

3.11 Maintenance of Assessment Guidelines

The Electrotechnology Industry Assessment Guidelines were developed and are owned by the industry. The guidelines must be maintained so that they reflect the ongoing needs of the industry sector and respond in a timely manner to changed technologies, work organisation, skills development and related circumstances.

Responsibility for maintaining the Assessment Guidelines is shared by the parties who constitute the sector:

- The maintenance of Assessment Guidelines will be coordinated and managed by EE-Oz Training Standards in its role as a declared Industry Skills Council for ElectroComms and EnergyUtilities
- Suggestions and proposals for changes from all parties are welcome. These should be documented and submitted to EE-Oz Training Standards the DEEWR declared Industry Skills Council for the ElectroComms and EnergyUtilities Industry.

1.3.12 Further Sources of Information

3.12 Further Sources of Information

The section provides a listing of useful contacts and resources to assist assessors in planning, designing, conducting and reviewing of assessments against this Training Package.

Contacts

The ElectroComms and Energy Utilities Industry Skills Council

EE-OZ Training Standards

48 Mort St

Braddon ACT, 2602

PO Box 1202

Dickson, ACT, 2602

Ph: 02 6254 5180

Fax: 02 6257 4222

Email: ee-oz@ee-oz.com.au

Web: www.ee-oz.com.au

Technical and Vocational Education and Training (TVET) Australia Limited

Level 21, 390 St Kilda Road, Melbourne VIC 3150

PO Box 12211, A'Beckett Street Post Office

MELBOURNE VICTORIA 8006

Ph: +61 3 9832 8100

Fax: +61 3 9832 8198

Email: sales@tvetaustralia.com.au

Web: www.tvetaustralia.com.au

For information on the TAE10 Training and Education Training Package contact:

Innovation & Business Skills Australia

Telephone: (03) 9815 7000

Facsimile: (03) 9815 7001

Email: virtual@ibsa.org.au

Web: www.ibsa.org.au

1.3.13 General Resources

3.13 General Resources

AQF Implementation Handbook, Fourth Edition 2007. Australian Qualifications Framework Advisory Board, 2002 <www.aqf.edu.au>

Australian Quality Training Framework (AQTF) and AQTF 2010 Users' Guide to the Essential Standards for Registration –
<http://www.training.com.au/pages/menuitem5cbe14d51b49dd34b225261017a62dbc.aspx>

For general information and resources go to <http://www.training.com.au/>

The National Register is an electronic database providing comprehensive information about RTOs, Training Packages and accredited courses - <www.ntis.gov.au>

The Training Package Development Handbook site provides National Quality Council policy for the development of Training Packages. The site also provides guidance material for the application of that policy, and other useful information and links.
<http://www.deewr.gov.au/Skills/Overview/Policy/TPDH/Pages/main.aspx>

Assessment Resources

Registered training organisations (RTOs) are at the forefront of vocational education and training (VET) in Australia. They translate the needs of industry into relevant, quality, client-focussed training and assessment.

RTOs should strive for innovation in VET teaching and learning practices and develop highly flexible approaches to assessment which take cognisance of specific needs of learners, in order to improve delivery and outcomes of training.

Resources can be purchased or accessed from:

- TVET Australia – provides an integrated service to enable users of the national training system to identify and acquire training materials, identify copyright requirements and enter licenses for use of that material consistent with the scope and direction of the NQC.

<http://www.productservices.tvetaustralia.com.au/>

Assessment Tool Design and Conducting Assessment

VETASSESS and Western Australian Department of Training and Employment, 2000, *Designing Tests – Guidelines for designing knowledge based tests for Training Packages*.

Vocational Education and Assessment Centre 1997, *Designing Workplace Assessment Tools*, A self-directed learning program, NSW TAFE.

Manufacturing Learning Australia, 2000, *Assessment Solutions*, Australian Training Products, Melbourne.

Rumsey, David 1994, *Assessment practical guide*, Australian Government Publishing Service, Canberra.

Assessor Training

Australian Committee on Training Curriculum (ACTRAC), 1994, *Assessor training program - learning materials*, Australian Training products, Melbourne.

Australian National Training Authority, *A Guide for Professional Development*, ANTA, Brisbane or its replacement – contact DEEWR for more information on www.deewr.gov.au

Australian National Training Authority, Facilitator Packs for Certificate IV in Training and Assessment or its replacement – contact DEEWR for more information on www.deewr.gov.au

Australian National Training Authority, Facilitator's Pack for Train Small Groups and Assessment or its replacement – contact DEEWR for more information on www.deewr.gov.au

Australian Training Products Ltd *Assessment and Workplace Training, Training Package - Toolbox*, ATPL Melbourne (available from TVET).

Green, M., Moritz, R., Moyle, K. and Vale, K., 1997, *Key competencies professional development Package*, Department for Education and Children's Services, South Australia.

Victorian TAFE Association, 2000, *The professional development CD: A learning tool*, VTA, Melbourne.

Conducting Assessments

Bloch, B. and Thomson, P., 1994, *Working Towards Best Practice in Assessment: A case study approach to some issues concerning competency-based assessment in the vocational education and training sector*, NCVER, Adelaide.

Docking, R., 1991, *An A-Z of Assessment Myths and Assessment in the Workplace, Competence assessment briefing series*, No. 4, Employment Department, Perth, Western Australia.

Hawke, Geoff, 1996, *Integrating Assessment of Learning Outcomes*, Assessment Centre for Vocational Education, Sydney.

Hawke, Geoff, 1995, *Work-based Learning: Advice From Literature*, Assessment Centre for Vocational Education, Sydney.

National Assessors and Workplace Trainers Body, *Putting it into practice* [Training Package implementation Guide].

Parsloe, E., 1992, *Coaching, Mentoring and Assessing: A practical guide to developing competence*, Kogan Page, London.

Rumsey, David, 1993, "Practical issues in Workplace Assessment" in National Assessment Research Forum: A forum for research into competency-based assessment. [VEETAC Competency Based Training Working party Assessment Steering Group], NSW TAFE Commission, Sydney.

Rumsey, David, 1994, *Assessment Practical Guide*, Australian Government Publishing Service, Canberra.

Evidence-Gathering Methods

Australian National Training Authority, 1998, *A new assessment tool*, ANTA, Melbourne or its replacement – contact DEEWR for more information on www.deewr.gov.au

Gonczi, A. (ed.), 1992, *Developing a competent workforce: adult learning strategies for vocational education and training*, TAFE National Centre for Research and Development, Adelaide.

Kearney, Paul, 1992, *Collaborative assessment techniques*, Artemis, Tasmania.

National Assessors and Workplace Trainers Body, *The evidence resource kit – containing language, literacy and numeracy video and CD ROM*

1.3.13 Further Sources of Information

3.13 Further Sources of Information

This section provides a listing of useful contacts and resources to assist assessors in planning, designing, conducting and reviewing assessments

Contact	Details
National Industry Skills Council (ISC) for the ElectroComms and EnergyUtilities Industry	EE-OZ Training Standards 48 Mort St Braddon ACT, 2602 PO Box 1202 Dickson, ACT, 2602 Ph: 02 6254 5180 Fax: 02 6257 4222 Email: ee-oz@ee-oz.com.au Web: www.ee-oz.com.au
Western Australia ITC	WA IEU ITC Inc P O Box 597 BALCATTA WA 6021 Tel: 08 9240 2688 Fax: 08 9240 2930 E-mail: admin@ieu.com.au
New South Wales ITAB	NSW U&E ITAB PO Box 615 DARLINGHURST NSW 1300 Tel: 02 9326 6097 Email: uensw@pacific.net.au Website: www.uensw.com.au

Contact	Details
Victoria	EPIC Industry Training 29 Drummond St CARLTON VIC 3053 Tel: 03 9654 1299 Fax: 03 9654 3299 Email: epicitb@epicitb.com

Contact	Details
South Australia	Electrical, Electrotechnology, Energy & Water Skills Board PO Box 2584 GPO REGENCY PARK SA 5942 Tel: (08) 8347-4008 Fax: (08) 8219-0015 Email: admin@eeewsb.com.au
Queensland	Energy Skills Queensland PO Box 160 COOPERS PLAINS QLD 4108 Tel: 07 3216 9604 Fax: 07 3345 8346 Email: qusitab@qusitab.com.au

Northern Territory	Major Industries Training Advisory Council GPO Box 1610 DARWIN NT 0801 Tel: 08 8981 0077 Fax: 08 8941 7470 Email: mitac@mitac.org.au

Access to Assessment Resources

Learning Resources**EE-OZ Training Standards**

48 Mort St
Braddon ACT, 2602
PO Box 1202
Dickson, ACT, 2602
Ph: 02 6254 5180
Fax: 02 6257 4222
Email: ee-oz@ee-oz.com.au
Web: www.ee-oz.com.au

Australian Training Products Ltd
Level 25, 150 Lonsdale Street
MELBOURNE VIC 3000
PO Box 5347BB
MELBOURNE VIC 3001
Telephone: (03) 9655 0600
Fax: (03) 9639 4684
Website: <http://www.atpl.net.au>
Email: sales@atpl.net.au

1.3.14 Appendix A - Australian Apprenticeships

3.14 Appendix A – Australian Apprenticeships

Australian Apprenticeships are work-related competency programs designed for entry level contracted employment for new entrants to the industry. All qualifications in this Training Package could be open to use as Australian Apprenticeships and are governed by State/Territory Training Authority arrangements and their limitations.

Australian Apprenticeships offer both employers and employees:

- relevant training
- a range of support service arrangements.

Typically they involve paid work and structured training and are underpinned by a training contract, which is registered with the relevant State/Territory Training Authority. Completion of the competency development program leads to an AQF qualification.

In some instances, and subject to any relevant State/Territory Training Authority arrangements, existing non-apprenticed workers may be eligible for Australian Apprenticeship opportunities. Inquiries with the relevant State/Territory Training Authority should be made in this regard.

Like traditional apprenticeships, Australian Apprenticeships involve a commitment from:

- the employer to provide an environment for systematic training of the Australian Apprentice
- the Australian Apprentices to apply themselves to learning the requirements of their vocation
- a Registered Training Organisation (RTO)¹ to be responsible for providing the vocational education, training and assessment support services and the eventual issuing of a national qualification

In the Electrotechnology Industry, Australian Apprenticeships are available for all the qualifications outlined in this Training Package. Australian Apprentices seeking one of the national qualifications will be required to undergo a training program or course of study that involves learning and assessment activities. The related learning and assessment activities are documented and involve:

- the employer
- the employee
- the RTO.²

On successful completion of the training program or course of study, an RTO will issue the Australian Apprentice a national qualification.

¹ TAFE Institutions, universities with TAFE sectors, Skills Centres and similar enterprises that can deliver vocational training are eligible to become RTOs. For more information on RTOs see DEEWR's 2005 *Australian Quality Training Framework Standards for Registered Training Organisations*, effective from 1 July 2005 publication.

² TAFE Institutions, Universities with TAFE sectors, Skills Centres and similar enterprises that can deliver vocational training are eligible to become RTOs.

Entry Requirement

Under Australian Apprenticeships the employer is able to determine the relevant employment criteria for recruiting a new entrant into the Electrotechnology Industry. However, the choice is usually dependent on enterprise employment practices and needs, including requirements that may be imposed by relevant regulations and codes of practice.

Subject to any relevant State/Territory Training Authority arrangements, existing non-apprenticed workers are eligible for Australian Apprenticeship opportunities. Inquiries with the relevant State/Territory Training Authority should be made in this regard.

There is a common set of attributes/profiles that are preferred by the industry for the recruiting of Australian Apprentices.

- Any person aged 15 years or more can apply for an Australian Apprenticeship.

- Most employers require that applicants have completed at least Year 10 of a secondary school education program.

Potential entrants should be aware that employers are looking for the following personal attributes:

- effective numeracy and literacy skills
- effective communications skills
- acceptable presentation
- punctuality
- a positive attitude
- interest in the industry as a career
- ability to work at heights or in confined spaces and around moving machinery
- ability to distinguish between colours.

The terms and conditions for Australian Apprenticeship training require a training agreement or contract, called an Apprenticeship/Traineeship Training Contract, provided by State/Territory Training Authorities and setting out the responsibilities of the parties to the contract.

- Parties to the Apprenticeship/Traineeship Training Contract select the appropriate qualification, appropriate competency standard units and adopt an industry-preferred model or design a new training plan/program that must be agreed to by all parties. Competency standard units used to make up a qualification must be used in the workplace of the employer or be accessible through some job rotation arrangement with other workplaces.

The employment of an apprentice (sometimes also called a trainee) by an employer is subject to the relevant legislation and any applicable industrial instrument, order or determination made under that related Statutory Act. Appropriate information should be obtained from relevant authorities in this regard.

General principles governing the Competency Development Program

In consultation the RTO, the employer and the apprentice/trainee reach agreement on the Competency Development Program that will be delivered. Typically the RTO will adopt the industry-preferred approach where regulatory arrangements are in place or they will design an appropriate program in consultation with the industry. The apprentice/trainee would be expected to undertake the Competency Development Program in order to attain competence in the given qualification.

The Competency Development Program

The training contract, developed in consultation with the RTO(s) provides a description of the process for undertaking training during the life of the training program. The training plan will outline the required on and off-the-job arrangements that apply to it.

The Training Program

1. Expected duration of workplace program in hours

The training program will detail the anticipated time in hours that the apprentice/trainee is expected to work in order to gain the necessary competencies. Information regarding the suggested nominal duration for AQF levels of Australian Apprenticeships is available from respective parties to the contract of training including EE-Oz Training Standards.

2. On-the-job skills development program

In consultation with the apprentice/trainee and employer, the RTO provides advice on how evidence is to be gathered when the apprentice/trainee is in the workplace. Apprentices/trainees are expected to assist RTOs in gathering and submitting workplace evidence in line with the industry-preferred approach. This is particularly important where regulatory arrangements are in place. RTOs in turn monitor the performance of the apprentice/trainee and provide appropriate feedback to them and the employer.

3. Off-the-job skills development program

The training contract will detail, where applicable, the off-the-job (technical education) program the RTO will deliver to provide the necessary underpinning skills and knowledge. For example where modules or essential knowledge and associated skills strategies apply, the number, title and duration of each will generally be advised. This will also include the expected duration of the technical educational program in hours. Typically this is a program preferred by the industry.

Typical duration of Australian Apprenticeships

A range of influencing factors, including NTQC policy, help to determine the typical period of employment and related training for individuals seeking a qualification, using the Australian Qualification Framework (AQF).

Detailed information on typical Australian Apprenticeship durations, at each of the AQF levels is available from EE-Oz Training Standards. This detail can be obtained directly from EE-Oz Training Standards or found on the EE-Oz Training Standards website at www.ee-oz.com.au. Additionally, more specific information may be contained within any related support materials that may exist as non-endorsed components of this Training Package and in particular the industry-preferred training plan applicable to each qualification.

As a general rule it is expected that new entry-level recruits require a 'nominal duration' of training to satisfy the outcomes of competency standard units. Nominal duration is usually defined by State/Territory and Federal Training Authority policies and/or regulations, set out in State/Territory Training Package Implementation Guides. For information refer to the relevant Training Package Implementation Guide which can be accessed via the State/Territory Training Authority websites.

1.3.15 Appendix B - Sample Assessment Instruments

3.15 Appendix B – Sample Assessment Instruments

These instruments are designed to Support Training and Assessment Material Design

This Appendix provides advisory and sample information for assessment material design to benchmark quality outcomes. It also contains information on resources available to support implementation of the Training Package and how these resources relate to the workplace and where they can be obtained.

The sample assessment tools/instruments in this Appendix were developed to assist:

- those involved in benchmarking activities designed to gather and record evidence about workplace tasks and experiences for training and assessment purposes
- in achieving consistency in the assessment of the underpinning knowledge and skills of the units.

The assessment strategies and instruments are primarily for use as advisory information for workplace assessors and/or their agents (workplace supervisors or technical experts) who may be employees of Registered Training Organisations or enterprises.

This Appendix should be read in conjunction with the following publications:

- The relevant volumes of this Training Package
- Training Package for Training and Assessment TAA04
- Training Acts and Regulations in the relevant Australian State/Territory
- Policies of the RTO involved with training and assessment for the industry.

See Appendix A Glossary of Terms for the meaning of specific terms used.

Competency Development Models

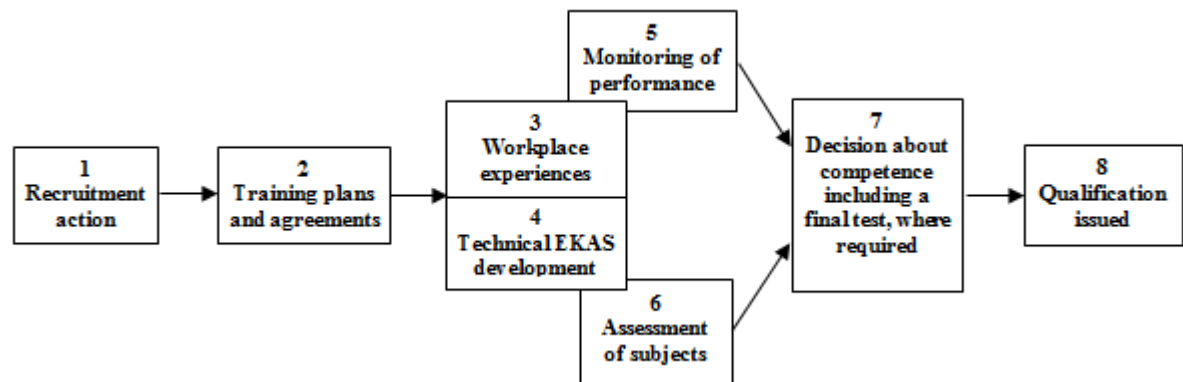
This section introduces competency development and/or recognition models based on combined on and off-the-job training and a model that allows individuals to have previous learning and work experience recognised.

Combined on and off-the-job competency development model

This model is structured around a new entry level learner undertaking a full competency development program. It recognises that learning occurs as a result of:

- experience in recurring workplace events
- directed workplace learning activities
- structured off-the-job essential knowledge and associate skills technical educational activities.

The model is a simplified version of the detailed contracted new entry level industry-preferred competency development model. A detailed copy of this model is available from EE-Oz Training Standards website at www.ee-oz.com.



Competency Development Model

This model can accommodate the assessment of prior learning within the continuum of new entrant to competent. In this way it is consistent with the Assessment Pathways outlined in this Assessment Guidelines part of the Training Package.

New entrant competency development model

In designing training and assessment materials and resources to support new entrant competency development, consideration should be given to the preferred industry approach to learner development, in particular

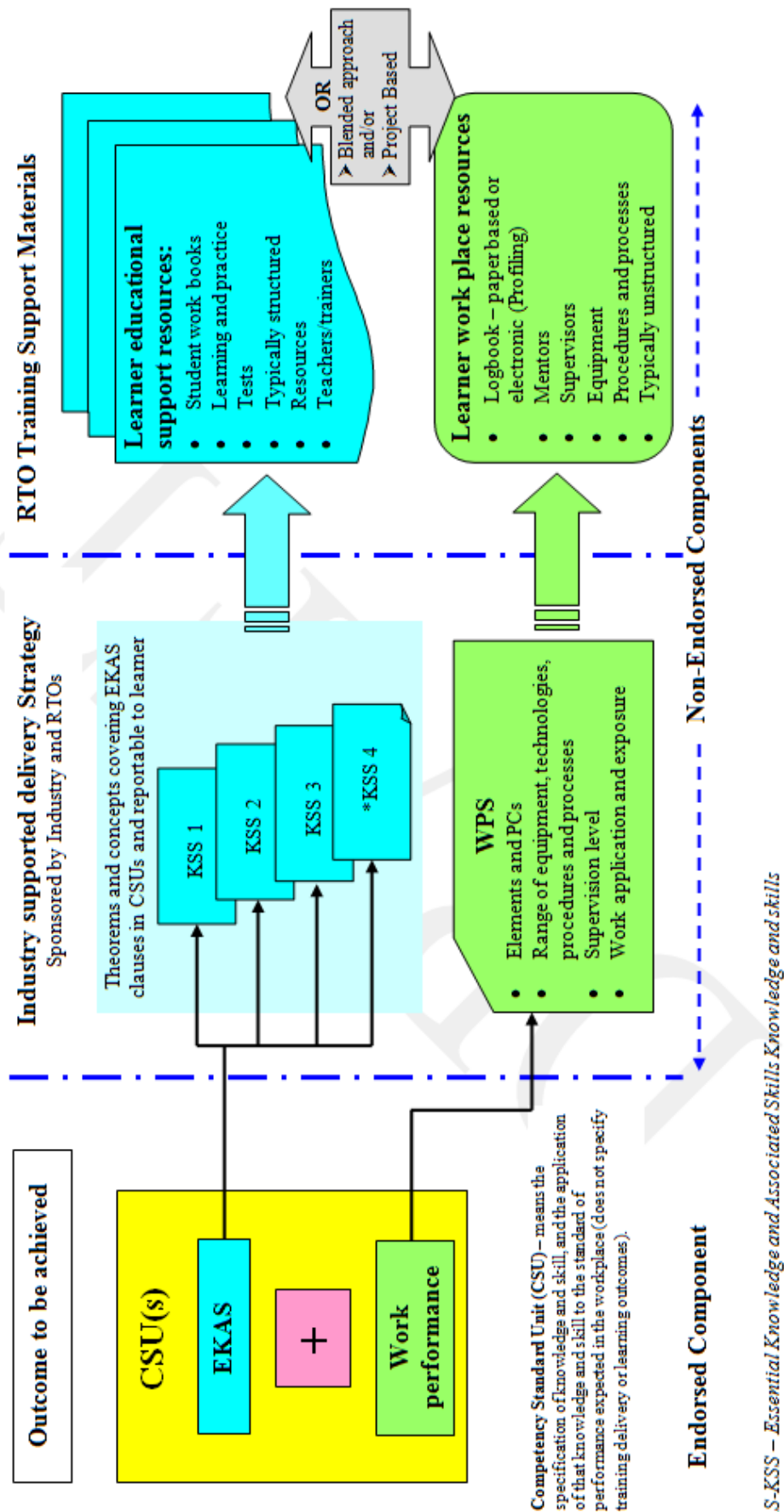
- recognising learning, eg the trainee has completed some aspects but not all the competency standard unit(s) required
- providing information that is transferable to other environments in the industry.

The concept model detailed on the next page explores how training and assessment materials and resources may be best developed for one or more competency standard units.

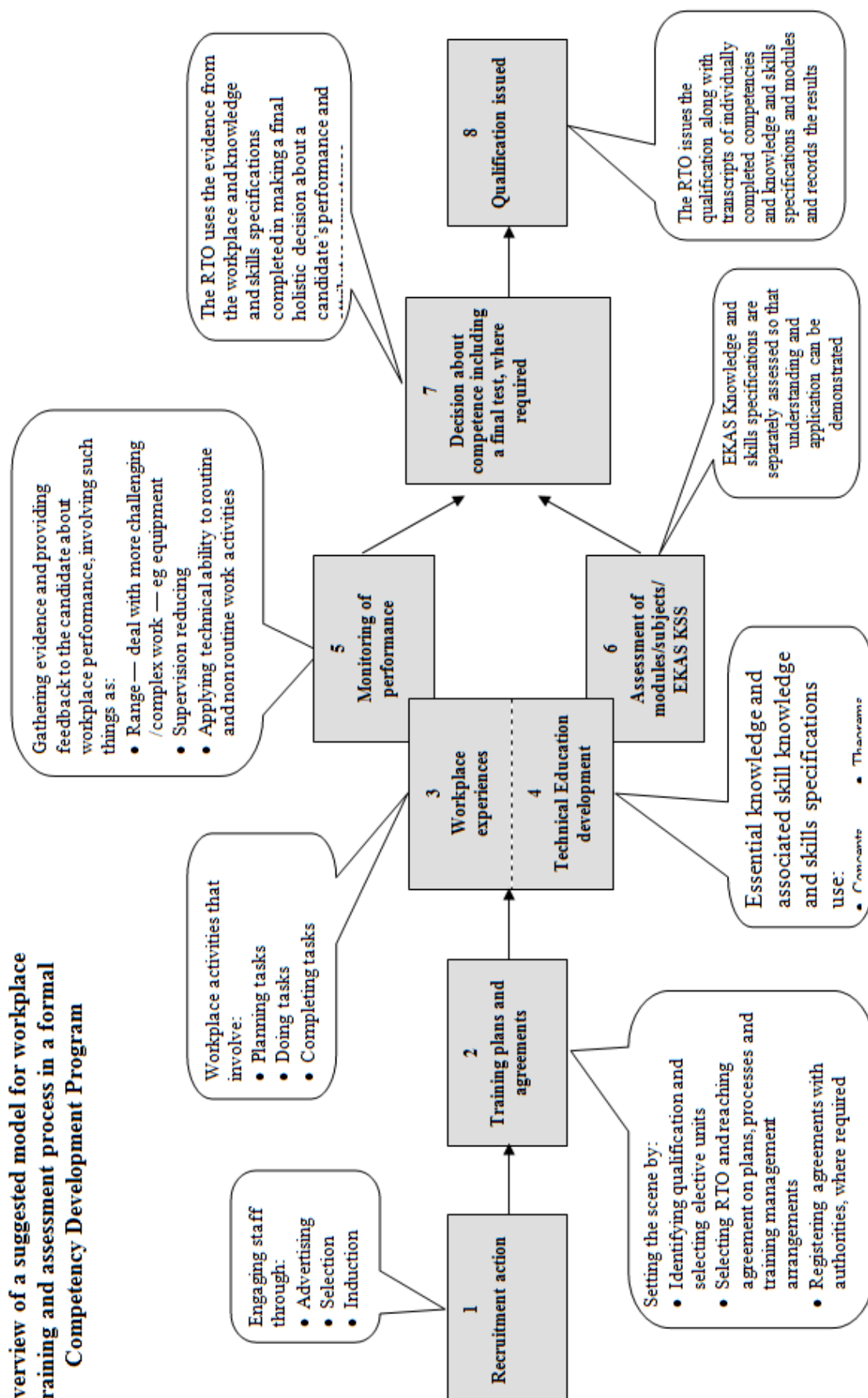
Using this approach an RTO can ensure increased consistency in

- meeting the specifications in learning and work performance against the competency standard units
- developing the learner in a cost effective way with little disruption to the day-to-day operation of the workplace.

RTO competency development training design model for new entrants using one CSU as an example

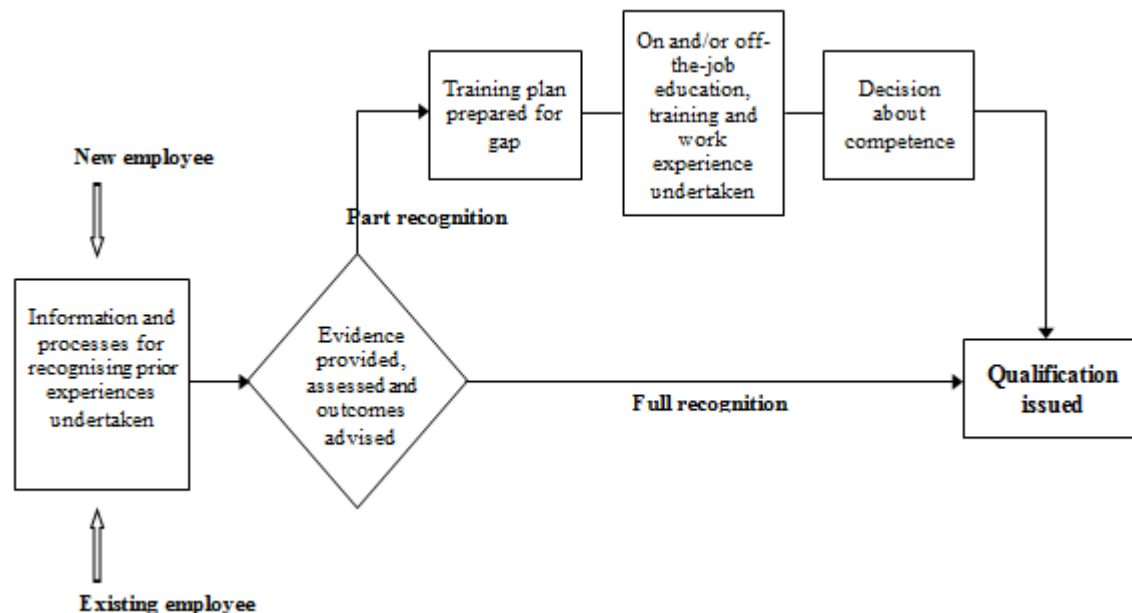


Overview of a suggested model for workplace training and assessment process in a formal Competency Development Program



Recognition of Prior Learning/Experience Model

A typical process for candidates seeking to have their prior experiences recognised within the model is shown in the following diagram.



Learning and Assessment strategies

The skills and knowledge required by a competent worker are described in terms of competency standard units. To be assessed as 'competent' against competency standards individuals need to demonstrate that they have the requisite workplace skills and the essential knowledge and associated skills (EKAS) underpinning performance as specified in the competency standard unit.

A candidate must be assessed by a qualified assessor. The assessor must use assessment processes, methods and tools which are in line with this Training Package.

Assessment involves gathering evidence to demonstrate essential knowledge together with requisite skills/work performance. This may include assessment of knowledge and skills obtained through educational courses as well as through application of knowledge and skills in the workplace using workplace processes, equipment and activities.

Assessment Planning

Good planning of workplace assessment is most important. The plan is to be based on a suitable process, one that is in line with the Competency Unit — TAAASS401A Plan and organise assessment. Assessors need to address the following components of competence in Training Package TAA04, which cover:

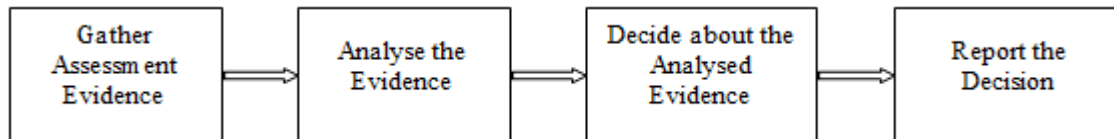
establishing evidence requirements for a specific context

establishing suitable assessment methods

developing assessment tools appropriate to a specific assessment context
trialling assessment procedure.

The Assessment Process

The general process for assessing competence is shown in the following diagram.



Assessors need to adapt the process to take account of physical and operational conditions as well as the characteristics and background of the candidate being assessed. Once the process has been finalised, the candidate should be advised.

Assessment Pathways

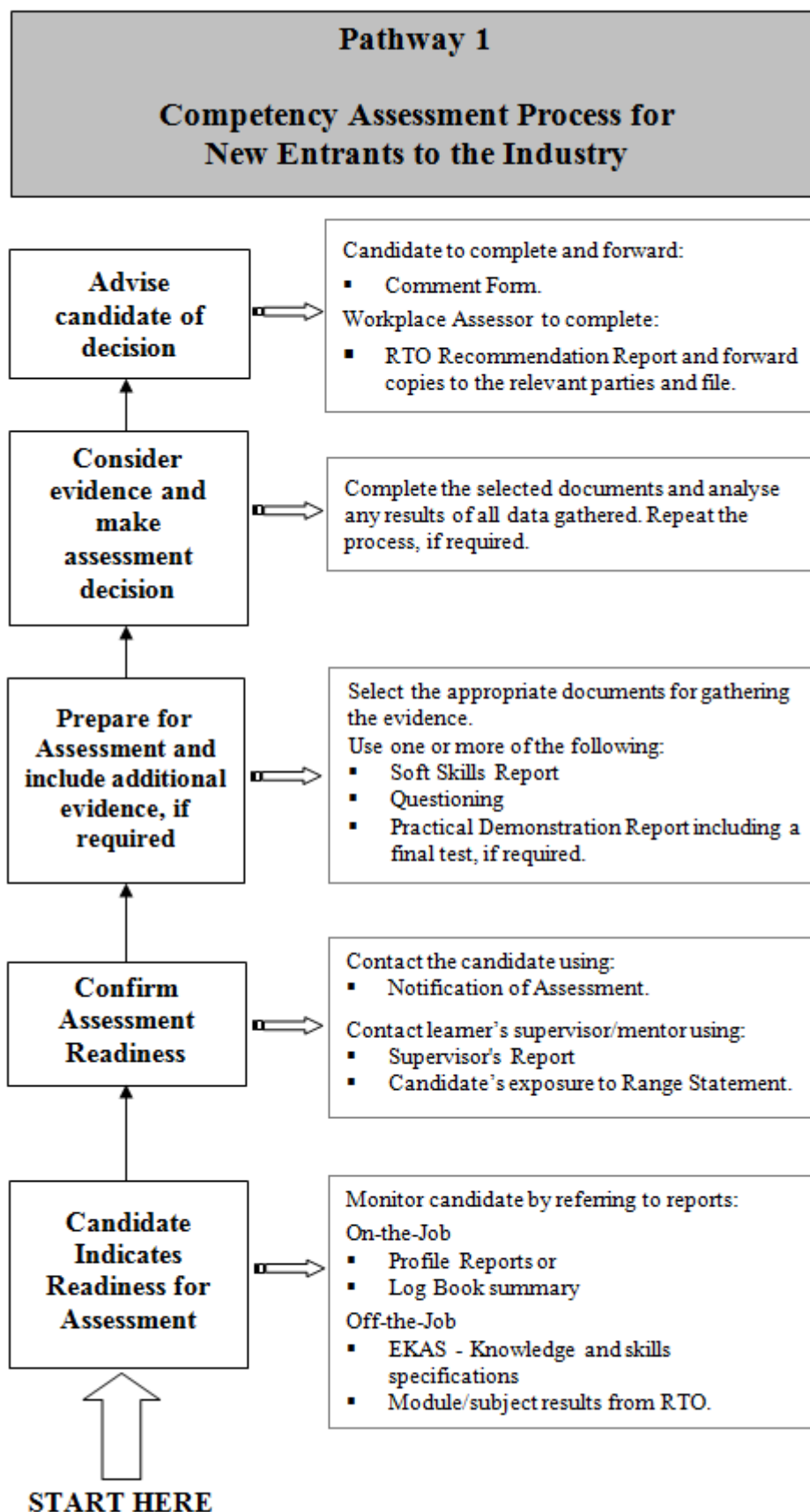
The Assessment Guidelines of this Training Package identify three assessment pathways for the Industry, as follows:

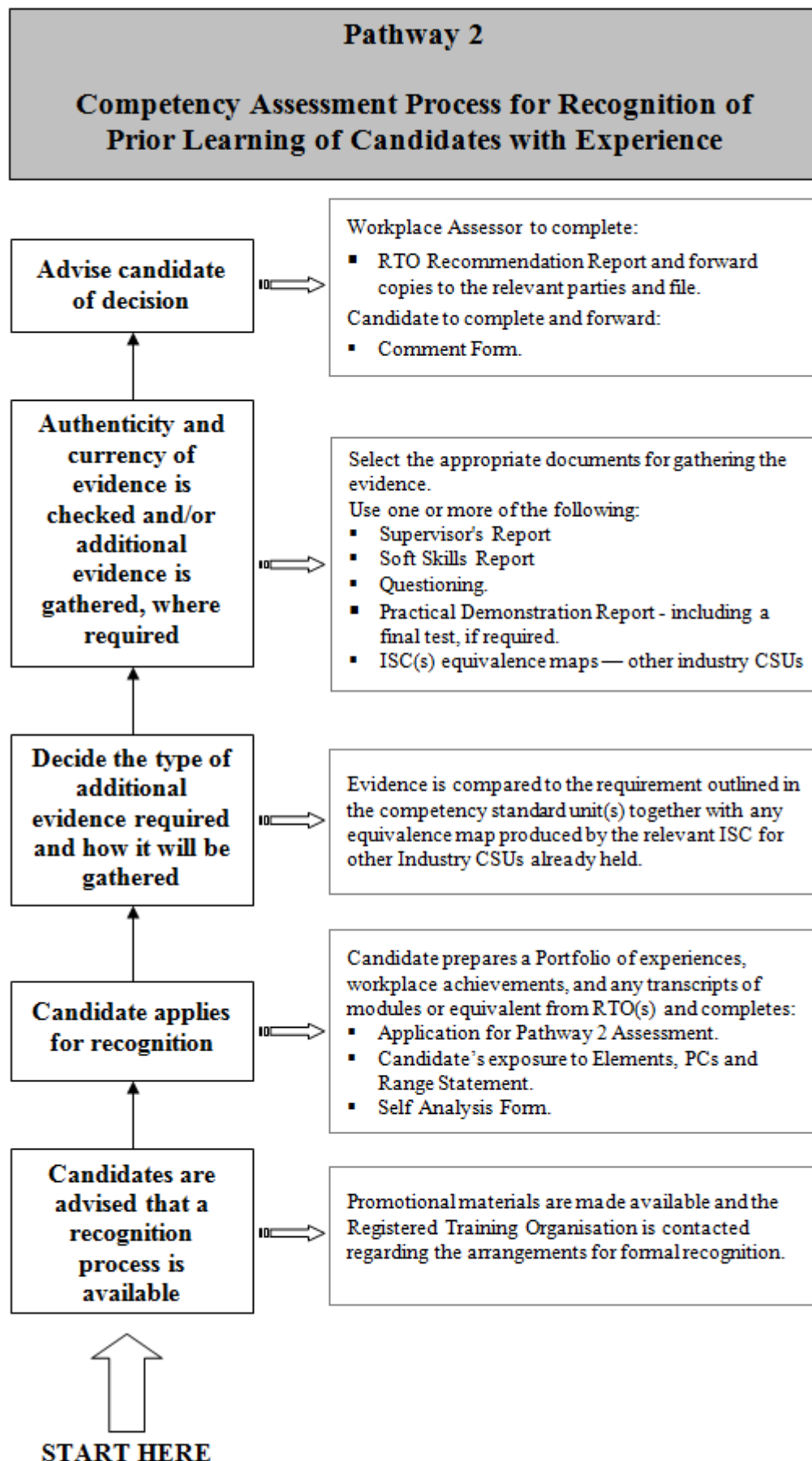
Pathway 1: For new entrants to the industry

Pathway 2: Recognition of prior learning of those with experience in the Industry

Pathway 3: Recognition of equivalent competency standard units from other Industry Training Packages

Note: Pathway 3 can be incorporated within the Pathway 2 processes and activities.





Establishing the Evidence Requirements

Training Packages provide a clear statement regarding the evidence requirements in the Evidence Guide and in particular the critical aspects of evidence of each competency standard unit. The following is an extract from one competency standard unit.

‘Critical aspects of evidence required to demonstrate competency in this unit

Before the critical aspects of evidence are considered all prerequisites shall be met.

Evidence for competence in this unit shall be considered holistically. Each element and associated performance criteria shall be demonstrated on at least two occasions in accordance with the "Assessment Guidelines – UEE07". Evidence shall also comprise:

A representative body of performance criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:

- *Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and*
- *Apply sustainable energy principles and practices as specified in the performance criteria and range; and*
- *Demonstrate an understanding of the essential knowledge and associated skills as described in this unit to such an extent that the learner’s performance outcome is reported in accordance with the preferred approach; namely a percentile graded result; and*
- *Demonstrate an appropriate level of skills enabling employment; and*
- *Conduct work observing the relevant Anti Discrimination legislation, regulations, policies and workplace procedures; and*

Demonstrated performance across a representative range of contexts from the prescribed items below:

- *Verify compliance and functionality of general electrical installations as described as described in 8) and including:*

A – Selecting correct tools and testing equipment

B – Identifying visual non-compliance defects

C – Using effective methods for conducting mandatory and optional tests

D – Identifying non-compliance from test results

E – Identifying causes of non-compliance

F – Completing mandatory reporting

G – Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in the holistic assessment with the above listed items’

The evidence on which competency is deemed shall be considered holistically.

‘Items’ of evidence that the industry deems critical and that also relate directly to the Performance Criteria and Range Statements include such items as:

- Specific tools, plant and equipment
- Specific testing techniques

- Any advice limiting assessment to actual workplaces, for example because of licensing, regulatory or unique infrastructure requirements
- Specific licensing and regulatory requirements
- Any advice dealing with unexpected and non-routine contingencies by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a holistic assessment.

Assessment Methods

Assessment involves determining whether a candidate has provided sufficient evidence to demonstrate that they have a specified level of skills and knowledge which they can apply in their work environment.

- The evidence provided may include:
 - work activity records
 - a transcript of training outcomes
 - a portfolio of learning experiences
 - a self-assessment by the candidate against the relevant competency standard(s).
 - supervisor's report(s), addressing requirements of the identified competency standard(s)
 - practical demonstration
 - details of training undertaken linked to requirements of the identified competency standard(s), such as a profiling or 'many samples' reports
 - outcomes of a challenge test.

The assessor may use a variety of assessment methods to gather evidence. Appropriate methods for documenting workplace experiences related to this Training Package are:

- on-the-job work observation
- practical exercises in the workplace or under simulated workplace conditions
- appraisal and report by a supervisor/trainer or colleague
- questioning and discussion with the candidate
- written/practical test
- any Industry Skills Council equivalence mapping declaration for competency standard units held from other Industry Training Packages.

Develop the Assessment Tools

The assessment tools include:

- instruments for gathering evidence – samples included as Enclosure A
- forms for administering the process – samples included as Enclosure B
- assessment design materials Glossary of Terms – included as Enclosure C.

Trial the Assessment Procedure

It is very important to trial the assessment strategy. There is a need to make sure it is appropriate to the context in which the assessment is conducted. This will involve:

- a focus on the specific requirements of the competency standard unit being assessed

- consideration of the characteristics and background of the person being assessed to make sure the assessor supports the candidate in their understanding of the process and the skills and knowledge that need to be demonstrated
- use of assessment methods and instruments to make sure the evidence gathered:
 - addresses the conditions required to meet the Critical Aspects of Evidence as outlined in this Training Package and related competency standard units
 - is drawn from a variety of sources and reflects the required range of work circumstances
 - provides reasonable certainty that the evidence submitted is sufficient, current and authentic.

The selection and application of assessment tools is a decision made by assessors. There is no standard answer, however the following is provided as general guidance.

- Assessors need only gather enough evidence so they can make a judgment that competence has been demonstrated. Too much evidence may be difficult to analyse in a consistent manner, whereas insufficient evidence fails to satisfy the assessment criteria.
- Assessors need to adjust or modify the assessment processes and tools as required, within the constraints of achieving a valid, reliable and fair outcome.
- Assessors need to make sure assessment procedures satisfy the principles of assessment (validity; reliability; flexibility; fairness).
- Assessors need to be cognisant and use the industry-preferred assessment approach, as a first option.
-

Appendix B – Enclosure A: List of Sample Assessment Instruments

Enclosure A1	Work activity records
Enclosure A2	Transcript of training outcomes
Enclosure A3	Portfolio
Enclosure A4	Self analysis
Enclosure A5	Candidates exposure to Range Statement
Enclosure A6	Supervisor's report
Enclosure A7	Supporting skills report
Enclosure A8	Questioning
Enclosure A9	Practical demonstration
Enclosure A10	Final/challenge test
Enclosure A11	Contracted entry level Profiling Model

Enclosure A1 – Work Activity Records

Work Activity Records summarise:

- relevant activities – jobs/tasks undertaken at work
- associated resources used such as tools, plant/equipment, procedures, and operating systems
- the period of exposure to each type of task
- the level of supervision provided in the workplace.

This type of record is completed by the candidate in conjunction with the supervisor and signed by supervisor. It is important that workplace experiences are documented by candidates to help them see how their work skills and knowledge are developing relevant competency standard units.

Work Activity Records may be produced in hard copy or in electronic form. A Work Activity Record may relate to a group of competency standards or a competency standard unit.

Most often the activities and experiences recorded should be recurring workplace events/performance that involves exposure to a range of plant, tools, equipment, components and operating systems. Appropriate supervision of representative normal work activities is important to a candidate's development.

Work Activity Records provide valuable data for:

- candidates and their supervisors to track progress in acquiring work-based competencies
- assessors to make decisions about a candidate's level of competence.
- From these records assessors can determine if:
 - exposure to the desired workplace activities has occurred
 - the level of supervision is in keeping with the degree of autonomy required by the competency standard unit
 - the learner is able to perform 'whole of job' activities.

The ElectroComms and EnergyUtilities Industry Skills Council trading as EE-Oz Training Standards has a model hardcopy document that candidates can use to record their workplace activities and experiences. The document is called a User Guide. It is formatted in a way that links workplace activities to competency standard units.

More information, including User Guides and techniques for recording workplace experiences electronically, are available from the EE-Oz Training Standards at website: www.ee-oz.com.au.

Enclosure A2 – Transcript of Training Outcomes

Essential knowledge and skills, including that gained from off-the-job training, enables learners to:

- deal with both routine and non-routine technical activities
- readily adapt their skills when new technologies are introduced
- transfer skills to new work environments.

The RTO issuing the credential can generally provide current information about an individual's progress in the essential knowledge and associated skills or mapped modules/topics/subjects.

Learners who have undertaken a recognised structured training program with an RTO should submit a formal transcript – "Statement of Results" (training outcomes) from the issuing RTO as evidence, for inclusion in the process of competency assessment.

Candidates seeking recognition of prior learning need to provide evidence of knowledge and skills equivalent to the content of the essential knowledge and associated skills specifications detailed in the competency standard units in which they are being assessed, as well as their workplace experiences. Applicants for recognition of prior learning may also seek advice from the RTO about the equivalence status of available evidence of their acquired knowledge and skills.

The ElectroComms and EnergyUtilities Industry Skills Council trading as EE-Oz Training Standards at www.ee-oz.com.au can provide advice in regard to the availability of the essential knowledge and associated skills knowledge and skills specifications which have been aligned to respective competency standard units and essential knowledge and associated skills clauses.

Enclosure A3 – Portfolio

A portfolio is a collection of documents that demonstrate an individual's professional experiences and achievements in relation to identified competency standards. Typically, portfolios include information from academic achievements, employment record, work activities, supervisor reports and references.

The candidate should prepare his/her own portfolio as an accurate reflection of work and academic history and achievements.

Assessors advise candidates about the amount, type and format of evidence they should submit for assessment against identified competency standard units.

The use of a Portfolio as an assessment instrument can be enhanced by the use of the Self-analysis form included as Enclosure A4.

Enclosure A4 – Self Analysis

Self-analysis involves candidates in assessing their own level of skills and knowledge acquired through work experience and relevant training programs.

Candidates should complete a Self-Analysis Form in relation to each competency standard being assessed; identifying the evidence they can provide to demonstrate each required component of their skills and knowledge.

Assessors can check the references to determine if the evidence provided links directly or indirectly to the requirements outlined in competency standard units and use this data as part of the overall assessment process.

Typically, the self-analysis form would be used for a Pathway 2 Assessment; however, it could have application in a Pathway 1 Assessment in certain circumstances.

Self-Analysis Application Form

This form allows candidates to summarise their vocational experiences in relation to a particular competency standard units or a group of units. The information provided is used to identify the list of competencies sought for assessment. Candidates need to support their responses to questions, claims and/or comments with authentic evidence. To do this, it is recommended that they develop a portfolio of evidence to be submitted with the Self-Analysis Application Form. The information provided in the Self-Analysis Application Form should be cross referenced with the information provided in the Portfolio.

Candidates must be provided with clear instructions about the information required before they complete each form. They also need to view and understand the detailed requirements of the competency standard unit(s) against which they are seeking assessment. A workplace assessor should assist them with the instructions and details.

Candidates may need to submit a separate Self-Analysis Form for each competency standard unit(s) for which they are seeking recognition.

A sample Self-Analysis Application Form is provided below.

Sample — Self-Analysis Application Form

Enter the codes and title of the National Qualification and title and codes the Competency Standard Unit(s) from qualification for which you are seeking recognition.

Title of National Qualification	Title and code of Competency Standard Unit(s) (For which recognition is being sought)
	•
	•
	•
	•
	•

	•
	•

Enter the codes and titles of Certificates, Qualifications, Transcripts of Academic achievement, or Licences that you believe to be supporting evidence.

(Remember to include these documents in your portfolio. You must be able to demonstrate how each document relates to the respective competency standards.)

Code and name of Certificate, Qualification, Transcript of academic record or Licence	Year Achieved

Note: For all Certificates, Qualification and associated transcripts of academic records identified above, a certified copy must be provided.

Approximately how many jobs have you been involved in that relates to each of the respective Competency Standard Unit(s)?

Competency Standard Unit 1 _____ Jobs

Competency Standard Unit 2 _____ Jobs

Competency Standard Unit 3 _____ Jobs

Competency Standard Unit 4 _____ Jobs

Competency Standard Unit 5 _____ Jobs

Competency Standard Unit 6 _____ Jobs

Competency Standard Unit 7 _____ Jobs

Give details about the **largest** job you have been involved with. Briefly describe the job and where it was carried out. (Portfolio Ref _____)

Estimate the total amount of time (for all similar job mentioned above of all size) you have been involved with - tick box. (Portfolio Ref _____)

	Less than 1 week	1 to 4 weeks	4 to 10 weeks	10 weeks to ½ year	More than ½ year
1					
2					
3					
4					
5					
6					
7					

Describe the level of involvement you have had in this type of work - tick box. (Portfolio Ref _____)

	Carrying out jobs organised by others	Carrying out jobs organised by others and completing all tests and/or writing of reports	Planning the job from the beginning, carrying out the work and completing all tests and writing of reports
1			
2			
3			
4			

5			
6			
7			

To what extent were you involved in this type of work? Tick box.
(Portfolio Ref _____)

	Carrying out routine tasks	Carrying out and manage several routine tasks at one time	Deal with non routine tasks including diagnosing and rectifying faults	Organising others you work with and dealing with clients
1				
2				
3				
4				
5				
6				
7				

How much training did you require to perform the work? Tick box.
(Portfolio Ref _____)

	Self taught skills	Basic technical knowledge and skills	Analytical technical knowledge and skills	People and customer skills
1				
2				
3				
4				

5				
6				
7				

To what degree were you supervised when performing the work? Tick box.

	Constant supervision		General supervision		Self supervision	
1						
2						
3						
4						
5						
6						
7						

Describe any special features or circumstances about the type of work you have been involved with. (Portfolio Ref _____)

List as many different types of equipment items you used when you carried out the work associated with the Competency Standard Units. Make the list under headings such as plant, tools, components, systems and the like. A workplace assessor can assist you with the headings. A separate form may be provided for supplying this information. (Portfolio Ref _____)

Unit code	Unit title	Items	

For the Competency Standard Units, have you completed a whole job using the equipment items listed above? Also indicate the number of times you have done so.

CSU - 1	Involvement (circle yes or no)			Number of times
	Planned the work	Yes	No	
	Carried out the work	Yes	No	
	Completed the work	Yes	No	

CSU -	Involvement (circle yes or no)			Number of times

2				
	Planned the work	Yes	No	
	Carried out the work	Yes	No	
	Completed the work	Yes	No	

CSU - 3	Involvement (circle yes or no)			Number of times
	Planned the work	Yes	No	
	Carried out the work	Yes	No	
	Completed the work	Yes	No	

CSU - 4	Involvement (circle yes or no)			Number of times
	Planned the work	Yes	No	
	Carried out the work	Yes	No	
	Completed the work	Yes	No	

CSU - 5	Involvement (circle yes or no)			Number of times
	Planned the work	Yes	No	
	Carried out the work	Yes	No	
	Completed the work	Yes	No	

CSU - 6	Involvement (circle yes or no)			Number of times
	Planned the work	Yes	No	
	Carried out the work	Yes	No	

	Completed the work	Yes	No	

CSU - 7	Involvement (circle yes or no)			Number of times
	Planned the work	Yes	No	
	Carried out the work	Yes	No	
	Completed the work	Yes	No	

Declaration by Candidate

All the information provided is entirely factual:

Name:

Signed **Date:**

Enclosure A5 – Candidate Exposure to Range Statement

Usually completed by the candidate, this assessment instrument augments other information needed for judging competence. It should provide a list of components from the Range Statement that the candidate has been exposed to in the workplace, e.g. tools, systems, plant, test equipment and associated items. Since the Range Statement is a component part of the whole unit, assessors should ensure that the gathering of evidence by the candidate is seen as a formative part of the assessment process. Once the evidence is presented, a holistic approach to judging and attributing competence is exercised in conjunction with other related data.

Competency standard unit – _____ <i>*(Assessor to complete this section)</i>		Candidate to Complete Identify the items you have worked on
*Range Statement Item Group	*Range Statement Items Involved	
A Personal protective equipment	Goggles	4
	Gas mask	4
	Boots	
	Gloves	4
B Wiring types	TPS	
	MIMS cable	4
	Armoured cable	

A separate form is required for each competency standard unit. The assessor should complete the following parts of this form in conjunction with the candidate to make sure they are clear about what is required:

- Competency Standard Unit Title and Unit Number
- Candidate's Name
- Date
- Range Statement – Item Group: Please consult the Range Statement as described in section *Establishing the evidence requirements* of this document. Each group alpha character is to represent an appropriate 'group' of variables, such as 'components', 'tools', 'system', 'plant', 'processes', 'equipment', as required by the particular competency standard.
- Range Statement Items Involved: Please list the particular items that have been predetermined as being 'Critical' from the critical aspects of evidence section when the evidence requirements were established (see *Establishing the evidence requirements*).

Candidates place a tick in the column against those items they have been exposed to in a work environment. Candidates should add to the list of items involved, where appropriate. An example is provided below.

**Candidate's work experience with items in the
Range Statement listed in this Competency Standard Unit**

Competency standard unit title:		Unit no:
Candidate's name:		Date:
Range Statement Item Group	Range Statement Items Involved	Candidate to Complete Identify the items you have worked on
A		
B		
C		

D		

Declaration by Candidate

All the information provided is entirely factual:

Name:

Signed **Date:**

Enclosure A6 – Supervisor’s Report

Comments made by the candidate’s supervisor/mentor are an important source of evidence for assessors. Typically, the ‘supervisor’ (mentor) approached to provide a report for competency assessment will have to spend considerable time guiding or monitoring the candidate in his/her development by providing supervised workplace learning experiences, appropriate to the candidate’s ability.

Supervisors should be asked to comment on the candidate’s ability to:

- demonstrate specific skills as described in the respective aspects of the competency standard units under assessment
- apply required essential underpinning knowledge and associated skills, e.g. as learnt in their technical studies, to the work undertaken
- work independently or in a team in a way that is productive and safe.

The Supervisor's Report can be completed as part of the pre-assessment planning process or during any other part of the process. More than one supervisor can provide information.

Assessors should make sure supervisors are clear about the specific detailed requirements of the Electrotechnology Industry Competency Standards targeted for assessment.

A sample report form is provided below.

Supervisor's Report on _____ (Learner's Name)			
Name of Supervisor/Assessor: _____		Date: ____/____/____	
Position in organisation: _____ Contact number: _____			
Approximate time (cumulative) providing guidance to the candidate _____ days / hrs in Unit(s): _____ _____			
Responses made by supervisors/mentors are for the purpose of providing information to a workplace assessor. The supervisor is <u>not</u> making a decision about competence. The assessor will include the information with other data in the decision making process.			
Question asked of the supervisor/mentor		Responses	
Taking into consideration the candidate technical development and work experiences, can they:	Yes	Requires further training	No
Carry out duties with confidence			
Work in a safe manner with care for self and others			
Perform tasks with the minimal amount of waste or rework			
Complete tasks within a reasonable time			
Identify ways of improving how jobs are done			
Initiate action to improve processes or practices			
Work with others to achieve the work outputs of the group			
Work independently to achieve work outputs			
Resolve non-routine work functions			
Other comments:			

Supervisor's/Assessor's Signature: /	Date: /

Enclosure A7 – ‘Supporting Skills’ Report

‘Supporting Skills’ refer to non-technical skills which are embedded in all the competency standard units. Demonstration of these is an essential part of competency assessment.

Non-technical skills include:

- the ability to work independently or in teams while dealing with customers
- knowledge of and ability to follow enterprise policies
- communication skills used in following and issuing instructions
- knowledge of and ability to address quality assurance requirements
- personal management and development skills
- knowledge of and ability to address environmental protection and sustainable energy policies issues.

A Supporting Skills Report may be completed by an assessor, the candidate’s supervisor or another third party. Below is an outline of aspects covered by Supporting Skills.

Supporting Skills – What do they cover?

1. *Enterprise Instructions*

Technical manuals

Using enterprise or manufacturers’ technical manuals to ensure equipment and parts are installed to manufacturer specifications.

Quality systems

Plan, apply and contribute to quality systems.

Computers systems

Use enterprise documentation and record systems, including where appropriate the use of data-capture equipment such as computers, information systems and technologies.

Environmental and sustainable energy requirements

The safe disposal of used oil, grease and chemicals, the reduction of electrical energy by turning off lights and heating devices and minimising the impact that engineering practices have on the environment.

Occupational Health and Safety (OHS) requirements

Follow OHS and standard operating procedures in a manner that is safe to the individual and others.

Equal opportunity / Ethical practice / Cultural diversity

Become familiar with enterprise, equal employment opportunity policies, ethical practices and principles and cultural diversity.

Enterprise vehicles

Vehicle log book details are completed accurately, ensure the vehicle is kept clean and secured, and fuel and liquid levels are maintained.

2. Customer relations

Public

Provide courteous and informative advice during construction, maintenance or service activities.

Workers providing other services

Cooperate with workers providing other construction, maintenance or service activities.

Clients and land owners

Recognise the responsibilities and rights of clients and land owners.

Authorities

Recognise the responsibilities and rights of statutory and other authorities.

3. Self development

Systematic problemsolving

Solve problems using technical literature, exploring theories, performing calculations and by making enquiries.

Personal well being

Maintain and promote personal well being in the workplace through fitness and by avoiding excessive use of alcohol, tobacco and other harmful substances.

Time management

Be punctual, complete work activities on time/to deadline and sequence activities to maximise the use of available time.

Professional development

Seek to improve technical ability by discussions with others or by technical research and on-going competency development.

4. Team work

Communication

Communicate plans, information, intentions and safety criteria to others using appropriate means.

Team involvement

Contribute positively to the work-team environment.

Competency Enhancement

Participate in the training of others by sharing ideas, explanation of operating systems and detailing the working arrangements of components and equipment.

Instructions for Completing the Supporting Skills Report

When completing a Supporting Skills Report, the workplace assessor (or nominee) should refer to documentation, ask the candidate questions and/or seek advice from the candidate's supervisor/mentor.

Complete the form in the following way.

Step 1

Place a cross (X) in the box to indicate areas from where evidence has been sourced.

Supporting Skills Report		
Candidate's name		Date
Supervisor's/Assessor's name		/ /
Enterprise instructions 1. Applies correctly without constantly making reference to them. 2. Refers to them regularly and applies information correctly. 3. Awareness of their existence but not referred to or used.		Rating ① 2 3
Technical manuals	X	Identify a minimum of three.
Quality systems	X	
Computer systems	X	
Environmental requirements	X	

Step 2

Review documentation and/or ask questions of the learner or their mentor/ supervisor.

Step 3

For each area, establish the appropriate level (1, 2 or 3) that reflects the capability of the learner. Place a circle around the corresponding number. Evidence should be collected from a number of sources before rating the candidate.

Note: A rating of 2 or 3 indicates further training or experience is required. A rating of 1 indicates the candidate has demonstrated their competence in this area.

Supporting Skills Report	
Candidate's name	Date
Supervisor's/Assessor's	/ /

name		
Enterprise instructions	Rating (circle #)	
1. Applies correctly without constantly making reference to them.	1	
2. Refers to them regularly and applies information correctly.	2	
3. Awareness of their existence but not referred to or used.	3	
Technical manuals		Identify a minimum of three.
Quality systems		
Computer systems		
Environmental and sustainable energy requirements		
Occupational health and safety requirements		
Equal opportunity/Ethical practice/Cultural diversity		
Enterprise vehicles		
Customer relations	Rating	
1. Customers are included in discussion effecting operational issues	1	
2. Knowledge of but limited application of customer relations.	2	
3. Requires more understanding of customer needs.	3	
Public		Identify a minimum of two.
Workers providing other services		
Clients and land owners		
Authorities		
Self development	Rating	
1. Desire to expand beyond the present job role.	1	
2. Keeps abreast of new products and services.	2	
3. Requires more understanding of the job role.	3	
Systematic problem solving		Identify a minimum
Personal well being		

Time management		of two.
Professional development		
Team Work 1. Shares ideas, assists and accepts assistance from others 2. Accepts ideas and assistance from others. 3. Prefers not to assist or accept assistance from others	Rating 1 2 3	
Communications		Identify a minimum of two.
Team involvement		
Competency enhancement		

Enclosure A8 – Questioning

As part of the assessment process it may be necessary to gather additional evidence to clarify specific aspects of competence.

The RTO assessor (or their nominee) may need to ask questions of the candidate, their supervisor or their trainer. A form is provided in this enclosure for documenting their responses. The form provides guidelines for questioning a candidate about the Performance Criteria related to each Element of competence. Below are two tables which provide guidelines for assessing a candidate's response to these questions.

If the assessment is formative, part of a training process, the response given by the candidate should be consistent with the 'Appropriate coverage to questions – level 1'.

If the assessment is summative, final, the responses should be consistent with the 'Appropriate coverage to questions – level 2'.

Note to assessors:

1. As competency standard units are typically structured around PLAN, CARRY OUT and COMPLETE jobs in the workplace, the form for recording responses is generic.
2. Please make reasonable adjustments to the form as required to accommodate particular aspects of individual Competency Standard Units.

Level 1 Appropriate Coverage of Responses to Questions

Element 1 – Planning for job/task functions (L1)
Issues about involvement of personnel, enterprises operational requirements and the requirements of regulators would not normally be expected. Coverage should involve such things as:

Element 1 – Planning for job/task functions (L1)**OHS**

- Clarifying instructions given if any doubt exists as to what is required.
- Checking with others involved if any personal protective equipment is needed.
- Identifying hazards and risks associated with the work, including any first aid and other similar requirements

Tools, equipment etc

- Identifying the tools and equipment that are required.
- Explaining where any special equipment is located and how arrangements will be made to have them available, if required.

The work schedule

- Identifying:
 - the work and relevant processes, procedures and personnel required
 - the process of work to be undertaken
 - the work site activities and issues to be attended to
 - the authorities associated with the work
 - any isolation procedures/permits that may apply.

Element 2 – Carrying out job/task functions (L1)

Coverage should involve such things as:

OHS

- Keeping:
 - the immediate work area clear of debris
 - tools clean and organised when not in use
 - clear of moving parts, live electrical conductors, hazards, and obstacles.
- Wearing work clothes and personal protective equipment when required.
- Performing the technical work required.
- Applying the relevant knowledge and skills underpinning performance.

Tasks

- Following instructions given by others.
- Observing what is occurring, listening to explanations about why tasks are performed in certain ways and asking questions when required.

Element 3 – Completing job/task functions (L1)

Coverage should involve such things as:

- Cleaning tools and equipment.
- Returning tools and equipment to their normal storage place.

Level 2 – Appropriate Coverage of Responses to Questions

Element 1 – Planning for job/task functions (L2)

Coverage should involve, but not be limited to, such things as:

OHS

- Clarifying instructions given if any doubt exists as to what is required.
- Arranging for any special personal protective equipment to be available.
- Checking to see if the work site is accessible.

Personnel

- Identifying other personnel involved in the work and coordinating proposed activities.

Regulatory requirements

- Arranging for relevant work instructions and installation specifications to be available, if required.
- Arranging work permits/isolation, etc.

Tools, equipment etc

- Ensuring that the tools and equipment that are required are available.
- Coordinating where any special equipment is located and how arrangements will be made to have them available, if required.

The Work Schedule

- Confirming:
 - the plan and process of work to be undertaken
 - the work and relevant processes, procedures and personnel required
 - the work site activities and issues to be attended to
 - the authorities associated with the work
 - isolation or work permits authorities.

Element 2 – Carrying out job/task functions (L2)

Coverage should involve, but not be limited to, such things as:

OHS

- Keeping the immediate work area clear of debris.
- Keeping tools clean and organised when not in use.
- Keeping clear of such things as moving parts, live electrical conductors and

obstacles.

- Wearing work clothes and personal protective equipment when required.
- Having barriers in place to exclude public access to the work place, as required.
- Ensuring all personnel involved are alerted to work activities and communications are established and maintained.
- Keeping alert to the working environment while watching for unexpected occurrences.
- Confirming appropriate competence of first aid and persons, including other requirements such as confined space and the like, where appropriate.

Engineering tasks – specific actions should be included that are additional to the following

- Performing tasks independently with reference to enterprise instructions.
- Accept and act on initial advice and feedback provided by others.
- Observing what is occurring, listening to explanations about why tasks are performed in certain ways and asking questions when required.
- Applying essential knowledge and associated skills and providing solutions to "what if" scenarios.

Technical assistance

- Further reference to enterprise instructions.
- Reference to the requirements of regulations, work instructions or other relevant standard.
- Recall of theory or application.
- Involvement of others with greater experience.

Element 3 – Completing job/task functions (L2)

Coverage should involve, but not be limited to, such things as:

Performance checks

- Checking that all guards and covers removed during the activities are replaced & adjusted.
- Checking that all temporary arrangements required during the process work have been removed.
- Carrying out any tests required by regulation or work instructions.
- Operating the installed/repairs parts or system to ensure it functions as specified.

Notification

- Informing all immediate personnel involved that the work is completed.
- Informing clients and others that the work is completed.
- Removing all signs and barriers, as necessary.
- Reporting any damaged tools and equipment and arrange replacement.

Element 3 – Completing job/task functions (L2)**Paperwork**

- Completing store/inventory paperwork.
- Completing the work log or management reports by recording what occurred and providing recommendations/solutions to be followed up in point form.

Instruction for Recording Responses to Questions**Step 1**

Identify the elements of competence on which questions will be asked.

Step 2

Identify if the response expected is typical of the candidate undergoing a formative assessment (level 1) or summative assessment (level 2). This may be different for each element involved.

Step 3

Ask the main question and indicate (Y or N) whether the candidate's response addresses the range and depth required.

Step 4

Ask follow up questions to probe any areas not recorded as Y in Step 3. Record Y or N to the response given in the space provided.

From all the evidence presented a holistic judgement is then made.

Questions

Unit Title:					
No.					
Candidate's name:					
Assessors name:					
Main Question for the 'Planning Work' Element	Expected Response Level			Not used	
	(circle)	1	2	(tick)	
What are the main things you would					
<i>consider when you are planning and preparing for work?</i>					
Issues to be covered in response to the main question – and – follow up questions, if required				Coverage	

Unit Title:					
No.					
Candidate's name:					
Assessors name:					
					(Y or N)
What occupational health and safety issues do you consider?					
Who are the personnel you would involve?					
What enterprise requirements need to be taken into account?					
What regulatory requirements need to be taken into account?					
What tools, equipment and other items need to be arranged to do this job, where will you get them from and how will you arrange to have them made available when you need them?					
What work schedule will be followed?					
Main Question for the 'Carry-Out Work' Element	Expected Response Level			Not used	
	(circle)	1	2	(tick)	
What are the main things you will do <i>to ensure the work you carry out is done productively?</i>					
Issues to be covered in response to the main question – and - follow up questions, if required					Coverage (Y or N)
What are the main OHS practices and precautions that are specific to this work function?					
What are the main engineering tasks involved in carrying out this job?					
What would you do if the work you were undertaking became technically difficult and you could not complete it to requirements?					
What essential knowledge and associated skills would support a response to providing solutions to "what if" scenarios?					

Unit Title: (Cont.)					
No.					
Main Question for the ‘Completing Work’ Element What are the main things you will do What are the main things you will do	Expected Response Level			Not used	
	(circle)	1	2	(tick)	
<i>What needs to be done to finalise the job?</i>					
Issues to be covered in response to the main question – and – follow up questions, if required				Coverage (Y or N)	
What checks need to be made to insure the work you undertook meets specified performance requirements?					
Who do you notify that the work has been completed?					
What paperwork needs to be completed and what will you write about?					

Enclosure A9 – Practical Demonstration

An assessor may need to observe a candidate demonstrating practical tasks. The Engineering Practical Skills Form is designed to help assessor’s record work-based observations. In the Sample Form below, notes taken are analysed and a rating is given for the candidate’s engineering skills.

Note to assessors:

- The form for recording responses is generic to all competency standard units.
- Make reasonable adjustments to the form as required to accommodate particular aspects of individual competency standard units.
- You may only need to observe candidates on particular (not all) elements of competence.
- If the assessment is formative (for feedback purposes), then the level of supervision that applies during work activities should apply during the assessment activity.

Instructions for Completing the Engineering Practical Skills Form

The form provides a means of recording information about a learner’s engineering practice. A workplace assessor (or nominee) does this by observing pre-arranged activities and determining an engineering skills rating.

Step 1

Enter the title of the competency standard unit and the unit number in the space provided.

Step 2

Enter the learner's name in the space provided.

Step 3

Enter the name of the person who is completing the form. This may be the assessor or someone who the assessor nominates to gather the information.

Step 4

Enter the date on which the evidence is gathered.

Step 5

Determine the elements of competence being observed (circle yes or no).

Step 6

Determine the level of supervision that is to apply to the Elements being observed. Use the Supervision Level Code from the bottom left of the form (A, B or C) and enter it in the second column.

Step 7

Observe the learner perform tasks related to the element(s) being assessed, checking that they address the required Performance Criteria. Record in the first column of the table under the heading 'Notes from Observation' key points to indicate whether the learner has acted in a way that meets specifications required by manufacturers, regulations or client specifications by: following established enterprise procedures, meeting the requirements of the Competency Standard being assessed and not needing prompting during the assessment.

- Needed to be shown or told how to perform tasks beyond what is reasonably expected given his/her level of experience and therefore requires further training.

Step 8

Using the Engineering Skills Rating codes at the bottom right of the table, enter the appropriate letter in the space provided to indicate the level of competence demonstrated in relation to the Competency Standard being assessed.

From all the evidence presented a holistic judgement is then made.

Engineering Practical Skills Form			
Competency Standard Unit title: _____		Date: ____/____/____	
Candidate's name: _____		Assessor's Name: _____	
Notes from observation		Supervision Enter A, B or C	Engineering Practice Enter D, E, F, G
Plan activities: Yes or No (circle to indicate if evidence is being gathered)			
Carry out activities: Yes or No (circle to indicate if evidence is being gathered)			
Complete activities: Yes or No (circle to indicate if evidence is being gathered)			
Supervision - Level		Engineering Skills - Rating	
A	The learner is working under direct supervision.	D	Met required specifications.
B	The learner is working under limited supervision	E	Followed established enterprise procedures.
C	The learner is working under general supervision with a high degree of autonomy	F	Met competency standard requirements
Learner's Signature		G	Further training required
Assessor's Signature			

Enclosure A10 – Final/Challenge Test

A test may be required if the assessment process does not provide:

- sufficient, authentic or current evidence
- particular aspects of evidence related to equipment operation
- particular aspects related to safety
- all the requirements related to the influence of external bodies such as regulatory authorities

A final test should:

- cover the conditions associated with the ‘Critical Aspects of Evidence’ statement in competency standard units
- take into account the principles of assessment and be sufficiently rigorous
- be consistent with the policies and practices of the RTO providing the recognition.

Enclosure A11 – Contracted Entry Level Profiling Model – Sample assessment instruments that support a profiling model

The industry-preferred assessment model for Australian Apprenticeships involves longitudinal approaches to assessment activities that are considered more efficient and effective. This is best achieved by implementing a process of frequently gathering reliable data from the workplace by the learner and having it verified in a form that can be easily and consistently interpreted.

One option is to use a machine-readable data scan card or direct web entry process operating in conjunction with a computer software program. The design of the system, known as Profiling, reflects the key requirements outlined in the relevant competency standard units making up the competency development plan/program. Learners report directly on their exposure to required work experiences in a structured way. Additional to the off-the-job technical training required for contracted entry level learners, Profiling gathers specific workplace information reliably and systematically.

Data gathered frequently from the workplace accumulates over the competency development period and is reported graphically at given periods. This approach encourages self review and participation in the system, eliminates bias and minimises the effects of low levels of literacy (see below for an example).

The information gathered under Profiling, forms one component of a two part, in some cases three part, Training Program that supports competency development in a way preferred by the industry. The components are:

1. off-the-job training (technical subjects/topics)
2. on-the-job training (workplace activities)
3. a specific final ‘safety systems (capstone)’ test, where applicable.

Typically, the off-the-job component requires the successful completion of technical subjects/topics of training against essential knowledge and associated skills (EKAS) clauses included in the relevant competency standard units. Usually the EKAS are aligned to EKAS Knowledge and skills specifications that expand on the essential knowledge and associated skills clauses, providing more detailed information on depth and breadth of learning required to be delivered by RTOs. The on-the-job component requires that a profile be developed from workplace experiences/exposures. Finally, a specific safety assessment test is conducted, where applicable, for regulatory and industry requirements.

On-the-job workplace data (experiences/exposures) is gathered for the required aspects of industry-determined competency standards, this data is then reported on relative to already developed industry norms. Typically the information gathered includes:

- activity measured against each element of competency against the performance criteria
- the range of equipment, processes, techniques and applications worked with/on in the workplace
- level of supervision of a learner's workplace experiences
- hours of exposure (recording hours only is not generally considered Profiling)

Data is entered against the prescribed criteria regularly (e.g. weekly) by the learner, the software program calculates the data against industry predefined norms and regular reports are produced (typically quarterly) for the use and information of RTOs, employers and the learner. Assessors use this information in a holistic way to identify and analyse trends and anomalies against the predefined industry norms.

The advantages of electronic Profiling over other methods such as manually based log-books are that the computer does the extensive and laborious analysis that the assessor would otherwise have to do and that it is simple and directly reflective of the workplace experiences undertaken by the trainee. It provides evidence for:

- managing workplace skill development/ performance of competency to required standards
- progressive assessment and supporting the attainment of a national qualification
- the attainment of an electrical workers' licence/regulated registrations, where appropriate
- the need for job rotation
- allocating work
- RTOs without invasive and expensive worksite visits by none worksite staff

To gain an appreciation of what a data card and a report may look like a sample of each is included over the page.

Sample Data Card and Quarterly Report – provided below

Note: details of fields determined by Industry to accommodate enterprise requirements

Sample Data Card

**Certificate III Electrotechnology
Systems Electrician**

Week Number

Profiling Registration No.

Apprentice Surname

Apprentice Signature _____

[illegible]

SAMPLE ONLY

SAMPLE ONLY				This week I :	Install support / protection	Install/terminate LV cables	Install H network comms cables	Test Apparatus / circuits	Install apparatus	Commission apparatus / circuits	Diagnose / rectify faults app/circuits	Maintain apparatus / circuits	Install explosion protected equip	Maintain hazardous area equip	Monitor energy usage	Install / maintain fluid m'tment equip	Electrical supporting activities	Off-job training attended (eg college)	Sick	Leave / RDO etc.	PASSED one module	PASSED half module
Choose appropriate combinations of hours	worked in the these areas				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	for approximately																					
	up to 2 hrs				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	4 hours				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	8 hours				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Choose one or more above	planned (ie interpreted diag etc.)				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	carried out (ie conducted work)				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	completed (ie compliance etc.)				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Choose one or more above	whilst under direct/constant supervision				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	general/intermittant supervision				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	broad supervision				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Cable/wiring support protection				aerial	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				cable tray/ladder	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				catenary support	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				metallic conduit	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				non-metallic conduit	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				trunking	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				underground systems	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				unenclosed support (eg clips,saddles,ties)	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				other	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
Power and control - LV cables				armoured cables	☐			☐	☐	☐	☐	☐	☐	☐	☐	☐						
				fire performance cables (eg. MIMS)	☐			☐	☐	☐												

Tradesperson's signature verifies that the work was performed to an acceptable standard within an acceptable timeframe given the experience of the apprentice

Electrical Licence No:

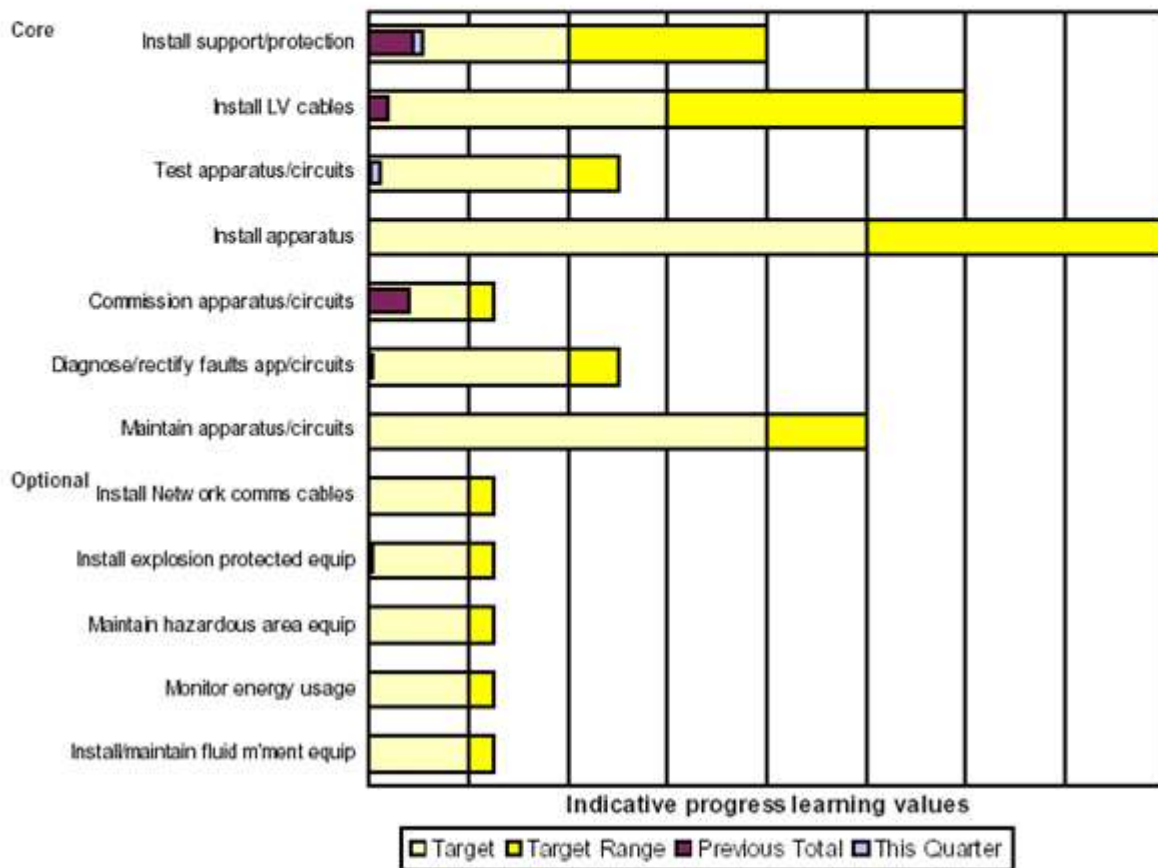
Tradesperson's Surname

Tradesperson's Signature _____

[illegible]

 Representative's Signature

NB. Both the Tradesperson's signature and Licence Number on the bottom of the card are **mandatory** - your signature means that you are simply checking that the work listed has been done. You are **not** assessing competence. There is no greater responsibility/obligation placed on the Tradesperson signing this card than there is currently under the Apprenticeship Act

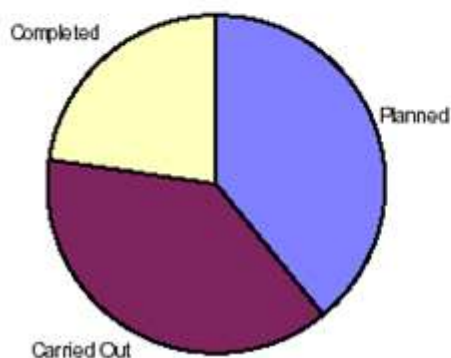
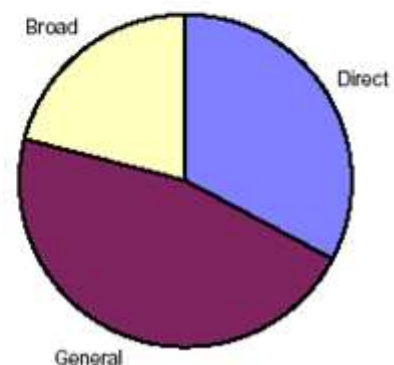
Sample Profiling Report**First Zzsample (999999)****Apprentice On Job Experience Profile - Progressive and Benchmarks Points
Systems Electrician - Quarterly Report, May 2002**

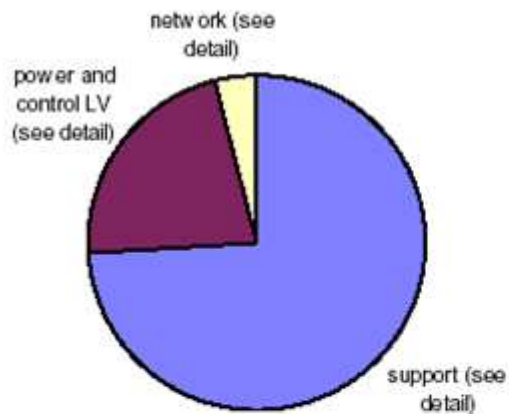
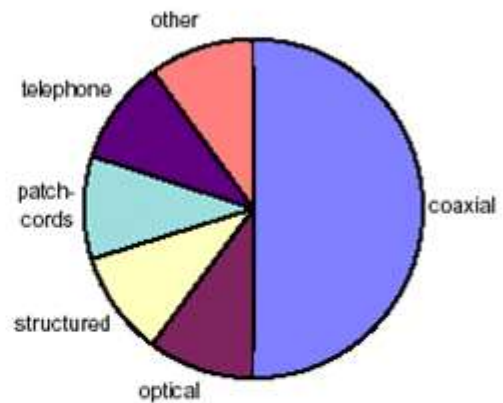
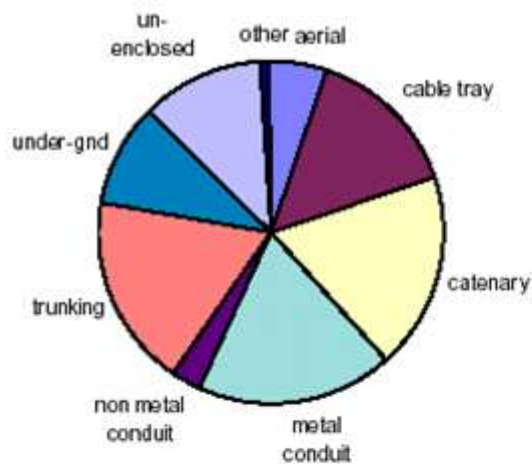
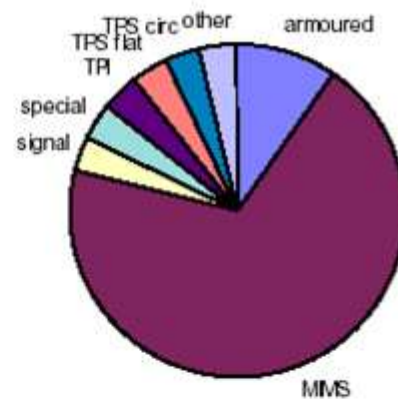
* indicates Optional competency selected by the learner in Schedule C

Apprentice Signature _____ Date _____

Employer Signature _____ Date _____

Host Signature (if applicable) _____ Date _____

Apprentice role**Supervision level**

Sample Profiling Report (cont.)**First Zzsample (999999)****Electrical wiring system type****Electrical wiring detail:
Network communications****Electrical wiring detail:
Support and protection****Electrical wiring detail:
Power & control - LV****Testing techniques used**

Appendix B – Enclosure B: Administrative forms

Enclosure B1	Notification of workplace assessment
Enclosure B2	Application for recognition of prior learning/ current competence
Enclosure B3	Assessee comment/feedback
Enclosure B4	Candidate's competency achievement report to a Registered Training Organisation

Enclosure B1 – Notification of workplace assessment

This form is used to notify a learner about their assessment. The learner is advised of the type of evidence being sought, the Competency Standard Unit(s) of competence being considered, who will be involved and the time and place of the activity.

Enclosure B2 – Application for recognition of prior learning/ current competence

Candidates should use this form to apply for recognition. The applicant needs to provide their personal details, the Competency Standard Unit(s) for which they seek recognition, the type of evidence being provided and the names of referees.

Enclosure B3 – Assessee comment/feedback

This form is used by the learner (or RPL applicant) to make comments about the workplace assessment process and/or decision. It should be distributed prior to an assessment being conducted. The workplace assessor should be sent a copy of each completed form and should retain these in case of any future review and/or inquiry.

Enclosure B4 – Candidate's competency achievement report to an RTO

This form summarises a workplace assessment process and allows workplace assessors to make recommendations to an RTO about deeming competence of a learner or RPL applicant.

Enclosure B1 – Notification of a Workplace Assessment

Learners Name: _____ **Date of notification:** / /

Assessors Name: _____ **Tel:** _____

Qualification Title: _____

The workplace assessment will be carried out on the following Competency Standard Units		For the following reason (tick)	
Unit No.	Unit Title	Advice	Completion

Location _____ **Date:** / / **Time:** _____

Information has already been gathered from or is to be gathered from the following sources indicated below.

No	Source of Information		Already Gathered (tick)	To be Gathered (tick)
1	Work Activity Records - experiences mostly relate to re-occurring workplace events.	Paper Based		
		Electronic		
2	Technical Results (i.e. modules) – part of the program that develops your technical knowledge and skill			
3	Portfolio – personal and academic detail, employment and work achievements, references and the like			
4	Self Analysis – provides guidance on the type of evidence required and guides reference to other information			
5	Item Range - list of components, tools, systems, plant, test equipment, etc on which experience is gained			
6	Supervisor's Report - general comments about applying technical skills, being safe and productive			
7	Soft Skills Report - your ability to follow instructions, deal with clients and work in teams			
8	Questioning - covers issues related to your performance when planning, carrying out and completing work			
9	Practical Demonstration - a demonstration of your ability to perform tasks in a actual or simulated situation			

10	Final Test – evidence related to critical aspects of what is required by you to demonstrate competence		
11	Other (list)		

Note: Once all the information is collected and the data analysed the results about your progress towards or achievement of competence will be forwarded to you for your comments. If you require any additional information you should contact the assessor (above telephone number) or your nominated supervisor/mentor.

Name _____ **Signature** _____

Enclosure B2 – Application for Recognition of Prior Learning/ Current Competence

Name: _____ Date of Birth: / /

Address: _____

Telephone: _____ Mobile _____ e-mail _____

Recognition Sought _____

Training Package _____

Qualification No. and Title _____

Competency Standard Units (Candidate to List)

Unit Title	Unit No.

Evidence Provided

Type	Tick if Attached
Certificates	

Relevant work history	
Transcript of Academic Record – modules completed/equivalent	
References	
(other)	

Referees

Name	Organisation and Title of Referees	Contact Number of Referees

Candidate's Signature: _____ Date: / /

Enclosure B3 – Assessee comment/feedback

To be completed by the candidate following an assessment event

Location: _____ **Date:** ____/____/____ **Time:** _____

•

Assessor's Name: _____

Please complete the following and return it to the Assessor.

Candidate's Name: _____

Contact N°: _____

I have read the Final Report for this assessment event and,

(tick)

Agree with the outcome.

☐

or

Disagree with the outcome.

☐

Comments:

Candidate's Signature: _____ **Date:** ____/____/____

Enclosure B4 – Candidates competency achievement report to RTO

This recommendation is made to (enter RTO name) _____

It is recommended that (learner's name) _____ (contact and identification details) _____

_____ be attributed competence in the following Competency Standard Units.

These Units are from the Qualification (Title and No.)

Unit No.	Competency standard unit Title	Assessors Initials

The recommendation was made based on analysed evidence taken from the following sources	Tick
Work Activity Records	
Knowledge and skills specification - Results	
Portfolio	
Self Analysis	
Item Range – Learner’s Report	
Supervisor’s Report	
Soft Skills Report	
Questioning	
Practical Demonstration	
Final Test	
Other (enter)	

Statement

The recommendation to attribute competence to the above mentioned individual is based on the evidence requirements outlined in Competency Standard Units from the _____ (Enter the Number and Title of the Training Package.)

Assessor's Name _____

Signature _____ **Date:** / /

Appendix B – Enclosure C Glossary of Terms

Definitions of all terms used in this section are set out below.

Term	Definition/Explanation
Appeal process	A process whereby the person being assessed or other interested party, such as an employer, may dispute the outcome of an assessment and seek reassessment.
Assessment	The process of collecting evidence and making judgements on whether competency has been achieved to confirm that an individual can perform to the standard expected in the workplace as expressed in the relevant endorsed industry/enterprise competency standards or outcomes of accredited courses.
Assessment context	The environment in which the assessment will be carried out. This will include physical and operational factors, the assessment system within which assessment is carried out, opportunities for gathering evidence in a number of situations, the purpose of the assessment, who carries out the assessment and the period of time during which it takes place.
Assessment guidelines	Assessment guidelines are the endorsed component of a Training Package which underpins assessment and which sets out the industry approach to valid, reliable, flexible and fair assessment. Assessment guidelines include the assessment system overview, assessor requirements, designing assessment resources, conducting assessment and sources of information on assessment.
Assessment judgement	Assessment judgement involves the assessor evaluating whether the evidence gathered is valid and authentic, and whether there is sufficient and reliable evidence to make the assessment decision. The assessment judgement will involve the assessor in using professional judgement in evaluating the evidence available.
Assessment materials	Assessment materials are any resources that assist in any part of the assessment process. They may include information for the candidate, assessment tools or resources for the quality assurance arrangements of the assessment system.

Term	Definition/Explanation
Assessment plan	An assessment plan is a document developed by an assessor that includes the elements and Competency Standard Units to be assessed, when the assessment will occur, how the assessment will occur, the assessment methods to be used and the criteria for the assessment decision.
Assessment process	The assessment process is the agreed series of steps that the candidate undertakes within the enrolment, assessment, recording and reporting cycle. The process must suit the needs of all stakeholders and be both efficient and cost-effective. The agreed assessment process is often expressed as a flow chart.
Assessment strategy	Assessment strategy means the approach to assessment and evidence gathering used by the assessor or RTO. It encompasses the assessment process, methods and assessment tools.
Assessment system	An assessment system is a controlled and ordered process designed to ensure that assessment decisions made in relation to many individuals, by many assessors, in many situations are consistent, fair, valid and reliable.
Assessment tool	An assessment tool contains both the instrument and the instructions for gathering and interpreting evidence: • Instrument[s] — the specific questions or activity developed from the selected assessment method[s] to be used for the assessment. A profile of acceptable performance and the decision making rules for the assessor may also be included. • Procedures — the information/instructions given to the candidate and/or the assessor regarding conditions under which the assessment should be conducted and recorded.
Candidate	A candidate is any person presenting for assessment. The candidate may be: • a learner undertaking training in an institutional setting • a learner/worker undertaking training in a workplace • an experienced worker wanting their skills recognised • any combination of the above.

Term	Definition/Explanation
Competency	The specification of knowledge and skill and the application of that knowledge and skill to the standards of performance required in the workplace.
Competency standard	Competency standards define the competencies required for effective performance in the workplace. Standards are expressed in outcome terms and have a standard format comprising of Unit title, Unit descriptor, Elements of Competency, Performance Criteria, Range Statement and Evidence Guide. See also Unit[s] of Competency.
Competency standard unit	Also see Unit of Competency
Critical aspects of competency	A statement in a Unit of Competency that provides clear meaning as to what is to be achieved in the assessment process.
Currency of evidence	Evidence that is relevant to what is outlined in competency units and not outdated or irrelevant.
Dimensions of competency	The concept of competency includes all aspects of work performance and not only narrow task skills. The four components of competency are: • task skills • task management skills • contingency management skills • job/role environment skills.
Electronic Profiling	An innovative electronic based logbook system used by apprentices to record, and report on their workplace activities. A specially designed data entry card is used to capture work experiences (e.g. weekly) against industry approved competency standards and reported against industry-defined benchmarks. See Section 3.5 Assessment Processes within the Electrotechnology Industry and section Appendix A — Enclosure A11 Contracted entry level Profiling Model.

Term	Definition/Explanation
Element of Competency	The basic building block of the Competency Standard Unit. Elements describe the tasks that make up the broader function or job described by the unit.
Essential Knowledge and Associated Skills clauses	EKAS clauses provide the content specifications that must be achieved by learners in terms of the body of essential knowledge and associated skills.
Essential Knowledge and Associated Skills knowledge and skills specification	EKAS knowledge and skills specification is specific learning content that is complete in itself and expands on the Competency Standard Units EKAS clauses in terms of depth and breadth. It may underpin many, few or one Competency Standard Unit(s). It covers one or more aspects of knowledge and skills. An EKAS KKS can be separately delivered and assessed with percentage achievement reporting, and may be linked with other EKAS KKSs for delivery purposes in the same discipline area.
Evidence / quality evidence	Evidence is information gathered which, when matched against the performance criteria, provides proof of competency. Evidence can take many forms and be gathered from a number of sources. Assessors often categorise evidence in different ways for example: • direct, indirect and supplementary sources of evidence • evidence collected by the candidate or evidence collected by the assessor • historical and recent evidence collected by the candidate and current evidence collected by the assessor. Quality evidence is valid, authentic, sufficient and current. It enables the assessor to make the assessment judgement.
Evidence gathering techniques	Evidence gathering technique means the particular technique or method used to gather different types of evidence. This may include methods or techniques such as questioning, observation, third party reports, interviews, simulations and portfolios.
Evidence Guide	Evidence Guide is part of a Competency Standard Unit. Its purpose is to guide assessment of the unit in the workplace and/or a training environment. The Evidence Guide specifies the context of assessment, the critical aspects of evidence and the required or

Term	Definition/Explanation
	underpinning knowledge and skills. The Evidence Guide relates directly to the Performance Criteria and Range Statement defined in the Competency Standard Unit.
Fairness	See section 3.4.1 Assessment Principles
Flexibility	See section 3.4.1 Assessment Principles
Holistic / integrated assessment	An approach to assessment that covers the clustering of multiple units/elements from relevant competency standards. This approach focuses on the assessment of a ‘whole of job’ role or function that draws on a number of units/elements of competence. This assessment approach also integrates the assessment of the application of knowledge, technical skills, problem solving and demonstration of attitudes and ethics.
Industry Skills Council/Industry Training Advisory Bodies (ITABs)	National bodies comprising representation from the industry parties responsible for the development, review, implementation, and providing advice on qualifications scopes and competency standards in given industries.
Module	A specific learning segment that is complete in itself. It deals with one or more aspects of knowledge and skills. A module is separately delivered and assessed and may be linked with other modules in the same study area and aligned to a competency standard unit(s).
Australian Apprenticeship Centre	An organisation that provides information on apprenticeships, traineeships and the related qualifications and processes.
Portfolio	See section 3.5 Assessment Processes in the Electrotechnology Industry.
Profiling	See section 3.5 Assessment Processes in the Electrotechnology Industry.

Term	Definition/Explanation
Performance Criteria	Evaluative statements which specify what is to be assessed and the required level of performance. The Performance Criteria specify the activities, skills, knowledge and understanding that provide evidence of competent performance for each Element Of Competency.
Qualification	Qualification means, in the vocational education and training sector, the formal certification, issued by a Registered Training Organisation under the Australian Qualifications Framework, that a person has achieved all the requirements for a qualification as specified in an endorsed Training Package or in an Australian Qualifications Framework accredited course where no relevant Training Package exists.
Range Statement	Part of a competency standard, which sets out a range of contexts in which performance can take place. The range helps the assessor to identify the specific industry or enterprise application of the Competency Standard Unit.
Reasonable adjustment	The nature and range of adjustment to an assessment tool or assessment method which will ensure valid and reliable assessment decisions but also meet the characteristics and background of the person(s) being assessed.
Recognition [Recognition of Prior Learning, Recognition of Current Competency and Skills Recognition]	Recognition is a term applied to Recognition of Prior Learning, Recognition of Current Competency and Skills Recognition. These all refer to acknowledgement of competencies currently held, regardless of how, when or where the learning occurred. Under the Australian Recognition Framework, competencies may be attained in a number of ways. This includes through any combination of formal or informal training and education, work experience or general life experience. In order to grant recognition of prior learning/current competency the assessor must be confident that the candidate can present evidence that he or she is currently competent against the endorsed industry or enterprise competency standards or outcomes specified in Australian Recognition Framework accredited courses. The evidence may take a variety of forms and could include certification, references from past employers, testimonials from clients and work samples. The assessor must ensure that the evidence is authentic, valid, reliable, current and sufficient.

Term	Definition/Explanation
Records of assessment	The information of assessment outcomes that is retained by the Organisation that is responsible for issuing the nationally recognised Statement of Attainment or qualification.
Registered Training Organisation (RTO)	Registered Training Organisation (RTO) means a training organisation registered in accordance with the Australian Recognition Framework, within a defined scope of registration (see Scope of Registration).
Reliability	See section 3.4.1 Assessment Principles
Sampling	See section 3.5 Assessment Processes in the Electrotechnology Industry.
Statement of Attainment	Statement of Attainment means a record of learning, recognised under the AQF, which although falling short of an AQF qualification, may contribute towards a qualification outcome, either as attainment of competencies within a Training Package, partial completion of an AQF accredited course leading to a qualification, or completion of a nationally accredited short course which may accumulate towards a qualification through Recognition of Prior Learning processes.
Sufficiency of evidence	See section 3.4.3 Assessment Judgments
Training Package	Training Package is an integrated set of nationally endorsed competency standards, assessment guidelines and Australian Qualifications Framework qualifications for a specific industry, industry sector or enterprise.
Training Agreement	An agreement outlining the training and assessment which forms part of an Australian Apprenticeship Training Contract and is registered with the relevant State or Territory Training Authority.
Training Plan	Training Plan means a program of training and assessment which forms part of an Australian Apprenticeship/traineeship Training

Term	Definition/Explanation
	Contract and is registered with the relevant State or Territory Training Authority.
Transcript of results — statement	List of candidate's modules/subjects/ EKAS knowledge and skills specifications completed as part of a Competency Standard Unit(s) or qualification.
Unit(s) of Competency / Competency standard units	Competency Standard Unit means the specification of knowledge and skill and the application of that knowledge and skill to the standard of performance required in the workplace. Competency Standard Units define the outcomes for training delivery and assessment and lead to the issuing of Australian Qualifications Framework qualifications and Statements of Attainment. See also <i>Competency Standard</i> .
Validity	See section 3.4.1 Assessment Principles
Validation	Validation involves reviewing, comparing and evaluating assessment processes, tools and evidence contributing to judgements made by a range of assessors against the same standards. Validation strategies may be internal processes with stakeholder involvement or external validations with other providers and/or stakeholders.

2.2.00 EKAS Contextualisation

EKAS Contextualisation

In some competency standard units there are 'notes' to specific content. These notes add value and clarity to the content. The notes may augment the scope, performance criteria, range statement, essential knowledge and associated skills or other related sections of the Competency Standard Unit.

The insertion of these 'notes' is primarily to provide users and support material developers with examples of the form and type related to technical content principles, technology, equipment, or processes that may be considered to be the range and depth of the outcomes.

As the type, form, process, or technique of technology and equipment may change it is the responsibility of RTOs to continue to be current in the content of their delivery.

It is therefore prudent for RTOs to consider the 'notes' in relation to their delivery and assessment.

As with the units generally where contextualisation of the ‘notes’ varies the outcome of a competency standard unit RTOs should consult with EE-Oz Training Standards to explore options for incorporating and/or covering the new arrangements so that currency of the Training Package is maintained.

It should be noted that any need to alter the competency standard units from its intended outcome requires a new or varied competency standard unit. Such changes are to be undertaken through the continuous improvement processes required of Training Packages, which in relation to this Training Package is managed by EE-Oz Training Standards.

2.2.01 Cables, conductors and terminations

2.1 Cables, conductors and terminations

2.1.1 Cable protection and support

Evidence shall show an understanding of cable protection and support method and accessories to an extent indicated by the following aspects:

a) Requirements to protect and support cables adequately

Note:

Examples of protection are protection against mechanical damage, protection from adverse temperatures and corrosion and protection from magnetic field that may affect the performance of the cable.

b) Cable support and protection devices, accessories and typical applications

Note:

Examples include metallic and non-metallic conduits, duct and trunking, cable ladder and tray, cable clips and ties and related accessories.

c) Installation techniques encompassing:

- Cable installation equipment
- Cable drawing and hauling techniques

2.1.2 Cable types and applications

Evidence shall show an understanding of the types of cables used in the electrotechnology industry and their application to an extent indicated by the following aspects:

a) Structural components of cables and their purpose

Note:

Components include conductors and conductor material; insulation; sheathings and

servings.

b) Application of various cables types

c) Cable variates

Note:

Cable varieties include single cables, flexible cables, flexible cords, shielded cables, armoured cables, ribbon cables, other similar and like cables

d) Typical characteristics and use of power circuit cables and control circuit cables

2.1.3 Cables in buildings, structures and premises

Evidence shall show an understanding of installing cables in buildings, structures and premises to an extent indicated by the following aspects:

a) Building construction method and construction sequence.

b) Typical cable routes through buildings, structures and premises.

c) Building codes affecting the installation of cables in buildings, structures and premises

Note:

Building codes include limitation on penetration structural elements and maintenance of fire protection interiority

d) Cable segregation requirements

2.1.4 Basic cable and conductor terminations

Evidence shall show an understanding of basic cable and conductor terminations to an extent indicated by the following aspects:

a) Insulation removal and replacement

b) Conductor handling and cable terminations encompassing:

- General aspects and soldering involving pins on electronic components and stranded conductors carrying current up to 25 amperes.
- Application of connecting devices for conductors and terminals
- Continuity through connections and insulation resistance testing
- Stress release on cables/conductors.

2.1.5.1 Power cable and conductor terminations

Evidence shall show an understanding of power cable and conductor terminations to

an extent indicated by the following aspects:

a) Types of cable glands and their application

Note:

Types include glands for circular sheathed cables; steel wire armoured (SWA) cables and mineral-insulated metal-sheathed (MIMS) cables.

- Cable termination techniques

b) Terminal types and applications

c) Conductor termination techniques encompassing:

- Need for sound termination
 - Consequences of poor conductor termination
 - Conductor and terminal preparation
-

Note:

Conductors include copper and aluminium

2.1.5.2 Bus bar techniques

Evidence shall show an understanding of bus bar techniques to an extent indicated by the following aspects:

a) Materials and applications

b) Shaping techniques

c) Terminations and connections

2.1.6.1 Telecommunication cable and conductor terminations

Evidence shall show an understanding of telecommunication cable and conductor terminations to an extent indicated by the following aspects:

a) Approved termination devices and sockets.

b) Special termination tools and their use.

c) Cable colour coding up to 100 pair indoor and outdoor cable

d) End to end testing

e) Methods of terminating cables encompassing:

- Cables less than twenty pair
- Twenty pair cable and greater

f) Cable labelling devices

g) Colour coding of cables, sockets and termination modules and standard connectors used with twisted pair, optical fibre and coaxial cables

2.1.6.2 Telecommunication aerial cabling

Evidence shall show an understanding of telecommunication aerial cabling to an extent indicated by the following aspects:

- a) Hazard and control measures in aerial cabling working environment
- b) Soundness of pole for aerial cabling
- c) Aerial safety equipment
- d) Procedure to applying pole top rescue
- e) Aerial construction methods and regulations
- f) Joining of an aerial cables

2.1.6.3 Telecommunication below ground cabling

Evidence shall show an understanding of telecommunication below ground to an extent indicated by the following aspects:

- a) Hazard and control measures in underground cabling working environment
- b) Types and purposes of mechanical and manual aids.
- c) Purpose, location, and capacity of man holes and pits.
- d) Types of underground cable
- e) Procedure for the excavation of a site for the installation of a man hole, pit, pipe and conduit

2.1.6.4 Voice and data cabinet cabling terminations

Evidence shall show an understanding of voice and data cabinet cabling terminations, to an extent indicated by the following aspects.

- a) Communication cable and conductor terminations encompassing:
 - approved termination devices and sockets
 - special termination tools and their use
 - cable colour coding up to 100 pair indoor and outdoor cable
- b) Methods of terminating cables encompassing:
 - cables less than twenty pair

- twenty pair cable and greater
- structured cables
- coaxial cables
- optical fibre cables
- termination safety practices

c) Cable labelling devices

2.1.7.1 Performance (copper) data cable installation and terminations

Evidence shall show an understanding of performance data cabling and conductor installation and terminations to an extent indicated by the following aspects:

a) High performance cable types encompassing:

- High performance transmission parameters
- Electrical characteristics
- Structure of UTP, FTP, and STP higher performance cables

b) High performance cabling installation and termination encompassing:

- Separation and segregation requirements and techniques
- Requirements for connecting hardware as defined in current Standards
- Installation requirements and techniques applicable to high performance cable

2.1.7.2 Coaxial cable installation and terminations

Evidence shall show an understanding of coaxial cabling installation and terminations to an extent indicated by the following aspects:

a) Coaxial cable types encompassing:

- Structure of qualshield and trishield coaxial cables armour plated coaxial cable
- Typical applications
- b) Coaxial cabling installation and termination encompassing:
 - Separation and segregation requirements and techniques.
 - Coaxial cable connectors compatible with the cable type and the environment
 - Installation requirements and techniques applicable to coaxial cables
 - Coaxial cable connectors and termination techniques

2.1.7.3 Optical fibre cabling installation and terminations

Evidence shall show an understanding of optical fibre cabling installation and terminations to an extent indicated by the following aspects:

a) Operating principles of optical fibre transmission encompassing:

- Types of optical fibre types available for telecommunications voice and data transmission.
- Difference between multimode and single mode transmission.
- Advantages of optical fibre cable compared to other cables.
- Applications of optical fibre cables.
- Requirements of optical fibre cables as specified in current Standards
- Hazards associated with working with optical fibre.

b) Installation techniques encompassing:

- Purpose and procedures for pre-testing optical fibre cable prior to installation.
- Regulations, standards and codes applicable to optical fibre installation
- Bending radii and hauling requirements.
- Cable support and securing mechanisms
- Safety precautions

c) Termination and splicing techniques

- Risk control measures applied in the preparation of fibre for termination.
- Termination devices and method
- Preparation and splicing techniques.
- Devices used to protect terminations and splices against mechanical damage and prevent contamination.

2.1.7.4 Specialist audio/video cabling installation and termination

Evidence shall show an understanding of specialist audio/video cabling installation and terminations to an extent indicated by the following aspects:

a) Features of high performance audio and video cables and interconnects

b) High performance audio and video cables and interconnects encompassing:

- Installation methods and limitations
- Terminations techniques as specified by cable manufacturers

2.1.8 Electronic cable and conductor terminations

Evidence shall show an understanding of terminating cable and conductor used in electronic equipment to an extent indicated by the following aspects:

a) Cable and conductor types and characteristics encompassing:

- Insulated wire
- Harness wiring,
- High performance cables

Note.

1. Examples of characteristics are transmission performance parameters and electrical characteristics

2. Types include UTP, FTP, and STP

b) Coaxial cables types and characteristics

Note.

Types include qualshield, trishield coaxial and armour plated coaxial cables

c) Cable anchoring and support methods

d) Termination methods

2.1.9 Winding wire types and connections

Evidence shall show knowledge and skills of winding wires and connections to an extent indicated by the following aspects:

a) Winding wires and their applications.

b) Winding wire connection methods encompassing:

- Conductor preparation
- Connection mediums
- Insulation methods

2.1.10 High voltage motor winding, conductors, connections methods and insulation

Evidence shall show knowledge and skills of high voltage winding conductors, connections and insulation to an extent indicated by the following aspects:

a) HV winding conductors and their applications.

b) HV winding wire connection methods encompassing:

- Conductor handling

- Conductor preparation
- Connection mediums

c) Insulation types and methods

2.1.11 Integrated cabling arrangements

Evidence shall show knowledge and skills of integrated cabling arrangements to an extent indicated by the following aspects:

a) Types of service that use integrated cabling arrangements, e.g. "Smart wiring" concept.

b) ELV communication and control cabling selection methods encompassing:

- Limitations imposed by equipment
- Limitations imposed by route length
- Communication rates

c) Cable schedules and planning

d) Cable identification methods

2.2.02 Common, commercial, processes and enterprise specific knowledge and skills

2.2 Common, commercial, processes and enterprise specific knowledge and skills

2.2.1 Enterprise communication methods

Evidence shall show an understanding of enterprise communication methods to an extent indicated by the following aspects:

a) Communicating with personnel encompassing:

- Oral communications
- Written procedures and work instructions

b) Communicating with suppliers

c) Communicating with customers

2.2.2 Enterprise work activities records

Evidence shall show an understanding of work activities records to an extent

indicated by the following aspects:

- a) Purpose and extent of maintaining work activities records in an enterprise
- b) Types of records for maintaining work activities in an enterprise
- c) Methods for recording and maintaining work records
- d) Work records required by regulation requirements

2.2.3 Fault finding techniques

Evidence shall show an understanding of technical fault finding to an extent indicated by the following aspects:

- a) Factors to consider in clarifying the nature of a fault encompassing:
 - Initial fault report
 - Confirmation of symptoms of the fault
 - Comparison of symptoms with normal operation
- b) Effect to cause reasoning — assumptions of possible causes
- c) Methods for testing assumptions encompassing:
 - Visual inspection
 - Sectional testing
 - Split-half tests
 - Component isolation
- d) Dealing with intermittent faults

Note:

Typical causes of intermittent faults are vibration, shock, changes in temperature and electromagnetic interference.

2.2.4 Problem solving techniques

Evidence shall show an understanding of problem solving concepts and techniques as they apply in the workplace, to an extent indicated by the following aspects:

- a) Identify problems

Note.

Examples may include: Process and quality problems; Equipment selection, availability and failure; Teamwork and work allocation problems; Safety and emergency situations and incident; Performance gaps; Profit improvement and the like.

b) Mathematical Tools

Note.

Examples may include: Average, Standard deviation and the like.

c) Use of analytical techniques in problem solving

Note.

Examples may include: Brainstorming; Fishbone diagrams/cause and effect diagrams; Logic trees; Process logic/process requirements; Similarity/difference analysis; Pareto analysis; Force field/SWOT analysis.

d) Using tools to assistance in problem solving

Note.

Examples may include: Procedures and work instructions; Safety data sheets; Job cards; Maintenance logs; Plant drawing.

e) Determine corrective action encompassing:

- Tools
- Mode of communication procedure used within each enterprise
- Established work procedures and policies
- Size and structure of the teams/enterprise
- Group goals - team, section, enterprise
- Enterprise specific conflict resolution procedures
- Action plans
- Priority requirements
- Measurable objectives
- Resource requirements
- Methods for reaching objectives
- Timelines
- Safety requirements
- Risk assessment
- Environmental requirements

f) Communicate recommendations

Note.

Examples may include: Feedback requirements; Corrective action and analysis; Following up recommendations and the like.

g) Implement Monitoring encompassing:

- Identifying components to be measured
- Measurement and monitoring techniques
- Measurement and monitoring tools

2.2.5 Enterprise customer relations protocols

Evidence shall show an understanding of enterprise customer relations protocols to an extent indicated by the following aspects:

- a) Purpose of customer relations
- b) Procedures for dealing with customers
- c) Dealing with customer issues

2.2.6 Enterprise quality management system, basics

Evidence shall show an understanding of enterprise quality management system to an extent indicated by the following aspects:

- a) Purpose of a quality system
- b) Procedures pertaining to the relevant work function
- c) Work instructions pertaining to the relevant work function

2.2.7 Enterprise purchasing system

Evidence shall show an understanding of the purchasing system within an enterprise to an extent indicated by the following aspects:

- a) Purchasing process
- b) Common suppliers
- c) Authorities to purchase

2.2.8 Enterprise costing methods

Evidence shall show an understanding of costing methods in an enterprise to an extent indicated by the following aspects:

- a) Costing policy
- b) Purchase prices and discounts for materials
- c) Labour charge out rates
- d) Margins

2.2.9 Enterprise stock control methods

Evidence shall show an understanding of stock control methods to an extent indicated by the following aspects:

- a) Enterprise purchasing policy
- b) Stock data base
- c) Purchase and sales entry mechanisms
- d) Reordering methods

2.2.10 Job costing techniques

Evidence shall show an understanding of costing small jobs to an extent indicated by the following aspects:

- a) Resources to be quantified and costed
- b) Costing labour plant and materials
- c) Service costs and margins.

2.2.11.1 Estimating techniques

Evidence shall show an understanding of estimating to an extent indicated by the following aspects:

- a) Documents used in estimating
- b) Resources to be quantified and costed
- c) Material take-off methods
- d) Costing encompassing:
 - resource (labour, plant, equipment and materials)
 - contingency
 - money
 - margins
- e) Labour rates method of costing
- f) Life cycle costing analysis
- g) Documenting estimations and costing.
- h) Evaluating estimates and costs

2.2.11.2 Specification development

Evidence shall show an understanding of specification writing to an extent indicated by the following aspects:

- a) Purpose and nature of specification
- b) Performance based specifications
- c) Prescriptive specifications
- d) Acceptable evidence of compliance
- e) Additional service required with the supply of equipment
- f) Dealing with suppliers and manufacturer's
- g) Documenting specification.

2.2.12 Tendering requirements

Evidence shall show an understanding of tenders to an extent indicated by the following aspects:

- a) Purpose and sources of a tender
- b) Documents supplied with a tender
- c) Typical special conditions included in a tender
- d) Tender submission requirements

2.2.13 User instruction techniques

Evidence shall show an understanding of instructing users in the use of specific items of equipment and systems to an extent indicated by the following aspects:

- a) Methods for evaluating user needs

Note:

User needs should include how equipment is used efficiently and safely and identifying wear and tear and damage to the equipment that requires repairing.

- b) Basic instruction methods

Note:

Methods of instruction should be appropriate to the culture of the users and the equipment for which instruction is given.

- c) Methods for evaluating user's ability use equipment correctly

2.2.14 Contracts, format, responsibilities and obligations

Evidence shall show an understanding of the format, responsibilities and obligations of a contract to an extent indicated by the following aspects:

- a) Contract purpose and formats
- b) Documents legally attached to a contract
- c) Responsibilities and obligations of parties entering a contract
- d) Regulatory requirements

2.2.15 Risk management, application and techniques

Evidence shall show an understanding of risk management to an extent indicated by the following aspects:

- a) The need for risk management within the broad project management framework
- b) Risk management methodologies, their capabilities, limitations, applicability and outcomes
- c) Uncertainty and the means of measurement
- d) The application of risk management tools and techniques
- e) Risk management in the context of the project life cycle and other project management functions
- f) Implementing risk management

2.2.16.1 Project Planning

Evidence shall show an understanding of project planning to an extent indicated by the following aspects:

- a) Purpose of project planning
- b) Documents needed to plan a project
- c) Factors influencing sequence and restraints of project activities
- d) Critical path analysis encompassing:
 - Graphical representation methods
 - Methods of representing time/rates

2.2.16.2 Project development

Evidence shall show an understanding of project development to an extent indicated by the following aspects:

- a) Purpose and source of a design brief
- b) Engineering solution development encompassing:
 - Role of standards
 - Use of proven designs
- c) Design and detail drawings required.
- d) Role of and form of job specification.
- e) Project documentation and legal issues

2.2.17 Project management

Evidence shall show an understanding of project management concepts to an extent indicated by the following aspects:

- a) Defining project parameters

Note:

Examples may include: Project scope; Project stakeholders and clients; Project phases and the relationship between phases; Time requirements and limitations; Resource requirements and limitations; Quality requirements and limitations.

- b) Time management

Note:

Examples may include: time management concepts; standard practices for ensuring a project runs to time and the like.

- c) Financial management

Note.

Examples may include: Financial management concepts; Standard practices for managing project finances; Project budgets; Costs, variations and estimations; Invoicing against project phases/deliverables; Acquittals and the like.

- d) Quality management

Note.

Examples may include: Quality management concepts; Standard practices for managing quality within a project.

- e) Human Resource management

Note.

Examples may include: human resource management concepts; standard practices for managing personnel within a project

f) Communication management

Note.

Examples may include: Communication management concepts; Standard practices for managing communication within a project and the like.

g) Risk management and contingencies

Note.

Examples may include: risk management concepts; standard practices for managing risk within a project; Internal risks; External risks; Risk minimisation; Risk removal; Contingencies and the like.

h) Procurement management

Note.

Examples may include: procurement management concepts; standard practices for managing procurement and the like.

i) Physical Resource management

Note.

Examples may include: Types of physical resource, including; Equipment, Technology, Information, Facilities; Physical resource management concepts; Standard practices for managing physical resources

j) Contracts

Note.

Examples may include: Understanding project contracts; Standard practices for working to contract specifications; Contract format; Contract content; Legal obligations of contract parties; Accompanying documentation including; Contract Schedules and the like.

k) Performance assessment and continuous improvement

Note.

Examples may include: standard performance assessment practices; standard continuous improvement practices and the like

l) Engineering ethics principles

2.2.18 Critical path and project analysis

Evidence shall show an understanding of customer/client relations to an extent indicated by the following aspects:

- a) Purpose of critical path analysis
- b) Essential data
- c) Relational sequence of work activities
- d) Graphical representation methods
- e) Methods of representing time/rates
- f) Monitoring methods

2.2.19 Customer/Client relations

Evidence shall show an understanding of customer/client relations to an extent indicated by the following aspects:

- a) Importance of customer/client relations
- b) Interpersonal skills that enhance customer/client
- c) Dispute resolution
- d) Customer/client relations strategies

2.2.20 Computer use basics

Evidence shall show an understanding of computer use basics to an extent indicated by the following aspects:

- a) Starting up
- b) Selecting application
- c) Entering information
- d) Saving
- e) Printing

2.2.21 Engineering analysis, decision making and reporting

Evidence shall show an understanding of analysis, decision making and reporting as they apply to engineering work functions to an extent indicated by the following aspects:

- a) Techniques of analysis encompassing:

- use of appropriate sampling techniques to collect data.
- types of data and classification.
- effective questionnaire design
- data collection errors.
- frequency tables.
- statistical diagrams – drawing and interpretation.
- the general shape of a frequency distribution.
- different types of diagrams.
- mean time between failures calculations

b) Summary of statistics encompassing:

- measures of central tendency
- measures of dispersion
- a 5-point summary for a given data set, box and whisker plot distribution
- data sets comparison using measures of centre and spread
- the effect of outliers on measures of centre and spread
- use computer programs or calculators to simplify calculations

c) Correlation and regression encompassing:

- bivariate data and scatter diagrams.
- product-moment correlation coefficient calculation and interpretation.
- difference between causation and correlation.
- equations of regression lines from bivariate data with a calculator and line plotting on a scatter diagram.
- using the equation of regression to make predictions in practical situations.
- investigation of practical problems using correlation and regression.

d) Investigation and reporting encompassing:

- presentation of a well formatted report with a clearly stated aim.
- using the internet to obtain relevant data.
- description of the statistical method and design chosen to meet the aim of the investigation.
- statistical analysis and results reporting.
- evaluation and interpretation of the results of the investigation.
- discussion of the investigation with reference to real world applications.
- chronology of the investigation.

2.2.22 Enterprise work/business coverage

Evidence shall show an understanding of the work covered by the employing enterprise to an extent indicated by the following aspects:

- a) Systems and equipment of the electrotechnology disciplines covered by the enterprise
- b) Where and how the electrotechnology disciplines are used
- c) The work activities involved
- d) Role of various sectors of personnel in the enterprise

2.2.23 Enterprise regulatory requirements and non regulatory standards

Evidence shall show an understanding of regulatory requirements to an extent indicated by the following aspects:

- a) Compliance regulations for businesses
- b) Methods of meeting compliance
- c) Non-regulatory standards and their effects on business

2.2.24 Technical examination and testing methods

Evidence shall show an understanding of technical examination and testing methods to an extent indicated by the following aspects:

- a) Compliance certification encompassing:
 - the purposes of certification of equipment;
 - the parties involved in the assessment/testing and certification of equipment, and
 - the scheme for recognition of assessment/testing and certification
- b) Preparation required to assess equipment for compliance with Standards encompassing:
 - documentation required prior to conducting conformity assessment;
 - tests necessary to establish that an item of equipment conforms with relevant Standards;
- c) Assessing and testing equipment encompassing:
 - types of assessment tests
 - test set ups and procedures.
 - recording and reporting requirements of conformity assessment.

2.2.25 Research Concepts

Evidence shall show an understanding of research concepts and techniques, as they

apply in the workplace, to an extent indicated by the following aspects:

a) Terminology

Note.

Examples may include: Terminology used in a research workplace; Terminology used in research-specific literature and the like.

b) Theory – why conduct research?

Note. Examples may include: The history of research; Past research successes; Past research failures; Research Protocols; Research practices and the like.

c) The research environment

Note.

Examples may include: The research work environment; Standard research practices; Industrial, legal, ethical, political and market environment considerations; Legislation and regulation; Contractual obligations of all parties and the like.

d) Planning to conduct research

Note.

Examples may include: Concept development and/or research brief analysis; Research objectives; Research deliverables; Research project plan; Literature reviews; Methodology development, including; Experimental design, Technology selection, Information Management system selection and the like

e) Clients

Note.

Examples may include: Identifying client viewpoints and stake in project; Identifying client requirements and parameters; Determining research budgets, timelines, milestones and quality attributes with clients.

f) Research, Development and Commercialisation

Note.

Examples may include: Research and Development goals versus Commercialisation goals and realities; Research and Development to inspire a commercialisation process.

2.2.26 Automated systems industry sector customs and practices

Evidence shall show an understanding of automated systems industry sector customs and practices to an extent indicated by the following aspects:

- a) Technical aspects of project planning and management encompassing:

- Method of ensuring equipment meets specified performance requirements
- Performance/cost benefit analysis
- Equipment procurement

b) Typical approaches to planning and management

c) Successful planning techniques

d) Best practice management methods and styles

2.2.27 Data and voice industry sector customs and practices

Evidence shall show an understanding of computer industry sector customs and practices to an extent indicated by the following aspects:

a) Technical aspects of project planning and management encompassing:

- Method of ensuring equipment meets specified performance requirements
- Equipment performance/cost benefit analysis
- Equipment procurement

b) Typical approaches to planning and management

c) Successful planning techniques

d) Best practice management methods and styles

2.2.28 Electrical industry sector customs and practices

Evidence shall show an understanding of electrical industry sector customs and practices to an extent indicated by the following aspects:

a) Technical aspects of project planning and management encompassing:

- Method of ensuring equipment meets specified performance requirements
- Performance/cost benefit analysis
- Equipment procurement

b) Typical approaches to planning and management

c) Successful planning techniques

d) Best practice management methods and styles

2.2.29 Electronic/computer systems industry sector customs and practices

Evidence shall show an understanding of electronic industry sector customs and practices to an extent indicated by the following aspects:

- a) Technical aspects of project planning and management encompassing:
 - Method of ensuring equipment meets specified performance requirements
 - Performance/cost benefit analysis
 - Equipment procurement
- b) Typical approaches to planning and management
- c) Successful planning techniques
- d) Best practice management methods and styles

2.2.30 Control systems industry sector customs and practices

Evidence shall show an understanding of control system industry sector customs and practices to an extent indicated by the following aspects:

- a) Technical aspects of project planning and management encompassing:
 - Method of ensuring equipment meets specified performance requirements
 - Performance/cost benefit analysis
 - Equipment procurement
- b) Typical approaches to planning and management
- c) Successful planning techniques
- d) Best practice management methods and styles

2.2.31 Refrigeration and air conditioning industry sector customs and practices

Evidence shall show an understanding of refrigeration and air conditioning industry sector customs and practices to an extent indicated by the following aspects:

- a) Technical aspects of project planning and management encompassing:
 - Method of ensuring equipment meets specified performance requirements
 - Performance/cost benefit analysis
 - Equipment procurement
- b) Typical approaches to planning and management
- c) Successful planning techniques
- d) Best practice management methods and styles

2.2.32 Renewable energy industry sector customs and practices

Evidence shall show an understanding of renewable energy industry sector customs and practices to an extent indicated by the following aspects:

- a) Technical aspects of project planning and management encompassing:
 - Method of ensuring equipment meets specified performance requirements
 - Performance/cost benefit analysis
 - Equipment procurement
- b) Typical approaches to planning and management
- c) Successful planning techniques
- d) Best practice management methods and styles

2.2.33 Working in a Team

Evidence shall show an understanding of the teams that may exist in the workplace, to an extent indicated by the following aspects:

- a) Types of teams

Note.

Examples may include; Managerial, Administrative, Project-based, Commercial and Social

- b) Roles, responsibilities and accountabilities of team members

Note

Examples may include; the role, responsibility and accountability of individuals, teams, organisational management, clients and the like.

- c) Working in a team

Note.

Examples may include; Identification and utilisation of team member skills and knowledge; Maximising benefits of team diversity; Team planning; Team commitment and cooperation; Improving/Maximising team performance to achieve goals; Team monitoring and adjustment; Plain English literacy and communication; Leading, facilitating, participating, coaching, mentoring.

- d) Working with clients

Note

Examples may include; client relations, client liaison, the practice of working with clients and the like.

- e) Conflict resolution

Note.

Examples may include: Personality analysis tools, Strategies for dealing with difficult people and the like.

2.2.34 Scientific Writing and Communication

Evidence shall show an understanding of scientific writing and communication concepts and techniques and they apply in the workplace, to an extent indicated by the following aspects:

a) Types of scientific writing and communication

Note.

Examples may include: The distinguishing characteristics of the different types of scientific writing.

b) Purpose of the different types of scientific writing

Note.

Examples may include: Product development justification and specifications; Management advice; Scientific papers/publications; Conference/meeting presentations; Policy documents; Planning documents; Reports and the like.

c) Types of audience

Note.

Examples may include: The features and characteristics of an audience, including; an audience's professional, social, cultural, ethnic background and physical and academic capabilities; the importance of 'Plain English' written and oral communication.

d) Scientific writing techniques

Note.

Examples may include: The component parts of scientific documents, including: Aim, Materials, Method, Results, Discussion, Conclusion, References; The required content of each component part; Scientific referencing techniques, including: Bibliographies, Reference Lists, Citations, Footnotes, Quotes, and Acknowledgements; Scientific labelling techniques, including: Graphs, Tables, Diagrams, and Figures; Techniques for documenting results, including: Text, Graphs, Tables, Diagrams, and Figures; Organisational standards for document and presentation production, including: Standard organisational document templates, letterheads, headers, footers, and logos.

e) Oral communication techniques

Note.

Examples may include: Techniques for communicating to large groups, including; Conference presentations, Speeches; Techniques for communicating to small groups, including: Meeting presentations, Team discussions, planning forums and the like.

f) Electronic communication formats

Note.

Examples may include: World-wide Web – protocols and practices; Email – protocols and practices; Transfer of information via CD Rom/Floppy Disk; Use of PDF and other secure files.

g) Confidentiality considerations

Note.

Examples may include: Confidentiality practices to protect the organisation; Confidentiality practices to protect the client; Confidentiality practices to protect providers of information/research cohorts.

2.2.35 Data Collection Techniques

Evidence shall show an understanding of data collection concepts and techniques as they apply in the workplace, to an extent indicated by the following aspects:

a) Data types

Note. Examples may include: Quantitative data, including; empirical, non-parametric, parametric; Qualitative data; Raw; Graphic; Diagrams; Original; Textual; Multimedia; Electronic and the like.

b) Data Collection

Note.

Examples may include: Data sources; Consultation protocols and practices; Survey methodologies, including; interviews, surveys, chat rooms, focus groups; Literature reviews, including; traditional and web-based; Group facilitation and presentation; Questioning, active listening and clarification; Obstacles to data collection, including; unavailable data, inconsistent data, confidentiality, security; Data limitations.

c) Evaluating data quality

Note.

Examples may include: Reliability; Accuracy; Clarity; Validity; Contribution to research; Relevance to research objectives.

2.2.36 Data Analysis and Presentation

Evidence shall show an understanding of data analysis and presentation concepts and techniques as they apply in the workplace, to an extent indicated by the following aspects:

a) Data analysis techniques

Note.

Examples may include: Univariate analysis; Multivariate analysis; Decision trees; Genetic Algorithms; Neural Networks; Gap Analysis; Urgency and impact, and the like.

b) Data analysis technique selection

Note.

Examples may include: Determining the correct analysis technique(s); Determining the correct sequence of analysis techniques; Accommodating influencing factors including research objectives, budget, timeline and quality requirements, data limitations, confidentiality, security and the like.

c) Data interpretation

Note.

Examples may include: Determining results; Determining conclusions; Benchmarking; Quality Assurance, including consideration of accuracy, validity, clarity and the like.

d) Data presentation encompassing:

- Determining the correct form of presentation for the audience, including; colleagues, scientific community, marketing and commercialisation specialists, general community, industry, mixed (i.e. conference audience).
-

Note.

Examples may include: Forms of documentary presentation, including reports, journal articles, scientific papers, graphs, tables, diagrams, electronic formats; Forms of verbal presentation, including meetings, client briefings, conferences, support of a new concept, need for further research, commercialisation opportunity; Quality Assurance, including accuracy, validity, clarity of information presented.

2.2.37 Product Development and Trials

Evidence shall show an understanding of product development and trial concepts and techniques as they apply in the workplace, to an extent indicated by the following aspects:

a) Identifying client and managerial requirements for production and trials

Note. Examples may include: Required outcome(s); Key performance indicators; Timelines; Financing; Resources; Quality Assurance and the like.

b) Influencing factors

Note. Examples may include: Internal business goals and strategies; Technical specifications (chemical, mechanical, environmental); Industrial considerations; Regulatory considerations; Legislative considerations; Intellectual Property; Australian & International Standards; Codes of Practice; Market requirements; Resource requirements, including personnel tools and equipment (principles and practices), materials, finances and the like.

c) Product development arrangements

Note.

Examples may include: Licensing agreements; Joint Ventures; Sole Ventures and the like.

d) Relevant Documentation

Note.

Examples may include: Codes of Practice; Standard Operating Procedures; Product formulation documentation; Material safety data sheets (MSDSs); Equipment and Quality manuals; Calibration and maintenance schedules; Enterprise recording and reporting procedures; Material, equipment and product specifications and the like.

e) Development & trial processes

Note.

Examples may include: Proof of concept; Trialing concepts; Definitions/Specifications; Types of development and trial processes, including Phase A product and trial, Phase B product and trial, User trials, Ergonomics and Usability testing; Pre-defined acceptance criteria, confidence limits; Data collection & analysis; Production; Evaluation and recommendation formulation.

2.2.38 Intellectual Property Concepts

Evidence shall show an understanding of intellectual property concepts as they apply in the workplace, to an extent indicated by the following aspects:

a) Intellectual Property and Australian Law

Note.

Examples may include: The place of Intellectual Property in Australian Law; Past cases and outcomes; Necessary considerations and the like.

b) The nature of Intellectual Property

Note.

Examples may include: What is Intellectual Property? What isn't Intellectual Property?; Why is Intellectual Property relevant?; What can Intellectual Property rights do?; What can't Intellectual Property rights do?

c) Intellectual Property Rights

Note.

Examples may include: Patents; Copyright; Designs; Confidential Information; Other specialty rights and the like.

d) Managing Intellectual Property

Note.

Examples may include: Identifying Intellectual Property; Deciding what to protect; Strategies for managing Intellectual Property; How can Intellectual Property rights work together?; Intellectual Property versus time, effort, finances; Sources of Assistance, including Publications, Intellectual Property professionals, Lawyers, Business Advisors, Marketing consultants and the like.

e) Enforcement of Intellectual Property

Note.

Examples may include: The enforcement process; The role of lawyers; Resolution.

f) The changing face of Intellectual Property

Note.

Examples may include: Development of Intellectual Property Right Laws; Changes to Intellectual Property Right laws; Extensions of Intellectual Property Rights into non-traditional areas, including cultural, property arenas; The global marketplace and the like.

2.2.39 Commercialisation Concepts

Evidence shall show an understanding of commercialisation concepts and techniques as they apply in the workplace, to an extent indicated by the following aspects:

a) Commercialisation

Note.

Examples may include: Definition of commercialisation; Triggers for commercialisation; Past commercialisation successes; Past commercialisation failures; Triggers for commercialisation; Methods for identifying a good product/idea/service/application; Sources of assistance in regard to

commercialisation, including documents; lawyers, business advisors, marketing consultants.

b) The commercialisation process

Note.

Examples may include: The concept; Does the concept fit with the organisation's goals? Is there a market, what is the market? Will the product meet the market requirements? Can the product be sold? How can the product be sold? Can the product be produced? How can the product be produced? Can the production be repeated?

c) Commercialisation arrangements

Note.

Examples may include: Sole venture; Joint venture; Licensing; Legal aspects of commercialisation.

d) Commercialisation planning

Note.

Examples may include: Costing; Marketing; Production/development; Distribution; Sales.

e) Competition

Note.

Examples may include: Who are the competitors? What are they doing and how quickly? Internal development relevant to competition.

f) Critical analysis of the commercialisation process for continuous improvement

Note.

Examples may include: Successes; Opportunities for improvement; Controllable influences; Uncontrollable influences; Formulation of recommendations.

2.2.40 Electrotechnology Industry organisations and practices

Evidence shall show an understanding of Electrotechnology industry organisations and practices to an extent indicated by the following aspects:

a) Electrotechnology vocations encompassing:

- Electrical
- Electronics
- Computer Systems
- Data Communication

- Refrigeration and Air Conditioning
- Instrumentation and Control
- Lifts

b) Career Paths in Electrotechnology encompassing:

- Australian Qualification Framework (AQF)
- Qualifications/Classifications
- Scope of work-installation, maintenance and servicing

c) Training in Electrotechnology Vocations encompassing:

- Traineeships, apprenticeships
- Licensed Electrician minimum requirements
- Career advancements

d) Industry Organisations encompassing:

- Employers
- EE-Oz Training Standards and EE-Oz State/Territory Network
- Employee – Trade union group (CEPU, ETU)
- Government - ITABs, TAFE, RTO, ERAC
- Private providers

e) Qualification Requirements encompassing:

- Unit of competency
- Qualification assessments

f) Policies and Practices in Electrotechnology Industry encompassing:

- Licensing requirements
- OH&S requirements
- Awards

g) Job Application encompassing:

- Research
- Writing
- Methods of application

h) Job Interview encompassing:

- Preparation
- Presentation
- Evaluation

2.2.41 Supervision fundamentals

Evidence shall show an understanding of Electrotechnology industry organisations and practices to an extent indicated by the following aspects:

- a) Responsibilities of workplace supervisors
- b) Effective instruction methods
- c) Methods for seeking the cooperation of others
- d) Dealing with conflict

2.2.42 Business Concepts

Evidence shall show an understanding of basic business management concepts and techniques as they apply in the workplace, to an extent indicated by the following aspects:

a) Basic business planning

Note.

Examples may include: Business plans; Performance plans; Strategic plans; Marketing plans and the like.

b) Basic business administration

Note.

Examples may include: Access and equity principles and practices; Financial concepts; Awards and enterprise agreements; Legislation (OH&S, Environmental, Industrial, and Anti-discrimination); Regulations; Australian Standards; Industrial specifications.

c) Basic business management

Note.

Examples may include: Codes of practice; Ethical standards; Quality Assurance; Innovation; Operation control; Customer service principles.

2.2.43 Commissioning processes and procedures

Evidence shall show an understanding of commissioning process processes and procedures to an extent indicated by the following aspects:

- a) Purpose of commissioning
- b) Commissioning planning and documentation
- c) Procedures for commissioning systems encompassing:
 - configuring
 - calibrating
 - tuning
 - validating system performance to specification

- procedures followed to commission instrument systems

d) Purpose and importance of documentation

2.2 44 Requirements and methods for maintaining currency in industry developments

Evidence shall show an understanding of requirements and methods for maintaining currency in industry developments to an extent indicated by the following aspects:

a) Requirements to maintain currency in industry practices and products encompassing:

- Regulatory
- Industry
- Professional/Association
- Other

b) Sources of information in industry changes and new developments encompassing:

- Legislation and regulation
- Technical Standards
- Codes and industry/work practices and processes
- Manufacture's product catalogues and instruction manuals
- Industry Journals
- Safety and environmental issues

c) Currency of technology, machinery, equipment and tools applications and uses

e) Acceptable methods of formally maintaining currency

Note.

1. Examples are formal industry refresher programs, industry seminars, product promotion programs and the like.

2. Acceptable methods may vary in different jurisdictions

2.2 45 Responsibilities under a competency development plan

Evidence shall show an understanding of responsibilities under a competency development plan to an extent indicated by the following aspects:

a) Competency Development (Training) Plans encompassing:

- state/territories requirements (acts/regulations)
- competency development (training) contracts

- competency development (training) period
- purpose of competency development (training) plans
- process in developing competency development (training) plans
- parties involved in the competency development (training) plan

b) Qualification Structure encompassing:

- scope of work
- training Packages - electrotechnology
- competency standard units (CSUs)
- structure of Qualification
- off-Job Requirements
- on-Job Requirements

c) Responsibilities of Parties to the contract encompassing:

- employer responsibilities
- learner responsibilities
- RTO responsibilities
- State Training Authorities (STA)

d) Electrotechnology Industry Career Opportunities encompassing:

- industry Areas
- qualification levels
- career paths

e) Industry customs and practices encompassing:

- industry bodies – employer and employee representatives
- regulatory bodies – including licensing/registration, OHS, IR, training authorities – apprentice/trainee regulation
- vocational and technical education system – Australian Qualification Framework (AQF), credentials, Australian Qualification Training Framework (AQTF)

f) Monitoring of Workplace Evidence encompassing:

- workplace exposure and practices and relationship with competency standard units
- methods of collecting workplace evidence
- monitoring period cycle
- requirements of workplace evidence
- actions taken for unsatisfactory progression
- role of state training authority (STA)
- apprentice/learner responsibilities
- employer responsibilities

g) RTO Policies encompassing:

- apprentice/Learner Responsibilities
- teachers/Trainers Responsibilities
- absenteeism
- off-Job component assessment specifications
- on-Job component assessment specifications
- qualification completion requirements and award
- advanced standing and/or RPL
- result review procedures

h) Apprentice/Learner Discipline Policy encompassing:

- apprentices/Learners rights
- apprentice/Learner responsibilities
- breaches of discipline
- types of penalties Apprentice/Learner Responsibilities

i) Attendance at the Vocational and Technical Education Centre encompassing:

- importance of attendance
- record management of attendance
- attendance cards
- advice to employer of absences

j) Fire and Emergencies at the Vocational and Technical Education Centre encompassing:

- designated fire and emergency exists
- procedures in the event of a fire
- evacuation procedures
- assembly points importance of attendance

k) Occupational Health and Safety at the Vocational and Technical Education Centre encompassing:

- eye protection
- foot protection
- protective clothing
- personal injuries
- mobile phones and personal belonging
- dress regulations
- rotating machinery, designated fire and emergency exists

l) Entry Requirements encompassing:

- numeracy requirements
- literacy requirements
- vocational and technical education centre support mechanisms
- testing and appropriate action by learner Eye protection

j) Vocational and Technical Education Centre Tour encompassing:

- vocational and technical education centre layout
- building layout
- tour of building and vocational and technical education centre

2.2 46 Methods of monitoring and reporting competency development activities

Evidence shall show an understanding of methods of monitoring and reporting workplace activities indicated by the following aspects:

- a) RTOs responsibility to receive and monitor workplace activities of the apprentice/learner
- b) Industry requirements for monitoring workplace evidence
- c) Acceptable methods for monitoring and reporting workplace activities
- d) Apprentice's/Learner's responsibility to participate in the reporting of workplace activities
- e) RTOs requirements in periodically evaluating development of apprentices/learners from the workplace activities information gathered, and providing feedback and advice on areas requiring improvement
- f) Employers responsibilities to participate in monitoring, reporting and confirming workplace activities, and assisting in overcoming areas requiring development by the apprentice/learner
- g) Options for appeal or assistance from RTO or State Training Authority (STA)

2.2 47 Electrotechnology engineering structures and occupations

Evidence shall show an understanding of electrotechnology engineering structures and occupations methods to an extent indicated by the following aspects:

- a) Structure and historical background of a specific engineering industry encompassing:
 - Historical background of significant technological developments and changes in the student's particular engineering discipline and industry.
 - Types of organisations in the student's engineering industry:
 - Private industry and government enterprises
 - Size of organisations
 - Location and market.
 - Types of activities performed in student's industry:
 - Research and development

- Design and consultancy
- Manufacturing installation and commissioning
- Servicing and maintenance.
- Industry groupings and organisations; trade and industry support and professional bodies.
- Engineering industrial practices of organizational controls/monitoring such as:
 - Budgeting and cost estimating processes
 - Setting production/service targets in terms of time, output and costs
 - Planning, coordination and control processes fundamentals, including such tools as PERT and project management charts.
 - Inventory controls of tools, stock and components
 - The tendering process, development of specifications and contracts
 - Application of industry standards
 - Quality control processes

b) Engineering occupations and employment, education, training & retraining encompassing:

- Types of engineering occupations in student's particular engineering industry; job titles and descriptions, with reference to both private industry award re-structuring and government organizations where appropriate.
- Qualification and training requirements for the occupations of the student's engineering industry.
- Areas of employment opportunities and growth; careers; changes in engineering work practices and requirements.
- Applying for employment in engineering occupations; interpreting job vacancy advertisements; appropriate forms of application; presentation of personal qualifications and experience; addressing the specified criteria of the vacant position.
- Education and industry training structures and opportunities; school, TAFE, CAE, university; on the- job experience; structure and accreditation of formal qualifications and recognition of prior learning.
- Re-training requirements of technological, organisational and social change; industry restructuring and work practice change; career change and recurrent education.
- Assessing future directions of change and the resulting impact on the student's particular industry and career path.

c) Operating environment of Australian engineering industry encompassing:

- General and background operating environment of the student's particular engineering disciplines and industry appropriate to the student's workplace:
- Technological environment including:
- Legal environment
- Education and training

- Industrial relations
- Political and public pressure groups
- Economics/economic climate
- Markets
- Cultural/social
- Ecological
- Government factors
- Customers/clients/end users of output
- Product
- Competitors

d) Industrial Awards and Trade Unions encompassing:

- The nature, typical content and application of Australian industrial awards in the engineering workplace.
- Trade union structures and membership in the engineering industries.

2.2 48 Enterprise work activities policies and procedures

Evidence shall show an understanding of enterprise work activities policies and procedures to an extent indicated by the following aspects:

a) Need for policies and procedures

b) Scope for an industry/enterprise to establish work activity policies and procedures

Note.

Examples are policies and procedure related to safety, effective work outcomes, customer relations, conflict resolution and competency development.

c) Following work activities procedures

2.2.49 Procedure and protocols for giving evidence in a court of law

Evidence shall show an understanding of procedure and protocols for giving evidence in a court of law to an extent indicated by the following aspects:

a) Process for responding to a witness summons

b) Requirements for preparing to appear in court to give evidence

c) Court procedures and protocols for giving evidence

2.2.50 Engineering design processes

Evidence shall show an understanding of engineering design processes to an extent indicated by the following aspects:

a) The functional and non-functional requirements of a customer encompassing:

- scope of the project,
- non-functional requirements

Note:

Examples include economics (time, cost) including total life-cycle costs - design, implementation (construction), maintenance (operation), decommissioning (recycling); aesthetics (quality)

b) Design objectives (specifications) to satisfy a given set of customer attributes

Note:

Establishing the specifications by defining the problem and producing a solution to satisfy the customer.

c) Creation of the design plan through solution synthesis by selecting or creating the solution

d) Analysis

e) Optimisation of the proposed solution

f) Validations of the resulting design against the customer's needs

f) Implementation of the selected design

2.2.03 Control technologies

2.3 Control technologies

2.3.1 Electrical control devices

Evidence shall show an understanding of control devices to an extent indicated by the following aspects:

a) Contactors, relays and timers encompassing:

- Operating principles
- Basic contact configurations and identification
- Common applications

b) Switches and push buttons encompassing:

- Switching configurations
- Common applications

c) Solid state devices encompassing:

- Types of devices and their function

Note:

Examples include soft starters, dimmers; smoke alarms, inverters, line conditioners and uninterruptible power supplies.

- Input and output parameters
- Risk control measure for isolating circuits when needed
- Risk control measure for preventing damage to devices during circuit testing.

2.3.2 Control circuit fundamentals

Evidence shall show an understanding of control circuit fundamentals to an extent indicated by the following aspects:

a) Conversion of circuit diagrams from one form to another.

b) Design and connection of basic control circuits

Note:

Examples include multiple (light) switching circuits, master control circuit, stop-start circuit, remote stop-start circuit, time controlled circuit, interlocked circuit, jogging circuit (non-latching) and machine safety circuit.

c) Sequence of operation of basic control circuits.

2.3.3 Process control principles

Evidence shall show an understanding of process control principles to an extent indicated by the following aspects:

a) Control systems and components encompassing:

- open and closed loop systems,
- final element, process measuring, transmitters, converters, controllers,

b) Control terminology encompassing:

- set point, offset, deviation, gain, proportional band, integral (reset), derivative (rate preact), process variable, feedback, conversion of gain to PB and vice versa and direct and reverse action.
- Integral - repeats/min and min/repeat

c) Types of control encompassing:

- on/off control, proportional amplitude control, proportional time control, proportional plus integral control, proportional plus integral plus derivative

control and reset wind-up.

Note:

These include control action generation using R/C networks.

d) Process characteristics encompassing:

- process lag, resistive lag, capacitive, dead time

e) Response of systems to controller parameter (PI and D) changes and load change.

2.3.4 Pneumatic/hydraulic control tubing/piping

Evidence shall show an understanding of pneumatic/hydraulic control tubing/piping to an extent indicated by the following aspects:

a) Fittings and their use

b) Control tubing/piping materials and sizes

c) Working techniques encompassing:

- Cutting pipe tubing/piping
- Bending, shaping/setting pipe and tubing
- Joining connecting/terminating tubing/piping
- Cleaning

d) Air cleaners and lubricants

2.3.5.1 Refrigerant pressure sensing controls

Evidence shall show an understanding of refrigerant pressure sensing controls an extent indicated by the following aspects:

a) Control systems and components encompassing:

- Refrigeration pressure sensing controls, including low and high
- Oil pressure controls and
- Defrost pressure controls

b) Control terminology, symbols and diagrams/drawings

c) Types of refrigerant pressure sensing controls, their operations, installation/replacement, setting adjustment and testing

d) Refrigeration process characteristics and control parameters

e) System responses to parameter changes

2.3.5.2 Refrigeration system controls

Evidence shall show an understanding of refrigeration system controls to an extent indicated by the following aspects:

- a) Control systems and electrical/electronic components encompassing:
 - Refrigeration controls, including thermostats, pressure controls, defrost controls
 - Electrical controls, including timers, relays (starting and control), contactors, three phase motor starters
- b) Control terminology, symbols and diagrams/drawings
- c) Types of controls, their operations, installation/replacement, setting adjustment and testing
- d) Refrigeration process characteristics and control parameters
- e) System responses to parameter changes

2.3.6 Air conditioning system controls

Evidence shall show a basic understanding of simple air conditioning system control principles, concepts, terms and applications to an extent indicated by the following aspects:

- a) Control systems and components encompassing:
 - Electrical controls,
 - Electronics controls,
 - Pneumatic controls,
 - Direct digital controls
- b) Control terminology, symbols, drawings/diagrams
- c) Types of control, their basics operation, installation/replacement, commissioning, setting/adjustment and testing
- d) Air conditioning process characteristics and control parameters
- e) System responses to parameter changes.

2.3.7 Smart device basics

Evidence shall show an understanding of smart devices with embedded controls to an extent indicated by the following aspects:

- a) Types of devices and their function.

- b) Connection into a circuit.
- c) Entering and verifying instructions.

2.3.8 Programmable controller basics

Evidence shall show an understanding of programmable controller basics to an extent indicated by the following aspects:

- a) Regulatory requirement/limitations
- b) Basics of control system concepts encompassing:
 - Input, process and output
 - Relay control, static logic control and programmable control.
- c) Typical applications of PLCs
- d) PLC system components and arrangement
- e) Definitions and terminology encompassing:
 - PLC, in/out (I/O), memory (RAM, ROM, E2PROM), CPU and power supply.
- f) Basic PLC operation encompassing:
 - scan cycle, basic programming rules, addressing for I/O, and halt/run
- g) Connection of input and output devices.

2.3.9 PLC programming basics

Evidence shall show an understanding of the programming basics functions in PLCs to an extent indicated by the following aspects:

- a) Basic control system design methods
- b) Programming basics encompassing:
 - Clearing memory
 - Using ladder format
 - Working with Boolean/mnemonic/statement
- c) Programming monitoring and editing basic control functions

Note.

Examples of basic control functions are Switching Latching, Timing, Counting, and Master control,

2.3.10.1 PLC programming

Evidence shall show an understanding of programming basics PLCs to an extent indicated by the following aspects:

- a) Extended control system design methods using ladder logic
- b) Advance discrete programming functions and controls encompassing:
 - derived timers (off delay,
 - self resetting,
 - constant duty cycle),
 - reversible counters,
 - cascading timers,
 - cascading counters,
 - combining timers and counters,
 - internal relays/flags/markers,
 - latching relays (set/reset),
 - jump instructions,
 - master control instructions,
 - bit shift registers,
 - scan time considerations,
 - one shot,
 - retentive (power fail) functions,
 - simple step sequence instructions

2.3.10.2 PLC high level programming

Evidence shall show an understanding of high level programming of PLCs to an extent indicated by the following aspects:

- a) Medium to high level PLC encompassing:
 - Hardware configuration
 - Software components

Note.

Examples of software components are, addressing (discrete, work and analogue), memory map, basic programming instruction syntax, file manipulation, documentation and saving/restoring programs.

- b) Number systems and codes encompassing:
 - binary, octal, integer and hexadecimal
 - conversions between formats
 - common codes such as BCD, Grey, ASCII and the like

c) Programming diagnostics encompassing:

- flags/status words (file)
- fault locations
- scan considerations
- fixed and variable parameters
- immediate update
- special internal relays (overflow bits)

d) Data Manipulation encompassing:

- binary word structure
- single and double words
- word devices
- arithmetic instructions, add, subtract, multiply, divide & square root
- compare instructions
- word logical instructions, AND, OR, EXOR)
- conversions of BCD to binary, binary to BCD
- indirect addressing

Note.

Examples are image register to word, word to IR, word to word, word to table and table to table

- word shift registers (LIFO FIFO)
- masking
- bit manipulation (bit set, bit clear, bit test)
- entering data constants
- multiplexing

e) Analogue input/output encompassing:

- common signal types
- module resolution
- scaling
- un-scaling
- signal offset

2.3.10.3 PLC system applications

Evidence shall show an understanding of PLC system applications to an extent indicated by the following aspects:

- a) Alternative/enhancing programming methods
- b) System diagnostics techniques.

c) Control loops encompassing:

- Regulated loop control
- Proportional / integral /derivative (PID) control
- Applications of PID control
- Methods used to achieve PID control using a PLC

d) Specialist instructions

Note.

Examples are interrupt driven applications, high speed counters, positional encoders

e) Communications methods and requirements encompassing:

- Common protocols and interface standards
- Requirements when networking/interfaces PLC's
- Communication mediums
- Network types and topologies
- Hierarchical networks
- Peer to peer networks
- Handshaking
- Open architecture communications
- Remote I/O

f) Intelligent terminals/graphic interfaces installation and communication requirements

2.3.11 Control system network basics

Evidence shall show an understanding of control systems networks to an extent indicated by the following aspects:

a) Purpose and application of control system networks systems

b) Open and common proprietary control system networks models (layers) and protocols

Note.

Examples of systems are CANopen, ControlNet, Devicenet, Ethernet, Foundation Fieldbus, Interbus, Modbus, and Profibus.

c) Control system networks interface.

2.3.12 Control network infrastructure

Evidence shall show an understanding of control network infrastructure to an extent indicated by the following aspects:

a) Data link layer encompassing:

- Device types
- Bus arbitration
- Device initialisation
- Synchronous / Asynchronous messaging.
- Time management
- Link active scheduler specific functions

b) Bus monitor encompassing:

- capturing
- filtering

c) Fieldbus message specification encompassing:

- Virtual field device
- Object dictionary
- Communicate objectives
- Communicate services

d) High speed Ethernet encompassing:

- Protocols
- FDA agents
- Messaging
- Sessions
- Time synchronisation
- Redundancy

2.3.13 Using supervisory control and data acquisition systems

Evidence shall show an understanding of supervisory control and data acquisition systems to an extent indicated by the following aspects:

a) SCADA system features and applications encompassing:

- Industries in which SCADA systems are used and
- Associate benefits of the package.
- Features and facilities of different SCADA packages.
- Hardware requirements

b) Reading mimics and animated graphics

c) Trending encompassing:

- Analysis of process to select data,
- Viewing data and graphical representation of selected information

- Trend graphs and data matching

d) Alarm logging encompassing:

- Analysing select data,
- Corrective action of alarm status

2.3.14 Supervisory control and data acquisition systems programming

Evidence shall show an understanding of supervisory control and data acquisition systems to an extent indicated by the following aspects:

a) SCADA system networking encompassing:

- PLC interface requirements
- Networking requirements of the system
- SCADA system differences from DCS
- Costs of different software packages.

b) Mimics and animated graphics encompassing:

- Graphic designs balance of layout
- Assessment of data required to be entered in software package

c) Trending encompassing:

- Analysis of process to select data, i.e., sampling of the process in terms of temperatures, time, weight, etc.
- Viewing data and graphical representation of selected information
- Trend graphs and data matching

d) Alarm logging encompassing:

- Analysing select data, applying limits and specification applied to processes
- Corrective action of alarm status

e) Recipes and scheduling encompassing:

- Methods of producing libraries for different process conditions, required for varied production runs
- Analysis of different production runs i.e., amounts of materials required, raw materials, pressure, temperature, weights, colour required in the process.
- Alarm limits/material specifications
- Scheduling, setting limits and evoking program changes.

f) Data Collection and data basing encompassing:

- Producing a data base of variables, and limit specifications involved in the process, i.e., individual items manufactures, or global manufactured products
- Conversion of raw data into appropriate data basing software package

Paradox, Lotus, Excel

Note.

Examples of software packages are Paradox, Lotus, Excel and the like.

Reports encompassing:

- Types and layout of reports
- Aims of the reports, i.e., customer, manager/s, or accountant reports. The report may include information on statistical process control for quality assurance etc.
- Analysis of data in report i.e., graphs, design, layout, balance of layout etc.
- Assessment of data required for the report.

g) Programming language encompassing:

- Automate tasks within the software package.
- Provide complex processing, where field equipment does not have the facilities.

h) Implementation and applications encompassing:

- Overview of implementation of SCADA systems i.e. summary of points required for implementation.
- Typical application in manufacturing and data control i.e., food processing, packaging, automotive industry, energy management, steel production etc.

i) Networking encompassing:

- Types of networks available
- Coordinate and access of networking by linking to factory network.

2.3.15 Appliances, electronic controls and communications basics

Evidence shall show an understanding of electronic controls and communications used in domestic appliances to an extent indicated by the following aspects:

a) Control systems and components encompassing:

- Appliance controls,
- Electrical/Electronic controls,

b) Control terminology

c) Types of control

d) Appliance characteristics and control parameters

e) System responses to parameter changes

f) Appliance integrated communications components and their function.

2.3.16 Integrated systems basics

Evidence shall show an understanding of the basics of integrated systems to an extent indicated by the following aspects:

- a) Systems purpose and principle of operation
- b) Scope of control and inter working in integrated systems
- c) System topology
- d) Basic functions and programming methods using on screen 'icons and function and operating instruction lists.

2.3.17 Integrated systems, subsystem interworking

Evidence shall show an understanding of subsystem interworking to an extent indicated by the following aspects:

- a) Types of subsystems an integrated system
- b) Typical subsystem interworking scenarios
- c) Higher level functions and scripting (programming) methods.

2.3.18 Complex integrated system programming

Evidence shall show an understanding of complex integrated system programming to an extent indicated by the following aspects:

- a) System complexities encompassing:
 - Networked systems
 - Extent of interworking subsystems
 - System monitoring
- b) Advance integrated system programming methods

Note.

Examples of programming methods are those used in systems by AMX, Creston, C Bus, I Control and the like.

2.3.19 Control programming fundamentals

Evidence shall show an understanding of control programming fundamentals to an extent indicated by the following aspects:

- a) Control applications of software
- b) Software terminology
- c) Programming languages currently used by industry
- d) Program development

Note:

Examples may include flowcharts, pseudocode, algorithms

e) Programming concepts encompassing:

- programming structure
- documentation
- compiling source code
- generating executable files
- scalar and structured data types
- constants and variables
- reading from keyboard and writing to screen
- arithmetic, relational and logical operations
- making decisions
- looping operations
- programming to access external devices via I/O boards
- functions

Note:

Examples may include macros; global and local variables, auto and static variables; Intrinsic functions used in control; Writing functions; Linking in external functions to control hardware

- numerical and character arrays

2.3.20 Microcontroller programming basics

Evidence shall show an understanding of microcontroller control system programming methods to an extent indicated by the following aspects:

- a) Programming terms
- b) Language levels and their features
- c) Language simulators and emulators
- d) Language programming basics encompassing:
 - Programming input/output functions
 - Timing loops

2.3.21 Complex control systems

Evidence shall show an understanding of complex control systems indicated by the following aspects:

a) Control systems encompassing:

- process controller and programmable controllers and personal computer
- control peripherals suitable control

b) Purpose built microprocessor controller multiple inputs resulting in different or changed outputs

c) Different types and applications of system transducers and sensors

d) Actuators and drive systems.

2.2.04 Communications and computer technologies

2.4 Communications and computer technologies

2.4.1.1 Telecommunications CPR regulations and installations

Evidence shall show an understanding of telecommunications CPR regulations and installations to an extent indicated by the following aspects:

a) Telecommunication industry overview encompassing:

- Telecommunications network
- Act 1997
- Role of ACMA and ACIF
- Telecommunications terminology

b) Telecommunication technical standards encompassing:

- ACMA Technical Standards TS008, TS009
- SAA Communications Cabling Manual (Restricted) (starter kit) as approved by relevant bodies – Standards Australia/ACIF
- International Standards – ISO, IEC, ITU
- Building Code of Australia (BCA)
- AS/NZS 3000 Wiring Rules
- National Association of Testing Authorities NATA

c) Cabling Provider Rules (CPR) encompassing:

- Australian Communications Authority (ACA)
- Telecommunications Cabling Provider Rules

- CPR registration
- Old Telecommunication Licensing structures
- Inspection of work
- Documentation – TCA1 form

d) Cable type and identification encompassing:

- Cable types – unshielded twisted pair, shielded twisted pair, indoor, underground and aerial.
- Cable construction
- Cable identification – codes (colour, banded, numbered, lettered)

e).Cable installation encompassing:

- Cable damage
- Cable packaging
- Cable dispensing devices
- Cable insertion and hauling
- Lead-in conduit requirements (including wall box installation)
- Wiring diagrams
- Segregation of cables
- Aerial cable fittings and additional safety aspects required.

f) Termination of Telecommunication Cables encompassing:

- Sheath stripping – methods, precautions
- Pair identification
- End to end testing
- Filled cable termination
- Termination systems – telephone outlets and sockets, network terminating devices (NTD)
- Connector jointing e.g. external to internal cable where required

g) Telecommunication earthing and protection encompassing:

- Customer lightning protection and (CLP) earthing
- Carrier's policy requirement covering materials (including surge suppression devices) and practices (including earth bonding arrangements)

h) Basic telephony encompassing:

- Basic telephone service
- Telephone
- Exchange number
- Connection equipment / lead in cable
- Dialling signals – pulse dialling, tone dialling, ring equivalence number (REN)

2.4.1.2 Telephone system fundamentals

Evidence shall show an understanding of telephone system fundamentals to an extent indicated by the following aspects:

a) The transmission of sound in a telephone system encompassing:

- Function of telephone transmitters and receivers
- Components and functions of the telephone

b) Purpose of earthing and protection in a telephone system

c) Customer Switching Systems encompassing:

- Basic function
- Difference between a key system and a PABX.
- Advanced features

d) Basic operations of System Distribution Frames (SDF)/Test Point Frames (TPF), power fail and line interface requirements (e.g. Indial, Rotary Groups, ISDN, Extension, Tie-line circuits)

e) Types, purpose, use, and requirements of metering devices.

f) Metering and installation arrangements of public/pay phones

g) Installation methods and requirements encompassing:

- Customer Switching Systems (CSS)
- Interfacing equipment
- Termination of CSS equipment

h) Requirements for programming of CSS

i) Hazard associated the electronic components of CSS encompassing:

- Static discharge
- Chemical damage
- Mechanical damage
- Electromagnetic Interference

2.4.1.3 Telephone network facilities

Evidence shall show an understanding of telephone system fundamentals to an extent indicated by the following aspects:

a) Network subsystems (i.e. functional blocks) components and operating parameters

b) Switches within the network

c) Customer accesses infrastructure

d) System security

2.4.1.4 Lift telecommunications cabling regulations and installation

Evidence shall show an understanding of lift telecommunications cabling regulations and installation to an extent indicated by the following aspects:

a) Regulations and Standards

- registration of Cablers
- standards
- record keeping (cable records)
- lift boundary

b) Telecommunication lift cables and termination methods

- cables identification
- types of cables (round travelling cable, flat travelling cable)
- cable wire identification (colour codes)

c) Installation methods of communication cabling

- requirements
- cable installation and cable stripping
- termination (solder, screw, insulation crushing screw, insulation displacement)
- segregation
- cable protection methods

d) Testing of communication cabling

- types of tests (continuity, correct sequence, revised pair, transposed or split pair and insulation resistance)
- test equipment

2.4.2.1 Telecommunication earthing and protection

Evidence shall show an understanding of telecommunication earthing and protection to an extent indicated by the following aspects:

e) Telecommunication overvoltage protection system

- Operating principles
- Overvoltage and surge/spike suppression protection techniques
- Overvoltage protection devices
- Installation of overvoltage protection systems

f) Earthing protection system encompassing:

- Components and arrangement of the MEN system
- TELEX functional earth system
- Telecommunication system earthing single and multi-storey
- Communication earth system
- Protective earth barriers for segregation, cable tray, duct and metal equipment enclosures

g) Electrical interference encompassing:

- Types – RFI, EMI
- Sources of interference
- Techniques in reducing interference
- Earthing cable shields

h) Earth testing instruments and procedure

i) Safety issues to be considered with earthing and bonding

2.4.2.2 Voice and data cabinet assembly and terminations

Evidence shall show an understanding of voice and data cabinet assembly and fit out, to an extent indicated by the following aspects.

a) Internal cable routing and management provisions

b) Ventilation requirements

c) Cabinet structure encompassing:

- internal framework
- cable entry
- removable panels
- multiple cabinets
- doors, locks and hinges
- mounting rails
- access to equipment and cabling
- earthing arrangements and methods

d) Mounting requirements for components that include

- rack Units
- patch panels
- routers
- servers

2.4.3.1 Data communication fundamentals

Evidence shall show an understanding of data communications fundamentals to an extent indicated by the following aspects:

a) Process of data transmission encompassing:

- codes used in data communications
- asynchronous and synchronous transmission
- bits per second and baud rate
- DCEs and DTEs.
- error control, parity and CRC.

b) Characteristics and limitations of the types of transmission media encompassing:

- information as a quantity.
- information content of symbols.
- redundancy in communications.
- common types of media used in data communications: twisted pair, coaxial.
- other communication systems: HF radio, satellite and cellular.

c) Simple protocols encompassing:

- reason for protocols.
- simple protocols: teletype, X modem, half-duplex and full duplex.

d) Types, characteristics and limitations of modems and interface standards encompassing:

- operation and types of modems

Note:

Examples include serial, parallel, USB, firewire, broadband, ADSL, cable modems

- modulation techniques: FSK, PSK and QAM.
- interface and signalling standards:

Note:

Examples include RS232, V.24, Current loop, RS422, RS423, RS449, RS485, V35, X21 and G703.

- Limitations interface standards, speed and distance.

e) Types, characteristic specifications and limitations of fibre optic systems encompassing:

- fundamentals of light and how it travels in a fibre.
- typical fibre composition, multimode and single mode propagation
- laser and other light sources and detectors.
- fibre cable and splice fibre cable.

2.4.3.2 Networking fundamentals

Evidence shall show an understanding of networking fundamentals to an extent indicated by the following aspects:

a) Analogue and digital signals encompassing:

- How information is carried
- Signal distortion

Note.

Examples include attenuation, reflection, noise, dispersion, jitter, latency and collisions

- b) Types of networks, network components and hardware
- c) Local Area Network (LAN) architectures
- d) Networking protocols and the OSI model
- e) Network signal propagation
- f) Transmission Control Protocol / Internet Protocol (TCP/IP)
- g) Basics of Encoding Networking Signals
- h) Internet services

2.4.4 Wireless networks infrastructure

Evidence shall show an understanding of wireless networks infrastructure to an extent indicated by the following aspects:

- a) Wireless components
- b) Network configurations
- c) Wireless network security

2.4.5 Wide area networks infrastructure

Evidence shall show an understanding of wide area networks infrastructure to an extent indicated by the following aspects:

- a) Network communication media
- b) Network servers
- c) Network configurations
- d) Network security

2.4.6 PABX fundamentals

Evidence shall show an understanding of PABX fundamentals to an extent indicated by the following aspects:

- a) Programming methods
- b) Configuration options
- c) Programming options

2.4.8 Switches, hubs and routers

Evidence shall show an understanding of switches, hubs and routers to an extent indicated by the following aspects:

- a) Purpose and function
- b) Circuit configurations
- c) Connection arrangements
- d) System protocols

2.4.9 Decoders

Evidence shall show an understanding of decoders to an extent indicated by the following aspects:

- a) Purpose and function
- b) Circuit configurations
- c) Connection arrangements
- d) System protocols

2.4.10 Reserved

2.4.11 Personal computers, hardware structure

Evidence shall show an understanding of personal computers, hardware structure to an extent indicated by the following aspects:

a) Structure and components and their function

Note:

Examples include motherboards, memory modules, video modules, connecting buses, storage devices and the like.

b) Assembling and dismantling techniques

c) Hardware faults and troubleshooting techniques

Note:

Confined to subsystem level

d) Basic network hardware and components

e) Connection of network media

f) Set up of standard network configuration

2.4.12.1 Computer hardware sub-assemblies

Evidence shall show an understanding of computers, hardware components to an extent indicated by the following aspects:

a) Sub-assemblies architecture and their function

b) Sub-assemblies faults and troubleshooting techniques

c) Repair techniques

2.4.12.2 Multimedia computer components

Evidence shall show an understanding of computer multimedia subsystem components to an extent indicated by the following aspects:

a) Multimedia subsystems

Note:

Examples include new multimedia standards, pixel resolution, scanning, resolution, output resolution, printer resolution, microprocessor speeds, INTEL INCOMP Index rating, cache memory speeds, system bus transfer speeds, configure a mother board, trouble shoot a mother board

b) Multimedia storage devices

Note:

Examples include USB/flash, hard disk drive, multimedia storage devices,

removable storage hard disk drive, CD-ROM/DVD drive, digital tape (DAT) drive

c) Video cards, types and specifications

Note:

Examples include video processor, graphic processing, video RAM, bus interferences, resolution, full motion video, still image, driver software and updates

d) Sound cards and sound card standards

Note:

Examples include MIDI interface, sound card applications, sound card connectors, FM synthesis, wave table, sound card file formats

e) CD-ROM's, CD-ROM/DVD standards

Note:

Examples include CD-ROM/DVD cache memory, CD-compatible, CD/DVD drive transfer speeds, CD-ROM/DVD interfaces, photo CD/DVD compatible, CD/DVD recordable, multi-session compatible.

f) Colour printers

Note:

Examples include types of colour printers, construction and operation, dot matrix, ink-jet, laser, dye sublimation.

g) Colour scanners

Note:

Examples include types of scanners, construction and operation, drivers and scanning software

2.4.13 Computer peripherals

Evidence shall show an understanding of computer peripherals to an extent indicated by the following aspects:

- a) Types and applications
- b) Operating principles
- c) Software (drivers) installation
- d) Network management of peripheral devices.

2.4.14 Personal computer operating systems, basics

Evidence shall show an understanding of personal computer operating systems to an extent indicated by the following aspects:

- a) Basic function, components and concepts.
- b) Operating systems in use.
- c) System installation and configuration

2.4.15 Computer operating systems

Evidence shall show an understanding of computer operating systems to an extent indicated by the following aspects:

- a) Operating system components and structure
- b) System installation and configuration

Note.

System installation includes drivers and internet access and simple networking

- c) File structure and management
- d) System tools

Note:

Examples include control panels, wizards and the like

- e) Operating systems malfunctions and solutions
- f) Troubleshooting techniques.

2.4.16 Personal computers, engineering applications software basic

Evidence shall show an understanding of computers applications to an extent indicated by the following aspects:

- a) Application software types
- b) Configurations and preferences
- c) Use of particular software packages

Note:

Examples may include word processor, spreadsheet, database, presentation software, web/document publisher, CAD/drawing packages, email client, business management

2.4.17 Servers

Evidence shall show an understanding of Servers to an extent indicated by the

following aspects:

a) Types and applications

Note:

Examples may include redundant array of independent disks (RAID),

b) Software installation and configuration

c) Access and security

d) Adding hardware and upgrading

2.4.18 Business equipment software basics

Evidence shall show an understanding of business equipment software to an extent indicated by the following aspects:

a) Programming methods

b) Configuration options

c) Administration and maintenance functions

2.4.19 Gaming equipment communications

Evidence shall show an understanding of gaming equipment communications to an extent indicated by the following aspects:

a) Online and stand alone systems

b) Common gaming networks

c) Linked jackpot networks

d) Player tracking systems

2.4.20 Programming elements

Evidence shall show an understanding of the programming elements to an extent indicated by the following aspects:

a) Algorithm Design encompassing:

- Problem Definition
- Steps in Problem-Solving
- Modular Design
- Top-Down Design

- Flow-Charts and Structured Programming
- Pseudo-Code
- Filtering allowable Data Input
- Using standard Input & Output methods
- Object-Oriented Design (brief intro.)
- Documentation Rationale
- Acceptable Documentation Method

b) Machine-Code, Assemblers and Compilers

c) Brief History of Languages & Limitations

d) Parameters of different programming languages encompassing:

- Constants and variables
- Data types and declarations
- Logical flow control
- Detecting breaches of structure
- Documentation instruction examples
- Procedures and function calls
- Parameter-passing
- Local and global variables
- Object-oriented methods
- Classes and objects,
- encapsulation and inheritance.
- Visual programming methods
- General-purpose program libraries

e) Data structures encompassing:

- Records
- Arrays
- File Input/output

f) Testing and validation encompassing:

- Sequencing the process
- Inconsistencies detection

Note,

An examples is comparing code to documentation, commonly called "Desk-Checking".

- Test data selection
- Modular testing & debug
- Problems with using non-standard methods for data input and output.
- Common bugs

2.4.21 Client side programming

Evidence shall show an understanding of client side programming them to an extent indicated by the following aspects:

- a) Client server architecture
- b) Hyper Text Markup Language (HTML) encompassing:
 - Forms
 - Table
 - Cascading style sheets
- c) Hyper Text Markup Language (HTML) scripting encompassing:
 - Exposed object model
 - Events and event handling
 - Objects methods, properties, events
 - Window, document, form, and form elements
 - String object, methods, properties
 - Form field validation

Note:

Examples of scripting language are JavaScript and Visual Basic (VB) Script

- d) Extendable Markup Language (XML) encompassing:
 - Syntax
 - Structure (well formed XML)
 - Schemas
 - Transformations
 - Parsing Document Object Model (DOM) and Simple API (SAX)
 - Scripting to Document Object Model (DOM)
- e) Extensible Stylesheet Language (XSL) generating HTML from XML
- f) Wireless thin client programming

Note.

Examples include Java2 Micro Edition (JEME), Mobile Information Device Profile (MIDP), Windows CE and Palm OS

- g) Consideration for system architecture
- h) Configurations and profile overview

2.4.22 Server scripting

Evidence shall show an understanding of server scripting the to an extent indicated

by the following aspects:

- a) Client server architecture
- b) Web and Application Servers
- c) Server scripting languages e.g. JSP, ASP, PHP, Perl
- d) Server script Tags
- e) Integrating script with HTML
- f) Server script object model
- g) Request, Response, Session, Application
- h) Using server objects
- i) Server components
- j) Using components in server scripts
- k) Scope of server components e.g. session, page, application
- l) Component get / set methods
- m) Deploying server components
- n) Advanced server scripting concepts

2.4.23 Database access

Evidence shall show an understanding of database access to an extent indicated by the following aspects:

- a) Relational Databases encompassing:
 - Tables, keys, design rules and normalisation
 - Database management utilities

Note.

Example include MSSQL, MYSQL and Access

- b) Structural query language (SQL) queries encompassing:
 - Select, insert, update and delete processes
 - Application of conditionals 'where', 'distinct' and 'like'
 - Create and dropping tables
- c) Data Base connectivity components encompassing:
 - Drivers, data sources
 - Database connectivity component loading
 - Query connection and execution
 - ResultSets / RecordSets

- Rows, columns, cursors, concurrency, pooling
- Iterating through ResultSets / RecordSets

Note.

Example include ODBC, JDBC, ADO

2.4.24 Web applications and services

Evidence shall show an understanding of web servers to an extent indicated by the following aspects:

a) Comparison of HTTP servers and platforms

Note.

Examples include IIS and Apache

b) Comparison of Application servers and platforms

Note.

Examples include J2EE / tomcat, .NET

c) HTTP Servers encompassing:

- Installation requirements and methods
- Security configuration
- Content publishing and security

d) WEB application technologies encompassing:

- Server installation and deployment
- Security

e) Server scripting technologies encompassing:

- WEB application installation and deployment
- Application server administration

f) Web services overview encompassing:

- WEB services XML, API, RPC
- XML API processing
- XML DOM
- SOAP (simple object access protocol)
- WEB Services Security

2.4.25.1 Local area network fundamentals

Evidence shall show an understanding of local area network fundamentals to an

extent indicated by the following aspects:

a) The OSI model for computer system interconnect

b) General principle of Local Area Network (LAN) encompassing:

- benefits of a LAN.
- the elements of a LAN.
- the different types of network topology and their applications.

c) Cabling and termination arrangements for a LAN system and define all the hardware requirements encompassing:

- Network standards:

Note.

Examples are 10/100 BASE T and 10/100 BASE F.

- Applications of different types of coaxial cable, twisted pair, optical fibre cable and microwave as the transmission medium for a LAN.

d) Multiple access units and their function

Note.

Examples are hubs, switches, routers and the like

e) LAN Standards

Note.

Examples are Ethernet (IEEE 802.3) Token Ring (IEEE 802.5).

f) Basic principle of medium access methods such as polling, token passing and CSMA/CD.

g) Current network operating systems available for establishing a LAN encompassing:

- Network protocols
- Concepts of TCP/IP addressing
- Peer-to-peer and server based
- Establishing workgroups.
- File and device sharing

h) Network hardware installation methods encompassing:

- Installing network card
- Installing hubs switches and routers

i) Concepts and the hardware required for internet and worldwide web working LANs

j) Network software installation and configuration methods encompassing:

- Loading and configuring operating software
- Installing and configuring the network card

- Setting up user accounts and permissions
- Establishing security

k) Network testing and diagnostic tools and methods

2.4.25.2 Network services design processes

Evidence shall show an understanding of network services processes to an extent indicated by the following aspects:

a) Analysis of business requirements encompassing:

- Existing and planned business model and organisational structure.
- Factors impacting on the design

Note.

Examples include priorities, growth, growth strategy, regulatory framework, risk, and cost.

- IT management structure

b) Analysis of technical requirements encompassing:

- Evaluation of the company's existing and planned technical and environment goals

Note.

Examples include company size, user and resource distribution, various site connectivity, bandwidth, service performance, availability and scalability, data and system access patterns, network roles and responsibilities and security considerations

- Evaluation of the company's existing and planned technical and environment goals

Note.

Examples include current resources, services, network infrastructure, protocols and hosts, Transmission Control Protocol / Internet Protocol (TCP/IP), hardware, planned upgrades, support and network and systems management

- Client access, end-user work needs and usage patterns
- Disaster recovery requirements

c) Design of a network infrastructure encompassing:

- Network topology
- TCP/IP networking strategy

Note.

Examples include Internet Protocol (IP) subnet requirements, addressing and implementation plan, measurement and optimisation of a TCP/IP design, software

routing integration and TCP/IP Wide Area Network (WAN) integration.

- Dynamic Host Configuration Protocol (DHCP) strategy
-

Note.

Examples include DHCP in a routed environment, an operating system remote locations service and measurement and optimisation of a DHCP infrastructure design

- Name resolution services
-

Note.

Examples include integrated Directory Name Service (DNS) and secure DNS, highly available DNS, DNS deployment strategy, other systems providing naming services such as Windows Internet Naming Services WINS and their secure naming services, deployment strategy and the measurement and optimisation of DNS and other naming services

- Multi-protocol strategy
-

Note.

Examples include Internetwork Packet Exchange / Sequenced Package Exchange (IPX/SPX) and Systems Network Architecture (SNA)

- Distributed File Strategy
-

Note.

Examples include placement of Dfs root and Dfs root replica strategy

d) Design of internet connectivity encompassing:

- Internet and extranet access
- proxy server, firewall, routing and remote access, Network Address Translation, connection sharing, web sharing and web or mail server
- Load balancing strategy

e) Wide Area Network (WAN) infrastructure encompassing:

- Dial-up remote access design
-

Note.

Examples include routing and remote access and integration of Remote Authentication Dial-in User Service (RADIUS)

- Virtual Private Network (VPN) design
- Routing and Remote Access design incorporating demand dial strategy

f) Design of a management and implementation strategy encompassing:

- Management strategy
-

Note.

Examples include strategy for monitoring and managing network services such as global catalogue, lightweight Directory Access Protocol, Services, Certificate

Services, DNS, DHCP, WINS, Routing and Remote Access, Proxy Server and Dfs

- Network services that support application architecture
- Interaction between network services and DNS, DHCP and WINS
- Resource strategy

2.4.26 Network services management processes

Evidence shall show an understanding of network services management processes to an extent indicated by the following aspects:

a) Management of print, file and web resources encompassing:

- Directory services

Note.

Examples include publishing resources, performing searches and configuring a printer object

-
- Data storage

Note.

Examples include NTFS and FAT file systems e.g. New Technology File Systems (NTFS) and File Allocation Table (FAT), quotas, Encrypting File Systems, configuring volumes and basic and dynamic disks, file and folder permissions and compression and domain-based distributed file systems

-
- Shared resources

Note.

Examples include folders, web sharing, folder permissions, printers and printer permissions

-
- Internet Information Services

Note.

Examples include configuring virtual directories and servers, internet and intranet browsing, authentication and Secure Sockets Layer (SSL), File Transfer Protocol (FTP) services and access permissions for intranet server

-
- Network security

Note.

Examples include user account lockout settings, password management, Group Policy to run logon scripts and link objects, auditing and security log file

b) Troubleshooting the network infrastructure

- Routing

Note.

Examples include using the tracert, route, arp, ping, pathping and ipconfig utilities

-
- Transmission Control Protocol / Internet Protocol (TCP/IP)

Note.

Examples include configuring TCP/IP properties, using the winipcfg, ipconfig and arp commands and connectivity using ping

-
- DHCP

Note.

Examples include unauthorised DHCP servers detection, DHCP authorisation, dynamic IP addressing, configuring DHCP properties and creating configuring a DHCP scope

- Domain Name Service (DNS)

Note.

Examples include configuring DNS server properties, managing DNS database records such as CNAME, A and PTR and creating and configuring DNS zones

- Name resolution using nbtstat, ipconfig, nslookup and netdiag commands, Host file and Lmhost files creation and configuration.

c) Troubleshooting Servers encompassing:

- Installation and configuring of server and client computer hardware

Note.

Examples include hardware compatibility using qualifies tools, driver signing options, digital signatures on driver files and systems support for legacy hardware devices

- Starting servers and client computers including, Safe Mode, Recovery Console, parallel installations, startup log file, repairing operating systems using startup options, recovery console, recovering data from hard disk and restoring from back up
- Use of System Monitor, Event Viewer and Task Manager
- Updates

Note.

Examples include service packs, hot fixes and security hot fixes

d) Directory service infrastructure encompassing:

Note.

Examples of directory service infrastructure are Active Directory, Organisational Units and Group Policy

- Creation, management and troubleshooting of User and Group objects

Note.

Examples include computer accounts, groups configuring accounts via a directory service, searching for objects, use of templates for creating user accounts and resetting accounts

- Managing objects and container permissions

Note.

Examples include Delegation of Control Wizard and active control lists.

- Diagnosis of directory service replication problems

Note.

Examples include those related to Wide Area Network (WAN) link connectivity, replication, latency, duplicate objects and LostandFound container

- Group Policy

Note.

Examples include deploying software, Windows Installer, updates and assigning and publishing applications

- Troubleshooting End-User Group Policy
-

Note.

Examples include problems involving precedence, inheritance, filtering and NO Override option and manual refreshing of Group Policy

- Implementation and management of security through Group Policy
-

Note.

Examples include security templates, secdit commands, Security Configuration and Analysis and modification of domain security policy to comply with corporate standards

e) Remote Access encompassing:

- Configuration, management and troubleshooting remote access and VPN connections
-

Note.

Examples include protocols such as client to client Point to Point Tunnelling Protocol (PPTP) and Layer Two Tunnelling Protocol (L2TP) connections, verification of security of VPN connections, configuration of client computer remote access properties, name resolution and IP address allocation.

- Troubleshooting remote access policy
-

Note.

Examples include diagnosis of problems with remote access policy priority, user account, group membership and nested groups, creation and configuration of remote access policies and profiles and selection of encryption and authentication protocols

- Implementation and troubleshooting of Terminal Services for remote access
-

Note.

Examples include configuring Terminal Services for remote administration or application server mode and local resource mapping and user properties

- Configuring and troubleshooting Network Address Translation (NAT)
-

Note.

Examples include configuration of routing and remote access to perform NAT and troubleshooting Internet Connection Sharing problems by using the ipconfig and ping commands.

2.4.27.1 Unix fundamentals

Evidence shall show an understanding of Unix fundamentals to an extent indicated by the following aspects:

a) UNIX operating systems encompassing:

- Overview of basic function, components and concepts of computer systems and operating systems
- History of UNIX and flavours of UNIX
- UNIX administrators role

b) Accessing UNIX and common desktop environment encompassing:

- User Accounts
- Desktop environment
- Customising using Style Manager
- Sub-panels

c) Graphical User Interface (GUI) Applications encompassing:

- Using Mail Tool, Calendar Manager and other applications
- Using GUI help and other help systems
- Troubleshooting

d) Accessing files and directories encompassing:

- File system structure and navigation
- Pathnames
- Listing directory contents
- Identifying and using meta-characters

e) Directory and file management encompassing:

- Using Command Line
- Using File Manager

f) File and user information utilities encompassing:

- File systems
- File processing commands
- Users
- Scripting

g) File security encompassing:

- Overview of security concepts and functions
- Permissions
- Changing permissions with Command Line and File Manager

h) Printing encompassing:

- Command line printing
- Print manager, print status and queue
- Printing from File Manager

i) Backup and restoring data encompassing:

- Overview of back up and restoring strategies
- Using tar utility to perform file storage
- Compression tools
- Using jar command
- GUI backup tools

j) System processes and memory management encompassing:

- Processes and PIDs
- Terminating a process
- Memory management

k) Korn and C Shells encompassing:

- Overview of shell
- Korn Shell features
- C Shell Features
- Shell Feature Comparison

l) Customisation encompassing:

- Overview of customisation
- Initialisation files
- Shell customisation
- GUI customisation

m) Network Basics encompassing:

- Client – Server
- Network commands
- NIS+ and NFS+

2.4.27.2 Linux fundamentals

Evidence shall show an understanding of Linux fundamentals to an extent indicated by the following aspects:

a) Linux operating systems encompassing:

- System Installation
- Examining and recording hardware details
- Disk partitioning
- Standalone installation from a CDROM

- Multi-boot installation and boot managers
- Network installation

b) Work on the command line

- Using a shell
- Navigating and managing the filesystem
- Streams, pipes and redirects
- Manipulating text and basic regexes
- Text editors
- Managing and monitoring processes

c) Networking

- Setup a host to connect to a LAN
- Use command line network tools
- Use networking protocols to connect to other hosts on the LAN—ssh, ftp, telnet, talk, finger etc.
- Share files over the network using nfs.
- Running X over a network

d) X window system

- X configuration
- Window manager configuration
- Configuring and using a display manager
- Using X over a network

e) Using Applications

- Installing applications using a package manager installing software from source tarballs
- Using command line applications
- Using GUI applications

f) Installing and managing server software

- Setting up servers for a variety of protocols
- Managing access to servers

2.4.27.3 Mac OSX fundamentals

Evidence shall show an understanding of Mac OSX fundamentals to an extent indicated by the following aspects:

a) Mac OSX operating systems encompassing:

- System structure and component functions
- System Installation

- Setting user preferences
- b) Security encompassing:
 - Setting up multiple user accounts
 - Role and function of Keychain
- c) Networking/internet set up procedures
- d) Installing applications software
- e) Installing and managing server software encompassing:
 - Setting up servers for a variety of protocols
 - Managing access
- f) Using 'Terminal'

2.4.28 Network operating systems essentials

Evidence shall show an understanding of network operating systems to an extent indicated by the following aspects:

- a) Installation of a personal computer operating system encompassing:
 - Attended and unattended installation
 - Server Remote Installation Services
 - System preparation tool
 - Use of attended answer files created using Set-up Manager
 - Upgrading from previous versions of operating systems
 - Applying update packs and deploying service packs
 - Failed installations troubleshooting techniques
- b) Personal computer operating system administration encompassing:
 - File compression
 - Permissions
 - File and folder optimisation
 - Shared folders and web server resources
 - Printers and print jobs
 - File system configuration and management
- c) Installation, configuration, management and troubleshooting of hardware devices encompassing:
 - Disk devices
 - Removable media devices
 - Display devices
 - Mobile computing hardware
 - Multiple processing units

- Network adaptors

d) Installation, configuration, management and troubleshooting of input / output devices encompassing:

- Printers, scanners keyboard, smart card and the like
- Multimedia hardware
- Modems
- Devices connected by differing media

Note.

Examples are wireless, USB and Firewire.

e) Managing and troubleshooting system performance and reliability encompassing:

- Driver signing
- Task scheduler
- Offline file synchronisation
- Optimising memory, processor utilisation, disk, network and application performance
- Hardware profiles
- Backing up and restoring data
- Safe mode and recovery console

f) Configuring and troubleshooting the desktop environment encompassing:

- Multiple users
- Multiple languages and locations
- Configuring local settings
- Managing applications using installer packages
- Desktop settings
- Fax support and accessibility services

g) Network Protocols and Services encompassing:

- Transmission Control Protocol / Internet Protocol (TCP/IP)
- Connecting computers by a virtual private network (VPN) connection
- Dial up connection to remote access server
- Connecting to the internet
- Managing internet connection sharing
- Connecting shared resources on a network

h) Implementing, monitoring, managing and troubleshooting security encompassing:

- Data encryption using Encrypting File System
- Local security policy
- Local user accounts

Note.

Examples are audits, creating accounts, account settings, user rights and policy

- User authentication
- Security configuration

2.4.29 Network operating systems implementation

Evidence shall show an understanding of implementing network operating systems to an extent indicated by the following aspects:

a) Installation of server software encompassing:

- Attended and unattended installation
- Server Remote Installation Services
- System Preparation Tool
- Use of attended answer files created using Set-up Manager
- Upgrading servers from previous versions of the operating system
- Applying update packs and deploying service packs
- Failed installations troubleshooting techniques

b) Installing, configuring and troubleshooting access to resources encompassing:

- Network services
- Printers
- Files and folders
- Standalone and domain based Distributed File System
- File and folder security
- Web access to files and folders
- Access to internet

c) Configuration and troubleshooting of hardware devices and drivers encompassing:

- Hardware devices
- Driver signing options
- Updating drivers

d) Managing and troubleshooting system performance, availability and reliability encompassing:

- Monitoring and optimising systems resources
- Managing process
- Optimising disk performance, systems state data and user data
- Backing up and restoring data
- Safe mode and Recovery Console

e) Managing, configuring and troubleshooting the storage encompassing:

- Disks and volumes
- Data compression
- Monitoring and configuring disk quotas
- Disk failure and recovery

f) Installation, configuration and troubleshooting network connections encompassing:

- Shared access
- Connecting computers by a virtual private network (VPN) connection
- Network protocols and services
- Remote access connection, policy and access profile
- Terminal services

Note.

Examples include remote administration and application configuration and sharing

- Network adaptors and drivers

g) Implementing, monitoring, managing and troubleshooting security encompassing:

- Data encryption using Encrypting File System
- Local and systems security policy
- Accounts

Note.

Examples include audits, creating accounts and account policy

- Security Configuration Tool Set

2.4.30 Network infrastructure

Evidence shall show an understanding of network infrastructure to an extent indicated by the following aspects:

a) Domain Name Service (DNS) encompassing:

- DNS Server Service
- Root name server
- Configuring zones

Note.

Examples include configuring for dynamic updates and delegating zone for DNS

- Caching – only server
- DNS client
- Testing DNS Server service
- Manually creating DNS source

- Managing and monitoring DNS

b) Dynamic Host Configuration Protocol (DHCP)

- Installation of DHCP Server Service
- DHCP scopes, superscopes and multicast scopes
- DHCP – DNS integration
- Active Directory™
- Managing and monitoring DHCP

c) Network Infrastructure encompassing:

- Configuring and troubleshooting remote access

Note.

Examples include remote access policy, configuration of remote access profile, Virtual Private Network (VPN), multi link connection, routing and remote access for DHCP

- Managing and monitoring remote access
- Remote access security

Note.

Examples include authentication protocols, encryption protocols and access policy

d) Network Protocols encompassing:

- Installation, configuration and troubleshooting of network protocols

Note.

Examples include Transmission Control Protocol / Internet Protocol (TCP/IP), NWLink and network bindings

- Configure TCP/IP packets
- Configuring and troubleshooting network protocol security and IP Security (IPSec)
- Managing and monitoring network traffic

e) Internet Naming Services in a network encompassing:

- Installation, configuring and troubleshooting
- Configuring Internet Naming Services replication
- Configuring an application networking interface
- Managing and monitoring Internet Naming Services

f) IP Routing encompassing:

- Installation, configuring and troubleshooting of IP routing protocols

Note.

This includes updating routing tables, and implementing demand-dial routing

- Managing and monitoring IP routing

Note.

This includes border routing, internal routing and IP routing protocols

g) Network Address Translation (NAT) encompassing:

- Installing Internet connection sharing
- Installing NAT
- Configure NAT properties and interfaces

h) Certificate Services encompassing:

- Installing and configuring Certificate Authority
- Issuing and revoking certificates
- Removing the Encrypted File System recovery keys

2.4.31 Directory services

Evidence shall show an understanding of directory services to an extent indicated by the following aspects:

a) Installing and configuring directory services encompassing:

- Installing forests, trees and domains including automatic domain controller
- Creating sites, subnets, site links and connection objects
- Configuring server objects including site membership and global catalogue designation
- Transferring of operations master roles
- Verification and troubleshooting of directory services installation
- Implementation of and organisational unit structure

b) Domain Name Service (DNS) for directory services encompassing:

- Installation and configuration of DNS for directory services

Note.

Examples are integration with existing DNS infrastructure, configuration of zones for dynamic and secure dynamic updates and creation and configuration of DNS records

- Management, monitoring and troubleshooting of DNS

c) Change and Configuration Management encompassing:

- Implementing and troubleshooting Group Policy

Note.

Examples are Group Policy Object (GPO), linking to an existing GPO, delegation of administrative control of Group Policy, filtering of Group Policy settings by using security groups and modification of Group Policy prioritisation

- Managing and troubleshooting user environments using Group Policy

- Configuring directory services to support Remote Installation Services (RIS) including configuration of RIS options and security.

d) Components of a directory service infrastructure encompassing:

- Management of directory objects

Note.

Examples are moving objects, publishing resources in the directory service infrastructure, location of objects in the directory service infrastructure, creation and management of objects manually and by scripting, access control of objects and delegation of administrative control

-
- Monitoring, optimisation and troubleshooting of the directory services infrastructure performance and replication
 - Backup and restoring directory services infrastructure

Note.

Examples are authoritative and non authoritative restoration of directory services, restoration from systems failure and the seizing of operations master roles

e) Security encompassing:

- Applying security policies using Group Policy
- Creating, analysing and security modification by using Security Configuration and Analysis snap-in and the Security Templates snap-in
- Implementation of an audit policy

f) Monitoring and analysing security events

2.4.32 Operating systems and networks fundamentals

Evidence shall show an understanding of fundamentals of operating systems and networks to an extent indicated by the following aspects:

- a) Operating system fundamentals
- b) Networking fundamentals
- c) Physical components of a network
- d) Transmission Control Protocol / Internet Protocol (TCP / IP) encompassing:
- e) Network Services
- f) Network Operating Systems
- g) Installation and boot processes

2.4.33 Operating systems and networks

Evidence shall show an understanding of operating systems and networks to an

extent indicated by the following aspects:

a) Operating systems encompassing:

- Operating systems installation and configuration
- Administration and user interface
- User accounts and group accounts
- Managing the file system
- Services and services management
- Servers
- Post – installation configuration and tasks
- Daemons
- Network operating systems

Note.

Examples of operating systems are current iteration of Windows, OS/2, Unix variants such as Linux and Mac OS X and the like.

b) Networking Operating Systems Administration encompassing:

- Backups
- Drive mapping
- Partition and process management
- Server Resources
- Network performance monitoring and optimisation

c) Installing and maintaining hardware encompassing:

- Hardware terms, concepts and components
- Hardware installation, configuration, and maintenance
- Checking hardware configuration
- Diagnosing and troubleshooting devices
- Laptop and mobile devices

d) Troubleshooting operating systems encompassing:

- Identifying and locating symptoms and problems
- Boot errors
- Error recognition
- Troubleshooting network problems
- Disaster recovery

e) Network Security encompassing:

- Developing a network security policy
- Threats to network security
- Implementing security measures
- Network operating system patches

- Firewalls

2.4.34 Routing methods and protocols

Evidence shall show an understanding of routing methods and protocols to an extent indicated by the following aspects:

a) The Routing Process

- Routing table establishment
- Routing advertisement methods

b) Scalable Internet Protocol (IP) addresses encompassing:

- Scaling with IPv4
- Variable Length subnet Mask (VLSM) and supernetting
- IPv6
- Network Address Translation (NAT) and Port Address Translation (PAT)

c) Routing protocols in current use.

Note.

1. Examples include Routing Information Protocol (RIPv2), Enhanced Interior Gateway Protocol (EIGRP), Open Shortest Path First (OSPF) covering single, multi and NBMA areas and Virtual links, OD Rights Language (ODRL), Border Gateway Protocols (BGP) covering applications, communities, peer groups and route reflectors.

2. Other relevant routing protocols may be included.

d) Multi-protocol routing encompassing:

- Static and floating static routes
- Route optimisation
- Route redistribution
- Route filtering

e) Default route

2.4.35 Networks, remote access

Evidence shall show an understanding of remote access to networks to an extent indicated by the following aspects:

a) Network devices and feature sets used for remote access networks encompassing:

- Typical Wide Area Networks (WAN) service.
- Devices for interfacing to WAN services
- Features of WAN services

- Required network device feature sets for effective WAN connectivity

b) Asynchronous On-Demand WAN services encompassing:

- Asynchronous vs. synchronous services.
- Configuring asynchronous Connections with modems
- Interfacing hosts and modems
- Configuring Point-to-point Protocols (PPP) and related network access with Password Authentication Protocols (PAP) and Challenge Hand Shake Authentication Protocols (CHAP)

c) Synchronous and leased WAN connectivity encompassing:

- Current industry-standard WAN services

Note.

Examples include X.25, ISDN and Frame Relay

- Configuring remote connections
- Configuring dial-on-demand routing.
- Traffic Flow
- Configuring backup links
- Managing network performance with queuing and compression

d) Scaling remote access networks with Network Address Translation (NAT) and Port Address Translation (PAT)

e) Controlling corporate network access

- Router-based access control (like access-control lists, reflexive access control, context-bases access control)
- Configuring access, authentication and accounting control systems using current current industry standard tools.

Note.

Example of current industry standard tools is Remote Authentication Dial-In User Service (RADIUS)

f) Troubleshooting the remote access network.

2.4.36 Multi-layer switched networks

Evidence shall show an understanding of multi-layer switched networks to an extent indicated by the following aspects:

- a) Campus network design encompassing:
 - core layer
 - distribution layer
 - access layer

- selection of appropriate devices
- defining workgroups

b) Managing Redundant Links encompassing:

- Spanning Tree Protocol (STP)
- Controlling STP in redundant environments
- STP in Virtual Local Area Network (VLAN) environments
- Configuring redundant routing protocols for a fault-tolerant routing

Note.

An example is Hot Standby routing protocol (HSRP)

c) Fast layer 2 services encompassing:

- Fast Ethernet
- Trunking
- Fast Ether channels
- Gigabit services

d) Inter VLAN Routing encompassing:

- Hardware vs. Software switching
- Overview of fast switching technologies
- Elements of a multi-layer switch
- Configuring multi-layer switches

e) Multicast encompassing:

- Multi-cast group management
- Configuring multi-cast control at layer 2
- Configuring multi-cast control at layer 3

f) Controlling Access to the Campus Network

g) Managing Network Traffic

2.4.37 Fundamentals of network security

Evidence shall show an understanding of fundamentals of network security to an extent indicated by the following aspects:

a) Network Security fundamentals

b) Securing Perimeter Routers

c) Access Control Lists (ACLs)

d) Router Authentication, Authorisation and Accounting (AAA) Security

e) Intrusion Detection

- f) Internet Protocol (IP) Security
- g) Virtual Private Network (VPN)
- h) Firewalls
- i) Translations and Connections
- j) Access Control Lists for Firewalls
- k) AAA and Firewalls
- l) Intrusion
- m) Intrusion Detection Systems (IDS)
- n) Firewall Failover and System Maintenance
- o) Firewall VPN's
- p) Firewall Device Management

2.4.38 Fundamentals of wireless security

Evidence shall show an understanding of fundamentals of wireless security to an extent indicated by the following aspects:

- a) Standards
- b) Wireless radio technology
- c) Wireless topologies
- d) Network Interface Cards (NICs)
- e) Access points
- f) Bridges
- g) Antennas
- h) Security
- i) Application design and site survey preparation
- j) Troubleshooting, management, monitoring and diagnostics
- k) Emerging technologies

2.4.39 Internet, network basics

Evidence shall show an understanding of network basics to an extent indicated by the following aspects:

- a) Workstation Configuration
- b) Function and interaction of workstation sub systems

- c) The OSI Model
- d) Network Devices at layers 2 and 3
- e) Physical Layer
- f) Data Link Layer
- g) Layer 2 Trouble Shooting
- h) IP addressing and sub netting
- i) Network Layer
- j) TCP and UDP
 - Purpose of the transport layer
 - Comparing TCP and IP
 - TCP and UDP
 - TCP segment format
 - UDP segment format
 - TCP Connection Methods
- k) The Session Layer
- l) The Presentation Layer
- m) The Application Layer

2.4.40 Internet, network routing

Evidence shall show an understanding of network routing to an extent indicated by the following aspects:

- a) Calculate subnet addresses and masks
- b) Layer 3 and 4 Protocols
- c) Static and dynamic routing
- d) Basic Router Configuration
- e) Router Security
- f) Router Boot Sequence
- g) Router OS management
- h) Password Recovery
- i) DNS Configuration
- j) Troubleshooting at all layers

2.4.41 Internet, local area networking

Evidence shall show an understanding of local area networking to an extent indicated by the following aspects:

- a) Basic Switch Configuration
- b) Basic VLAN Configuration
- c) VLAN Design
- d) IGP Configuration
- e) Access Lists configuration
- f) Network Documentation
- g) Network Security and Risk Management
- h) Network Performance Assessment
- k) Network Structures encompassing:
 - Peer-to-Peer
 - Client-Server
 - Network control
- l) Design Report Presentation

2.4.42 Internet, wide area networking

Evidence shall show an understanding of wide area networking to an extent indicated by the following aspects:

- a) Wide Area Networks (WANs) technologies
- b) WAN Design
- c) WAN Protocols including authentication
- d) WAN Management and security

2.4.43.1 Object orientated programming basics

Evidence shall show an understanding of object orientated programming basics to an extent indicated by the following aspects:

- a) Object-Oriented programming language elements
- b) Object-Oriented programming language operators and control structure

2.4.43.2 Object orientated programming

Evidence shall show an understanding of object orientated programming to an extent indicated by the following aspects:

- a) OO programming language elements
- b) OO programming language operators and control structures
- c) Creating new classes
- d) Using system libraries

Note: Examples may include:

System, Strings, String Buffer, Math and Wrapper classes.

e) Inheritance encompassing:

- Inheritance and object orientated programming
- Support for inheritance
- Access modifiers and inheritance
- Overriding
- Use of this and super
- Inheritance and constructors
- Extending classes
- Interfaces
- Polymorphism and dynamic binding

f) Defining and using arrays

g) Creating Graphical User Interfaces (GUI) applications using library classes

h) Using GUI components and event-driven programming

i) Exception handling

j) File I/O

l) Collections and collection framework

m) Multithreading

2.4.44.1 Microprocessor/microcontroller assembler language programming

Evidence shall show an understanding of microprocessor assembly language to an extent indicated by the following aspects:

a) CPU Architecture

- registers.
- instruction set considerations, common and advanced instructions.
- addressing modes supported: direct, indirect, indexed etc.
- software interrupts and system calls.

b) Processor And System Support

- instruction pre-fetch pipeline.
- system timer chip, function and programming.
- hardware interrupts programming considerations.
- DMA devices and support.
- co-processors and bus interface.

c) Modular Programming

- separately compiled and linked assembly language modules.
- library modules.
- macros.

d) Documentation And Debugging

- system specification and documentation
- debugging and tracing program execution

2.4.44.2 High level programming

Evidence shall show an understanding of high-level language programming as it is applied to engineering applications to an extent indicated by the following aspects:

a) Complex data types and structures encompassing:

- Pointers/references
- arrays and strings
- user-defined data types

b) Interfacing high-level languages to assembler encompassing:

- in-line assembly.
- bit manipulation
- IO port addressing

c) Interrupt Service Routines**2.4.44.3 Advanced high-level programming**

Evidence shall show an understanding of advanced high-level language programming as it is applied to engineering applications to an extent indicated by the following aspects:

a) Object Orientated Programming concepts

- Encapsulation
- Inheritance
- Polymorphism

b) Creating applications with a Graphical Interface

c) Using external libraries

2.4.45 Copier/printer software functions and configuration

Evidence shall show an understanding of copier/printer software to an extent indicated by the following aspects:

- a) Copier/printer software functions and configuration options
- b) Device driver software installation and configuration
- c) Available user function
- d) Diagnostic software functions and their use:

2.4.46 Security systems basic software functions and configuration

Evidence shall show an understanding of security systems basic software to an extent indicated by the following aspects:

- a) Security system software functions and configuration options
- b) Access and detection functions
- c) Diagnostic functions and their use

2.4.47 Security systems programming methods

Evidence shall show an understanding of security systems programming methods to an extent indicated by the following aspects:

- a) Vender programming codes and functions encompassing:
 - Input/output instruction
 - Variable
 - Timers
 - Limitations of vender software
- b) Program loading methods using a personal computer
- c) Program testing methods

2.4.48 Security systems alarms programming

Evidence shall show an understanding of security systems alarms programming to an extent indicated by the following aspects:

a) Vender programming codes and functions encompassing:

- Input/output instruction
- Variable
- Timers
- Limitations of vender software

b) Program loading methods using a personal computer

c) Program testing methods

2.4.49.1 Security systems access control programming

Evidence shall show an understanding of security systems access control programming to an extent indicated by the following aspects:

a) Vender programming codes and functions encompassing:

- Input/output instruction
- Variable
- Timers
- Limitations of vender software

b) Program loading methods using a personal computer

c) Program testing methods

2.4.49.2 Security systems closed circuit television programming

Evidence shall show an understanding of security systems closed circuit television programming to an extent indicated by the following aspects:

a) Vender programming codes and functions encompassing:

- Input/output instruction
- Variable
- Timers
- Limitations of vender software

b) Program loading methods using a personal computer

c) Program testing methods

2.4.50.1 Integrated security systems

Evidence shall show an understanding of integrated security systems to an extent indicated by the following aspects:

- a) security scenarios
- b) security network standards and protocols
- c) network topology
- d) physical media
- e) disaster planning

2.4.50.2 Internetworking security systems

Evidence shall show an understanding of internetworking security systems to an extent indicated by the following aspects:

- a) Security scenarios
- b) security network standards and protocols
- c) network topology
- d) physical media
- e) disaster planning

2.4.51 Fire protection systems programming methods

Evidence shall show an understanding of fire protection systems programming methods to an extent indicated by the following aspects:

- a) Vender programming codes and functions encompassing:
 - Input/output instruction
 - Variable
 - Timers

Limitations of vender software

- b) Program loading methods using a personal computer
- c) Program testing methods
- d) Program back up, version control and documentation requirements

2.2.05 Drawings, diagrams, schedules, manuals, standards and regulations

2.5 Drawings, diagrams, schedules, manuals, standards and regulations

2.5.1.1 Drawings interpretation and sketching

Evidence shall show an understanding of drawings interpretation and sketching to an extent indicated by the following aspects:

- a) Basic technical drawing conventions and symbols
- b) Freehand technical sketching techniques

2.5.1.2 Drawings and diagrams

Evidence shall show an understanding of drawings, diagrams and schedules used in electrotechnology work to an extent indicated by the following aspects:

- a) Drawing types and applications encompassing:
 - Drawing layouts and conventions

Note:

Examples may include mechanical drawings, electrical/electronic schematics, wiring diagrams, PC boards, location diagrams (architectural drawings), and cable routes and switching arrangements and building details.

-
- Drawing symbols

Note:

Examples may include symbols representing electrotechnology circuit components, equipment location and cable routes and control arrangements.

-
- b) Cable/wiring/connection and equipment/component/schedules.

2.5.2.1 Technical standards, regulations and codes for general electrical installations

Evidence shall show an understanding of technical standards and regulations that apply to electrical installations to an extent indicated by the following aspects:

- a) Regulation for undertaking electrical work

b) Standards philosophy and format

- How to read and apply a standard.
- Standards and Codes that apply to all types of electrical installations

Note:

1. Standards include Standards mandated under regulation or by an authority, deemed-to-comply standard and local service requirements.
 2. Codes include those applicable to electrical safe working practices.
-

c) Applying standards, regulations and codes to general electrical installation encompassing:

- Protection for safety
- Installation design
- Selection of electrical equipment
- Installation of electrical equipment

d) Testing and verification**2.5.2.2 Technical standards, regulations and codes for special electrical installations**

Evidence shall show an understanding of technical standards and regulations that apply to special electrical installations to an extent indicated by the following aspects:

- a) Additional requirements for special installations
- b) Applying standards, regulations and codes to special electrical installation

Note:

Special installations are those in caravan parks, construction and demolition sites, marinas, medical treatment areas and moveable premises and HV installation in consumer's premises

2.5.2.3 Technical standards, regulations and codes for testing and tagging portable and cord connected electrical apparatus

Evidence shall show an understanding of technical standards and regulations that apply to testing and tagging portable and cord connected electrical apparatus to an extent indicated by the following aspects:

- a) Regulation for undertaking testing and tagging work
- b) Standards and Codes that apply to testing and tagging
 - How to read and apply a standard
 - Standards and Codes that apply to testing and tagging

Note:

1. Standards include Standards mandated under regulation or by an authority, deemed-to-comply standard and local service requirement

2. Codes include those applicable to electrical safe working practices

c) Applying standards, regulations and codes to testing and tagging encompassing:

- Apparatus and cord inspection and testing
- Tests and testing methods
- Test results and compliance requirements

d) Tagging system methods and requirements.

2.5.3 Technical standards, regulations and codes for lifts and escalators

Evidence shall show an understanding of technical standards and regulations that apply to lifts and escalators to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard
- c) Standards and Codes that apply to lifts and escalators
- d) Applying standards, regulations and codes

2.5.4 Technical standards, regulations and codes rail networks

Evidence shall show an understanding of technical standards and regulations that apply to rail networks and escalators to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard
- c) Standards and Codes that apply to rail networks
- d) Regulations

2.5.5 Technical standards, regulations and codes for extra low voltage work

Evidence shall show an understanding of technical standards, regulations and codes related to extra-low voltage work to an extent indicated by the following aspects:

- a) Limitation imposed by regulations
- b) How to read and apply a standard
- c) Aspects of technical Standards that apply to extra-low voltage work

2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning

Evidence shall show an understanding of technical standards and regulations that apply to refrigeration and air conditioning to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard
- c) Standards and Codes that apply to refrigeration and air conditioning
- d) Regulations
- e) Equipment manufactures specifications

2.5.7 Technical standards, regulations and codes for telecommunications cabling

Evidence shall show an understanding of technical standards and regulations that apply to telecommunications cabling to an extent indicated by the following aspects:

- a) Role of Australian Communications Authority (ACA) under the Telecommunication Act 1997
- b) Penalties for non compliance
- c) Standards and Codes that apply to telecommunications cabling encompassing:
 - Current technical standards applicable to cabling
 - Aspects of other technical standards or codes of practice called up by regulation
 - Cabling Provider Rules' requirements
 - Certified components
 - d) Application of Standards, Codes and regulations encompassing:
 - Cabling installation, protection and segregation
 - Earthing and protection
 - Cable connections
 - Certification
 - Labelling and documentation of cabling and active communication

equipment

e) Cabler Registration requirements and processes

2.5.8 Technical standards, regulations and codes for electronic apparatus

Evidence shall show an understanding of electronic apparatus to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard
- c) Standards and Codes that apply to electronic apparatus
- d) Applying standards, regulations and codes

2.5.9 Building codes applicable to general electrotechnology installations

Evidence shall show an understanding of building codes to an extent indicated by the following aspects:

- a) Building code philosophy and format
- b) How to read and apply a code
- c) Codes that apply to general electrotechnology installations
- d) Applying codes

2.5.10 Technical manuals and catalogues

Evidence shall show an understanding of the use of technical manuals and catalogues for electrotechnology work to an extent indicated by the following aspects:

- a) Typical format
- b) How to read and apply information

2.5.11 Environmental and heritage awareness

Evidence shall show an understanding of environmental and heritage regulation effecting electrotechnology work to an extent indicated by the following aspects:

- a) Purpose of environmental and heritage regulation

- b) Typical issues affecting electrotechnology services and systems
- c) Meeting requirements

2.5.12 Electricity distributors, supply requirements

Evidence shall show an understanding of supply arrangements of electricity distributors to an extent indicated by the following aspects:

- a) General requirements for the supply of electricity.
- b) Supply and metering requirements.
- c) Acceptable arrangement of switchgear and controlgear.
- d) Acceptable earthing methods and arrangements

2.5.13 Electricity regulatory safety requirements

Evidence shall show an understanding of safety requirement of electricity regulator to an extent indicated by the following aspects:

- a) Regulatory requirements for ensuring the safety and integrity of electrical installations.

Note:

Regulatory requirements are relative to the jurisdiction for which competency is sought

- b) Types and scope of electrical inspections and safety audits
- c) Authority of electrical inspectors

2.5.14 Technical standards, regulations and codes applicable to instrumentation and control

Evidence shall show an understanding of technical standards and regulations that apply to telecommunications cabling to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard.
- c) Standards and Codes that apply to instrumentation and control

Note:

1. Examples of standards and code are those covering hazardous materials, potentially explosive atmospheres, certification of apparatus, environment

protection, safety and the like

d) Regulations

2.5.15 Measurement standards applicable to process instrumentation

Evidence shall show an understanding of technical standards and regulations that apply to telecommunications cabling to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard.
- c) Certification standards that apply to process instrumentation
- d) Process instrumentation that apply to certification

2.5.16 Measurement standards applicable to scientific instruments

Evidence shall show an understanding of technical standards and regulations that apply to telecommunications cabling to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard.
- c) Certificate standards that apply to scientific instrumentation
- d) Scientific instrumentation certification process

2.5.17 Regulatory requirements for the generation, transmission and distribution of electricity

Evidence shall show an understanding of regulations that apply to the generation, transmission and distribution of electricity to an extent indicated by the following aspects:

- a) Generation, transmission and distribution technical standards
- b) Scope of regulatory requirements

2.5.18 Regulatory requirements and codes of practice for the gaming equipment

Evidence shall show an understanding of regulations that apply to gaming equipment to an extent indicated by the following aspects:

- a) Types of equipment permitted —
 - Location restrictions and requirements
 - Operational restrictions and requirements
- b) Security encompassing:
 - Access to customers premises
 - Access to machines

2.5.19 Technical standards, regulations and codes for mining

Evidence shall show an understanding of technical standards and regulations that apply to mines to an extent indicated by the following aspects:

- a) Regulation governing mining and related activities
- b) Standards and Codes that apply to mining electrical systems

Note:

1. Standards include Standards mandated under regulation or by an authority, deemed-to-comply standard and local service requirements.
 2. Codes include those applicable to electrical safe working practices
-

- c) Applying standards, regulations and codes to mining electrical systems encompassing:

- Protection for safety
- Installation arrangement
- Certified/approved electrical equipment
- Installation of electrical equipment
- Testing and verification

2.5.20 Technical standards, regulations and codes for security systems

Evidence shall show an understanding of technical standards and regulations that apply to security systems to an extent indicated by the following aspects:

- a) Regulation governing security system installations
- b) Standards and Codes that apply to security systems and equipment

Note:

1. Standards include Standards mandated under regulation or by an authority, deemed-to-comply standard and local service requirements.

2. Codes include those applicable to electrical safe working practices

c) Applying standards, regulations and codes to security systems encompassing:

- Installation arrangement
- Certified/approved security equipment
- Installation of security equipment
- Testing and verification

2.5.21 Technical standards, regulations and codes for fire protection and warning systems

Evidence shall show an understanding of technical standards and regulations that apply to fire protection and warning systems to an extent indicated by the following aspects:

a) Regulation governing fire protection and warning system installations

b) Standards and Codes that apply to fire protection systems and equipment

Note:

1. Standards include Standards mandated under regulation or by an authority, deemed-to-comply standard and local service requirements.
 2. Codes include those applicable to electrical safe working practices
-

c) Applying standards, regulations and codes to fire protection systems encompassing:

- Installation arrangement
- Certified/approved fire equipment
- Installation of fire equipment
- Testing and verification
- Final commissioning verifications

2.5.22 Performance standards and regulatory requirements for the electrical rotating machine

Evidence shall show an understanding of performance standards and regulations that apply to electric motors and generators to an extent indicated by the following aspects:

a) Standards philosophy and format

b) How to read and apply a standard

c) Performance standards encompassing:

- Safety requirements

- Machine efficiency
- d) Regulations

2.5.23 Performance standards and regulatory requirements for electrical equipment

Evidence shall show an understanding of performance standards and regulations that apply to electrical equipment to an extent indicated by the following aspects:

- a) Standards philosophy and format
- b) How to read and apply a standard
- c) Performance standards encompassing:
 - Safety requirements
 - Machine efficiency
- d) Regulations

2.2.06 Electrical applications and apparatus

2.6 Electrical applications and apparatus

2.6.1 Protection devices and applications

Evidence shall show an understanding of protection devices and their application to an extent indicated by the following aspects:

- a) Purpose, types and applications.

Note:

Types include rewirable fuses, HRC fuses, circuit breakers, residual current devices and overvoltage and undervoltage protection.

- b) Operating principles and characteristics

Note.

Principles include the purpose of earthing and the MEN system.

- c) Requirements for coordination and discrimination of circuit protection devices.

2.6.2.1 Switchboards / distribution boards

Evidence shall show an understanding of switchboards / distribution board to an

extent indicated by the following aspects:

- a) Purpose, types and applications.
- b) Equipment installed on switchboards.
- c) Arrangements of equipment.

2.6.2.2 Electrical metering arrangements

Evidence shall show an understanding of electrical metering arrangements to an extent indicated by the following aspects:

- a) Purpose, types and applications.
- b) Metering equipment.
- c) Arrangements for metering.

2.6.2.3 Interval metering concepts and applications

Evidence shall show an understanding of interval metering to an extent indicated by the following aspects:

- a) Purpose, types and applications.
- b) Installation and power connection arrangements.
- c) Communication methods and arrangements.
- d) Connections for gas metering.
- e) Procedures for setting meter parameters.

2.6.3 Single phase alternators

Evidence shall show an understanding of single phase alternators to an extent indicated by the following aspects:

- a) Purpose, types and applications
- b) Operating principles and characteristics
- c) Installation and starting/running requirements and limitations
- d) Connection arrangements
- e) Typical fault symptoms and related conditions

2.6.4 Three phase alternators

Evidence shall show an understanding of three phase alternators to an extent indicated by the following aspects:

- a) Purpose, types and applications
- b) Operating principles and characteristics
- c) Installation and starting/running requirements and limitations
- d) Connection arrangements
- e) Typical fault symptoms and related conditions

2.6.5 Single phase motors

Evidence shall show an understanding of single phase motors to an extent indicated by the following aspects:

- a) Purpose, types and applications
- b) Operating principles and characteristics
- c) Installation and starting/running requirements and limitations
- d) Connection arrangements
- e) Typical fault symptoms and related conditions

2.6.6.1 Three phase motors

Evidence shall show an understanding of three phase motors to an extent indicated by the following aspects:

- a) Purpose, types and applications
- b) Operating principles and characteristics
- c) Installation and starting/running requirements and limitations
- d) Connection arrangements
- e) Typical fault symptoms and related conditions

2.6.6.2 Alternating current rotating machines

Evidence shall show an understanding of alternating current rotating machines to an extent indicated by the following aspects:

a) Three phase motors encompassing:

- principles of operation.
- construction features of various induction motor types.
- relationship between torque, speed, and power in an induction motor.
- conditions necessary for an induction motor to produce maximum torque.
- operating characteristics of an induction motor from name plate information and by measurement.
- full load efficiency and power factor of induction motors.
- minimum energy performance standards (MEPS)

b) Motor protection encompassing:

- conditions that cause motors to overheat.
- protection of motors against overcurrent and undervoltage.
- operating principles of microtherm devices, thermal and magnetic overloads and current control relays.
- HRC fuses/circuit breakers selection to protect a motor circuit.
- overload devices for a given motor and load condition.

c) Purpose of limiting starting current of machines encompassing:

- operating characteristics and applications of DOL, star-delta, auto transformer, soft start, primary resistance and secondary resistance starters.
- relative starting torque produced by a motor using each type of starter.
- components and operating sequence of each type of starter.
- conditions necessary for a motor to accelerate when coupled to a load.
- effects on motor performance when a load variation occurs.

d) Connection methods of three phase starters encompassing:

- interpretation of motor starter wiring diagrams.
- connection of motor starters with local or remote stop-start stations.

e) Wiring Rules and service rule requirements encompassing:

- Wiring Rules' requirements relating to motors, their protection and control.
- state local Supply Authorities' requirements for the limitation of starting current, connection and controls of electric motors.

f) Three phase induction motor controls encompassing:

- reversing motor direction of rotation.
- braking methods.

Note:

Braking methods to include: dynamic, plugging, regenerative, eddy current and mechanical.

- speed control methods

Note:

Speed control methods to include: voltage control, pole changing, variable voltage/variable frequency and slip control.

g) Single phase motor principles and characteristics encompassing:

- production of 'rotating' magnetic field in split-phase and shaded-pole motors.
- relative difference in torque produced by various types of 'phase-splitting' motors using a phaser diagram.
- torque/speed characteristics of single phase motors.
- circuit diagrams of split-phase, capacitor start, capacitor start-run motors, shaded-pole motor and universal motor.
- methods of reversing the direction of rotation of single-phase motors.

h) Single phase motor construction encompassing:

- identification of the run winding and the start/auxiliary winding in a split-phase motor by resistance measurement at the motor terminals.
- identification of the starting circuits switching devices and explain how they operate.
- identification of the components in single-phase motors and explain their purpose.
- identification of the devices used with single-phase motors to provide overload protection, over-temperature protection, automatic or remote starting and speed control.

i) Single phase motor applications encompassing:

- power, torque and speed characteristics of various types of motors.
- power, torque, speed and efficiency of single-phase motors.
- typical applications for various types of single-phase motors.

j) Fault testing encompassing:

- common causes of motor malfunction.
- load test on a motor to determine whether the terminal voltage is correct, line current is balanced and the motor operates within rated speed.
- faults in various motor windings for various winding conditions.
- tests on motors and circuits to locate faults.

k) Three-phase synchronous machines encompassing:

- constructional details of three-phase alternators, induction generators and synchronous motors.
- operation of three-phase alternators, induction generators and synchronous motors.
- applications of induction generators and three-phase synchronous motors.
- nameplate data.

- full load current ratings of synchronous machines.

l) Three-phase synchronous machines encompassing:

- effect of a given load on the output characteristics of a three-phase alternator.
- effect of excitation variation on a given operating condition of a three-phase alternator.
- effect of load on a three-phase synchronous motor.
- effect of excitation variation in relation to a three-phase synchronous motor.

m) Single phase synchronous machines encompassing:

- constructional details of common single-phase portable alternator.
- operating characteristics of common single-phase alternators.
- type of common single-phase synchronous motor given constructional details.
- appropriate application of each type of motor identified.

2.6.7 Single phase transformers

Evidence shall show an understanding of single phase transformers to an extent indicated by the following aspects:

- a) Purpose, types and applications
- b) Operating principles and characteristics
- c) Installation and operating requirements and limitations
- d) Connection arrangements
- e) Typical fault symptoms and related conditions

2.6.8.1 Three phase transformers

Evidence shall show an understanding of three phase transformers to an extent indicated by the following aspects:

- a) Purpose, types and applications
- b) Operating principles and characteristics
- c) Installation and operating requirements and limitations
- d) Connection arrangements
- e) Typical fault symptoms and related conditions

2.6.8.2 Single & three-phase transformers

Evidence shall show an understanding of single and three phase transformers to an extent indicated by the following aspects:

a) Transformer construction and operating principles encompassing:

- types of lamination style and core construction used in single-phase, three-phase, double wound and auto transformers.
- different winding styles/types used in transformers.
- no load and load operating parameters.
- transformation ratio.
- nameplate data.
- operation of a transformer under load/no loads conditions.
- application of transformers.
- safety features specified in AS/NZS 3000:2000 with respect to transformers.
- safety features specified in AS/NZS 3000:2000 with respect to isolating transformers.
- basic insulation resistance, continuity and winding identification tests.

b) Transformer parameters encompassing:

- percentage impedance of a transformer.
- equivalent circuit of a transformer.
- voltage regulation.
- losses that occur in a transformer.
- tests to determine losses.
- efficiency and all day efficiency of a transformer.

c) Cooling methods encompassing:

- methods of natural and forced cooling.
- properties of transformer oil.
- tests performed on transformer oil.
- auxiliary equipment
- purpose and operation of auxiliary equipment used on transformers

Note:

Examples are: bushings, explosion vents, surge diverters, tap changers, conservator, breathers and desiccants, gas relays, temperature indicators.

d) Instrument transformers encompassing:

- construction of current transformers.
- uses and ratings of current transformers.
- construction of voltage transformers.
- uses and ratings of voltage transformers.

- safety techniques when using instrument transformers.

e) Transformer connections encompassing:

- vector group of a transformer from a connection diagram.
- connections of a three-phase transformer to create a particular vector group.
- using the different vector groups.
- tertiary windings.
- consequences/effect of an incorrect connection.

f) Parallel operation encompassing:

- polarity markings for the windings of a transformer.
- conditions/restrictions for parallel operation of transformers.
- loading on transformers operating in parallel.
- connection of transformers in parallel to supply a common load.
- the consequences/effect of an incorrect connection.

g) Harmonics in transformers encompassing:

- harmonics generated in transformers.
- problems caused by harmonics in transformers.
- observation and measurement of the harmonics in a transformer.
- methods/equipment used to overcome harmonics in transformers.
- h) High voltage isolation encompassing:
 - the term high voltage.
 - procedures for isolating high voltage apparatus.
 - regulations with respect to *access permits*.
 - clearances to be observed with respect to high voltages up to 33kV.
 - the term ‘step’ and ‘touch’ potential.

2.6.8.3 Power transformers diagnostics

Evidence shall show an understanding of power transformers to an extent indicated by the following aspects:

a) Transformer construction and operating principles encompassing:

- various types of lamination style and core construction used in single-phase, three-phase, double wound and auto transformers.
- different winding styles/types used in transformers.
- how input current is limited on no load and how power is transferred from primary to secondary when a load is connected.
- using the transformation ratio to determine an unknown quantity of V, I, VA.
- significance of nameplate data items.

- operation of a transformer under load/no load conditions.
- the reason any particular type of transformer is used in a specific application.
- safety features specified in regulatory standards with respect to transformers.
- safety features specified in regulatory standards with respect to isolating transformers.
- basic insulation resistance, continuity and winding identification tests.

b) Transformer parameters encompassing:

- the percentage impedance of a transformer by test.
- percentage impedance of a transformer by calculation.
- the equivalent circuit of a transformer.
- calculation of voltage regulation.
- losses that occur in a transformer.
- tests to determine losses.
- efficiency and state typical values.
- the all day efficiency of a transformer.

c) Cooling methods encompassing:

- methods of natural and forced cooling.
- properties of transformer oil.
- tests performed on transformer oil.
- auxiliary equipment
- the purpose and operation of the types of auxiliary equipment used on transformers

Note.

Examples are bushings, explosion vents, surge diverters, tap changers, conservator, breathers and desiccants, gas relays, temperature indicators.

d) Instrument transformers encompassing:

- construction of current transformers.
- uses and ratings of current transformers.
- construction of voltage transformers.
- uses and ratings of voltage transformers.
- safety techniques when using instrument transformers.

e) Transformer connections encompassing:

- vector group of a transformer from a connection diagram.
- connections of a three-phase transformer to create a particular vector group.
- reasons for using the different vector groups.
- purpose of tertiary windings.
- consequences/effect of an incorrect connection.

f) Parallel operation encompassing:

- polarity markings for the windings of a transformer.
- conditions/restrictions for parallel operation of transformers.
- calculation of loading on transformers operating in parallel.
- connection of transformers in parallel to supply a common load.
- the consequences/effect of an incorrect connection.

g) Harmonics in transformers encompassing:

- how harmonics are generated in transformers.
- problems caused by harmonics in transformers.
- measurement of the harmonics in a transformer.
- methods/equipment used to overcome harmonics in transformers.

h) High voltage isolation encompassing:

- the term high voltage.
- procedures for isolating high voltage apparatus.
- regulations with respect to *access permits*.
- clearances to be observed with respect to high voltages up to 33kV.
- the term 'step' and 'touch' potential.

2.6.9.1 Lighting fundamentals

Evidence shall show an understanding of luminaires - lighting fundamentals to an extent indicated by the following aspects:

a) Lighting concepts

- Principles of light
- Common lighting terms

Note.

Example are lumens, lux, candela, efficacy, lamp, lamp life, luminance, illuminance, luminaire and lamp colour.

- Measurement of lighting levels using light meters.

b) Light producing principles of incandescent, fluorescent and gas discharge lamps.

2.6.9.2 Luminaires and lighting systems

Evidence shall show an understanding of luminaires to an extent indicated by the following aspects:

a) Types and applications of luminaires

b) Operating principles and connection arrangements

Note:

Principles and connections include ancillary equipment and power factor improvement methods

c) Installation and operating requirements and limitations**d) Typical fault symptoms and related conditions of lighting circuits**

- Common faults in fluorescent lights
- Testing techniques – dead and live testing

e) Supply authority requirements for lighting circuits

- Requirements for power factor correction
- Requirements to prevent interference of supply authority control signals
- Terms lead/lag, LPF, HPF/BI and stroboscopic effect.

f) Evacuation lighting systems

- Requirements of system (Building Codes and Standards)
- Types of systems (central battery system and self contained system)
- Luminaire types (non-maintained, maintained and sustained)
- Maintenance requirements.

2.6.9.3 Venue lighting for audio/video/live presentations

Evidence shall show an understanding of venue lighting to an extent indicated by the following aspects:

- a) Lighting types and colour
- b) Effects of direction of light
- c) Use of natural light
- d) Lighting levels and control

2.6.10 Electric heating

Evidence shall show an understanding of electric heating to an extent indicated by the following aspects:

- a) Heating and heat energy encompassing:
 - heat and temperature.
 - methods of heat transfer.
 - thermal conductivity and its dependent factors.

b) Control of heating encompassing:

- methods of heat control, manual and automatic
- function of a thermostat with respect to its mechanical operation, sensitivity and differential
- thermostat testing for correct operation within its specification
- applications of thermostats
- operation and application of a simmerstat
- electronic techniques employed for heat control

Note.

Example are zero crossing, phase control, voltage control, half/full wave

c) Heating process encompassing:

- Types of domestic and industrial water heaters and their control.
- Intrinsic safety precautions employed with water heaters.
- Solar heating as a supplement or replacement for electrical heating.
- Tariff mechanisms employed with heating processes.
- Types of space heaters and their control methods

Note.

Examples are strip heaters, storage heaters, under carpet heating, reverse cycle air conditioning and infra-red heating.

- Types of cooking appliances and their control method
-

Note.

Examples are resistance, induction heating and microwave.

- Industrial process heating and their control
-

Note.

Examples are resistance heating, infra-red ovens, induction heating, dielectric heating, electric arc.

- Causes of a fault in a malfunctioning electric heating device/circuit
-

Note.

Faults may include open circuits, short circuits, high resistance, low insulation resistance, thermostat or cut-out failure.

2.6.11 Direct current machine fundamentals

Evidence shall show an understanding of d.c. machine to an extent indicated by the following aspects:

a) Types and applications

- b) Motor circuit configurations
- c) Name plate details

2.6.12 Direct current machines

Evidence shall show an understanding of d.c. machines to an extent indicated by the following aspects:

- a) Purpose, types and applications
- b) Operating principles
- c) Installation and starting/running requirements and limitations
- d) Connection arrangements
- e) Typical fault symptoms and related conditions.

2.6.13 Motor starters and overload protection basics

Evidence shall show an understanding of motors starter and overload protection to an extent indicated by the following aspects:

- a) Purpose of motor starters and overload protection
- b) Starting current limitations
- c) Types and applications
- d) Basic motor starter control circuits and safety interlocks

2.6.14 Direct-on-line (DOL) motor starters

Evidence shall show an understanding of DOL motors starter to an extent indicated by the following aspects:

- a) Operating principles
- b) Power and control connection arrangements encompassing:
 - Built-in stop/start control
 - Remote stop/start control
 - Overload protection
 - Interlocking with other starters
- c) Overload protection characteristics

2.6.15 Reduced voltage a.c. motor starters

Evidence shall show an understanding of reduced voltage motors starter to an extent indicated by the following aspects:

a) Types of starter and their operating principles

Notes:

Types include star/delta; primary resistance; secondary resistance; auto transformer and soft starters.

b) Power and control connection arrangements encompassing:

- Built-in stop/start control
- Remote stop/start control
- Overload protection
- Interlocking with other starters and controls

2.6.16 Direct current motor controls

Evidence shall show an understanding of direct current motor controls to an extent indicated by the following aspects:

a) Types of starter and their operating principles

Notes:

Types include back emf; series-lockout, timed starters and electronic controllers

b) Power and control connection arrangements encompassing:

- Built-in stop/start control
- Remote stop/start control
- Overload protection
- Interlocking with other starters and controls

c) Braking methods encompassing:

- Dynamic,
- Plugging,
- Electromechanical, and
- Regenerative.

d) Speed control methods encompassing:

- Field control
- Reostatic control
- Voltage control

e) Protection of d.c. motors

2.6.17 Cells and batteries

Evidence shall show an understanding of cells and batteries to an extent indicated by the following aspects:

a) Types and electricity production processes.

Notes:

1. Types include primary and secondary cells in common use.
 2. Processes include discharging and recharging
-

b) Cell parameters.

Note:

Examples include terminal voltages, capacity and discharge and recharge characteristics.

c) Battery configurations and applications.

d) Cell and battery safety practices.

2.6.18 RAPS systems basics

Evidence shall show an understanding of RAPS systems. to an extent indicated by the following aspects:

a) System components and their functions.

Note:

1. System components are engine driven generator sets, photo voltaic arrays, wind driven generator sets, battery banks, system inverters and controls.
 2. The function of each component includes how they operate within the system.
-

b) Operating parameters of each component and of the system

Note:

Operating parameters include voltage range and current supplied by each power component to the system and limitations on system components to supply various loads.

2.6.19 RAPS systems demand side management

Evidence shall show an understanding of RAPS systems demand side management to an extent indicated by the following aspects:

a) Need for demand side management

b) Demand limitations and seasonal variations in capabilities of given RAPS systems

Note:

Factors limiting demand are rating of the system and its components, demand of individual appliances, most suitable source of supply for individual appliances, population of local community and how and when appliances are used

c) Optimisation of system performance

d) Methods for evaluating long term changes to community and/or household power requirements

2.6.20 Electrical mining systems overview

Evidence shall show an understanding of electrical mining systems to an extent indicated by the following aspects:

a) Mine reticulation encompassing:

- Mine reticulation
- Substations
- Transmission lines
- Switchgear
- Earthing

b) Electrical control and protection encompassing:

- Types of protection
- Operation of protection devices and systems
- Prospective fault currents
- Discrimination

c) Mining cables encompassing:

- Handling
- Storage
- Testing

d) Ventilation fans

e) Operation and safety of mining equipment encompassing:

- Battery charging
- Battery operated vehicles
- Conveyors
- Mine winder and package systems
- Ore extraction machinery
- Shuttle cars

- Ventilation fans

f) Environmental monitoring and control encompassing:

- Basic principle
- Types and application of sensors
- Control methods

g) Equipment monitoring methods

h) Fire detection, warning and control systems

2.6.21 Electricity supply and reticulation

Evidence shall show an understanding of electricity supply and reticulation systems to an extent indicated by the following aspects:

a) Generation

- primary energy sources
- power stations
- power station output
- acts and legislation relating to generation
- renewable energy sources and techniques

b) Transmission

- system requirements
- principal components of a power system
- voltage levels
- grid systems
- acts/legislation relating to transmission
- future trends

c) Distribution

- high voltage distribution systems
- medium/low voltage distribution systems
- radial feeders
- parallel feeders
- ring main feeders
- acts/legislation relating to distribution

d) Substations

- purpose
- location
- layout

e) Overhead and underground systems

- relative merits
- applications
- planning
- installation

f) Power distribution system electrical characteristics

- transmission and distribution systems
- inductance, capacitance and resistance

g) Voltage problems in a power distribution system

- low voltage
- unbalanced voltages
- voltage rises

h) Voltage regulation

- autotransformers with OLTC
- transformers with OLTC
- static capacitors
- load control

i) Control of OLTC

- regulation relays
- control circuits
- line drop compensation

j) Power distribution system faults

- type/classification of fault
- typical causes/effects of faults
- three-phase symmetrical fault levels
- fault level limitation

k) Voltage surges in a power distribution system

- lightning surges
- switching surges
- typical surge levels
- surge impedance, typical values
- significance of the system surge impedance.

l) Metering and metered quantities

- purpose
- energy
- maximum demand
- accuracy classes for metering systems

m) Energy and demand meters

- construction
- operation
- adjustments
- testing

n) Metering circuits

- direct metering
- instrument transformer metering

o) Electronic metering systems and recording meters

- types
- applications
- connections

p) Load control

- purpose
- methods

2.6.22.1 Electrical power system protection

Evidence shall show an understanding of protection methods and devices for electrical power systems to an extent indicated by the following aspects:

a) Protection fundamentals encompassing:

- purpose of protection
- features of a protection scheme

b) Instrument transformers for protection encompassing:

- Operating principles
- Applications of current transformers
- Applications of voltage transformers

c) Feeder protection encompassing:

- fuse protection
- overcurrent & earth fault
- sensitive earth fault
- unit schemes
- distance protection
- trip/close sequences for feeders
- recloser/sectionaliser systems

d) Transformer protection encompassing:

- overheating protection
- overcurrent protection
- restricted earth fault protection
- differential protection
- oil and gas devices

e) Busbar protection encompassing:

- types of fault
- requirements of busbar protection
- system protection
- frame-earth protection

f) Surge protection encompassing:

- voltage surges (revision)
- surge diverters
- arcing horns

2.6.22.2 Electrical power system operations

Evidence shall show an understanding of electrical power system operations to an extent indicated by the following aspects:

a) Control of voltage encompassing:

- Conditions leading to voltage collapse and system disintegration.
- Effects on the system of high/low volts
- Voltage control devices

Note.

Examples are voltage regulators applied to generators and synchronous phase modifiers, electromagnetic voltage regulators, series and parallel capacitors, OLTC transformers and static Var compensations (SVCs) such as saturated reactor compensations (SRs), thyristor controlled reactor compensators (TCRs), combined TCR/TSCs and the production of wave-form distorting harmonics and control devices.

b) The importance of the location in the system of voltage control devices.

c) The use of graphical methods to calculate the size of VAr regulating plant.

d) Control of power encompassing:

- Base load and spinning reserve
- Regulating machines
- Rapid start plant,
- Phase shifting transformers and various forms of load shedding.
- Principles and practices of automated control of individual machines

- Stations and transmission/tie-line elements.
- Synchronising power

e) The relationship between power and frequency encompassing:

- Limiting values
- Machine stabilising

Note.

Examples are steam by-pass, rapid valving, slip stabilisers and over speed limiting.

- Use of single pole generator CB's.
- Use of machine AVR's as angular stabilisers.
- Damped and un-damped system oscillations.
- Relationship between fault clearance times and system stability.
- Calculation of critical clearance angles based on equal area criteria.

f) Types of communication systems

Note.

Examples are telephone, power line carrier, dedicated cable, microwave links and fibre optics.

- Quantities and signals to be communicated.
- Advantages and disadvantages of the various systems.
- Equipment requirements.

g) Transient over-voltages in power systems encompassing:

- Switching and lightning overvoltages and their effect on different plant items.
- Transient over-voltage control and reduction using surge diverters, shield wires and CB are control.
- Insulation systems, insulation coordination, insulation grading in plant items, bushings and capacitor bushings.

h) Factors leading to the generation of corona encompassing:

- Consequences of corona.
 - Reduction of corona
-

Note.

Examples are conductor bundling, grading rings and conductor surface treatment.

i) Power System Protection encompassing:

- Location of CT's in major plant items.
- Earthing principles and devices.
- Fault current control/limitation using neutral earthing compensators (NEC's), neutral point earth impedances, high conductivity shield wires and parallel feed interlocking.
- Application of different types of protection.

2.6.22.3 Electrical power system transmission faults

Evidence shall show an understanding of electrical power system transmission faults to an extent indicated by the following aspects:

a) Overview of the transmission system including lines, buses, transformers and cables. Line/bus layouts including single and double switching, breaker and a half systems and HV crossing methods.

b) The principles involved in high voltage a.c. transmission including tower types and configurations, choice of towers or poles (economic and environmental), insulator types and configuration, types of conductors, their configuration and standard nomenclature. Typical line spacing and ground clearances. Line ratings based on ambient temperature. Conductor terminating and clamping equipment including vibration damping principles and equipment.

c) The principles involved in d.c. transmission including the economics, harmonic generation, VAR requirements and protection difficulties. Types of connections and transformer requirements. Advantages and disadvantages of d.c. transmission. Typical overseas systems. Likely (future) use in this country.

d) The principles of operation, voltage and current range, breaking capacity and field of use of the following types of circuit breakers.

- bulk oil
- small oil volume
- air break
- air blast
- air puffer
- vacuum and
- SF6 (double pressure and puffer types).

e) The types of isolators in use. Examples include duo-roll, blade and scissor type.

f) Circuit breaker auxiliary systems including:

- high pressure air systems and air storage and handling processes
- d.c. systems including battery types, charging and protection systems and earth fault detection systems
- SF6 conditioning, storage and handling system

g) The characteristics of lines and cables including the calculation of R, X and B for different arrangements of conductor. Typical values for actual lines. Transposition. Models based on line length. Voltage and line regulation. The transmission of power (P) and VARs (Q).

h) Control of voltage. Conditions leading to voltage collapse and system disintegration. Effects on the system of high/low volts. Voltage control devices including:

- voltage regulators applied to generators and synchronous phase modifiers
- electromagnetic voltage regulators
- series and parallel capacitors
- OLTC transformers and static Var compensations (SVCs)

i) Range of devices covered by SVCs including:

- saturated reactor compensations (SRs)
- thyristor controlled reactor compensators (TCRs)
- combined TCR/TSCs and
- production of wave-form distorting harmonics and control devices

j) Importance of the location in the system of voltage control devices

k) Use of graphical methods to calculate the size of Var regulating plant

l) Types of communication systems including telephone, power line carrier, dedicated cable, micro-wave links and fibreoptics. Quantities and signals to be communicated. Advantages and disadvantages of the various systems. Equipment requirements

m) Transient over-voltages in power systems. Switching and lightning overvoltages and their effect on different plant items. Transient over-voltage control and reduction using surge diverters, shield wires and CB are control. Insulation systems, insulation co-ordination, insulation grading in plant items, bushings and capacitor bushings

n) Factors leading to the generation of corona. Consequences of corona. Reduction of corona including conductor bundling, grading rings and conductor surface treatment

2.6.22.4 Distributive generation systems

Evidence shall show an understanding of distributive generation systems to an extent indicated by the following aspects:

- a) Concept and application
- b) Anti-islanding control and protection
- c) System monitoring and load management.

2.6.22.5 Electrical power system protection diagnostic

Evidence shall show an understanding of diagnosing faults in electrical power system protection to an extent indicated by the following aspects:

- a) Protection scheme requirements

- Requirements of a protection scheme

Note:

Includes relationship to primary system design, purpose of protection, safety of persons, protection of plant, system instability, system break up, loss of customers, loss of revenue, protection zones, restricted schemes, unrestricted schemes, duplicate protection, local backup protection, remote backup protection, selectivity, discrimination, stability, sensitivity, reliability

- Components of a protection scheme

Note:

Includes current transformers, potential transformers, summation current transformers, interposing transformers, multitapped transformers, all-or-nothing relays, induction relays, balanced beam relays, directional relays, biased relays, solid state relays, microprocessor based relays, gas relays, thermal sensors, hardwired communication, powerline carriers systems, microwave systems, fibre optic systems, need for isolation, need for interfacing

- Protection applied to buses

Note:

Includes overload, differential, earth leakage, structure leakage, combined schemes, protection overlap

- Protection applied to transformers

Note:

Includes biased differential, gas, winding temperature, oil temperature

- Protection applied to single/radial lines

Note:

Includes overcurrent, earth leakage, slow earth leakage, distance, auto reclose, sectionalising, over voltage

- Protection applied to interconnected lines

Note:

Includes overcurrent, pilot wire, directional, directional overcurrent, current differential, phase comparison, current comparison, distance, impedance, admittance, offset

b) Discrete protection systems

- Earth fault protection

Note:

Includes master earth leakage schemes, sensitive earth fault relays and schemes, residual earth fault scheme, core balance earth fault scheme, frame/structure earth leakage scheme, time graded discrimination, backup protection

- Overcurrent protection

Note:

Includes feeder overcurrent protection, instantaneous overcurrent schemes, inverse timed overcurrent schemes, types and location of components of an overcurrent scheme, CT summation, time graded discrimination, backup protection

- Alarms and controls
-

Note:

Includes auxiliary relays, voltage regulating relays, line drop compensation, gas relay types, gas relay scheme operation and setting, over temperature schemes

c) Interdependent protection systems

- Overcurrent and earth leakage intertripping, interlocking and blocking
-

Note:

Includes logic mapping, master control, electromechanical, electronic, shading coils

- Pilot wire, phase comparison
-

Note:

Includes opposed voltage schemes, circulating current schemes, location of components of a scheme, pilot supervisory techniques,

- Load shedding, voltage control, parallel operation, load rejection
 - CB failure protection
 - Reclose systems
-

Note:

Includes applications, single shot, multishot, blocking schemes, synchronisation checking

d) Complex protection systems

- Distance
-

Note:

Includes characteristics, electromechanical, electronic, impedance, mho, offset mho, switched schemes, non-switched schemes, blocking schemes, bus zone

- Differential, transformer differential, bus overcurrent
-

Note:

Includes principles, feeder protection, transformer protection, bias systems, harmonic restraint, CT connections, bus protection, low impedance schemes, high impedance schemes, bus overcurrent schemes, generator protection, CT connections, special considerations, digital systems

- Types of revenue metering
 - Applications of SCADA
 - Complex protection systems for communications
 - Harmonic control
-

- Point on wave switching

2.6.22.6 Electrical power distribution systems diagnostic

Evidence shall show an understanding of diagnosing faults in power distribution systems to an extent indicated by the following aspects:

a) Distribution system overview including:

- regulatory conditions of supply and utilisation
- compliance with Australian Standards.
- reticulation system including overhead/underground, urban/rural, HV customers and high-rise building systems. The effects of industrial customers
- methods used to ensure continuity of supply.
- types of substations in current use.
- systems of distribution used, (primary and secondary)
- voltage levels, power factor, wave-form distortion and transient loading
- supply quality
- load curve profiles (residential/industrial/commercial)
- types of feeders
- distribution systems (urban, rural single-phase systems, SWER, spur, parallel and ring systems etc.)

b) Overhead lines and installation

- industry and safety regulations
- overhead conductors
- conductor material
- current rating factors (heating, voltage drops, power losses)
- aerial bundled cables (HV and LV)
- covered conductors

Note:

The characteristics of lines and cables including the calculation of R, X and B for different arrangements of conductor. Typical values for actual lines. Transposition. Models based on line length. Voltage and line regulation

- overhead line poles
- types (wood, concrete and steel)
- installation of poles (tooling, rake, life, labelling, sinking)
- maintenance of poles – above & below ground
- pole strength and loads
- crossarms
- types and standard sizes

- insulators
- insulation types
- types (pin, suspension or disc, shackle)
- creepage, necessary clearances
- arcing horns, insulator mounting
- structure types
- mechanical properties (working strength, maximum tension, limiting size)
- interpretation of stringing charts
- determination of sag (by calculations or measurement and/or tension measurement)
- sight and wave sagging, sag correction
- stays
- components, anchorage

c) Use of design schedules

- sample design problems

Note:

Examples of common design practice line, voltage, structure types used, line deviation, span sag, crossarms, insulators and stays wind loading and line deviation loading basic surveying

- measurement of levels, deviation angle and compass bearings
- perform survey of short distribution line extension of produce field notes

d) Underground cables

- cable types, ratings, core material, design considerations, cable dielectrics, insulating materials and abbreviations, electric stress, cable volt drop and volt drop calculations, cable termination, joints and installation.
- induction and eddy currents
- cable testing, cable fault location
- cable drawing

e) Voltage regulations of feeders and associated equipment

- terminology used: distribution system, service line, customer's terminals, customer voltage, utilisation voltage, base voltage, voltage variation and bandwidth
- voltage limits and effects of voltage variation
- causes of variation: inductance, capacitance and reactance of distribution lines, transformers
- methods of voltage control: off-load, on-load tap changers, voltage regulating relays, line drop compensation, different types of voltage regulators
- voltage profiles: principles, effect on voltage profiles, limits of voltage, voltage drops due to LV mains transformers, tapsettings feeder and service

lines

- determining volt drops for components within the profile.

f) Control of voltage. Conditions leading to voltage collapse and system disintegration. Effects on the system of high/low volts. Voltage control devices including:

- voltage regulators applied to generators and synchronous phase modifiers
- electromagnetic voltage regulators
- series and parallel capacitors
- OLTC transformers and static Var compensations (SVCs)

g) Range of devices covered by SVCs including:

- saturated reactor compensations (SRs)
- thyristor controlled reactor compensators (TCRs)
- combined TCR/TSCs and
- production of wave-form distorting harmonics and control devices

h) Importance of the location in the system of voltage control devices

i) Types of communication systems including telephone, power line carrier, dedicated cable, micro-wave links and fibreoptics. Quantities and signals to be communicated. Advantages and disadvantages of the various systems. Equipment requirements

j) Transient over-voltages in power systems. Switching and lightning overvoltages and their effect on different plant items. Transient over-voltage control and reduction using surge diverters, shield wires and CB are control. Insulation systems, insulation co-ordination, insulation grading in plant items, bushings and capacitor bushings

k) The principles of operation, voltage and current range, breaking capacity and field of use of the following types of circuit breakers.

- bulk oil, small oil volume, air break, vacuum and SF6 (double pressure and puffer types).

l) The types of isolators in use. Examples include duo-roll, blade and scissor type.

m) Circuit breaker auxiliary systems including:

- d.c. systems including battery types, charging and protection systems and earth fault detection systems
- SF6 conditioning, storage and handling system

2.6.23 Marine electrical systems overview

Evidence shall show an understanding of marine electrical systems to an extent indicated by the following aspects:

a) Marine electrical systems

- Switchboards
- Instrumentation
- Earthing

b) Alternators

- Construction
- Characteristics
- Synchronised operation

c) Switchboards and protection

- Purpose
- Testing and maintenance
- Equipment removal

d) Lighting systems

- Purpose
- Types

e) Power supplies

- UPS systems
- Batteries
- Maintenance
- Safety procedures - battery banks

f) Cathodic protection

- Purpose
- Operating parameters
- Corrosion factors

g) Safety

- Equipment
- Codes and Regulations

h) Electrical system commissioning requirements and surveys

2.6.24.1 Switchgear/controlgear

Evidence shall show an understanding of switchgear/controlgear to an extent indicated by the following aspects:

- a) Types and applications
- b) Operating principles
- c) Interlocking systems

- d) Control and protection
- e) Installation requirements

2.6.24.2 Control panel wiring

Evidence shall show an understanding of control panel wiring to an extent indicated by the following aspects:

- a) Equipment layout methods and accessories
- b) Connection identification methods
- c) Wiring techniques

2.6.25 Hand power tools repairs

Evidence shall show an understanding of hand power tools to an extent indicated by the following aspects:

- a) Types, applications, operating principles and characteristics
- b) Motors and drive mechanisms
- c) Control and over current protection methods and devices
- d) Typical hand power tool faults encompassing:
 - Motor faults
 - Power supply faults

Note.

Examples include open circuit or tripped circuit in cord connected tools and battery charging and discharging problems in battery operated tools.

- Control faults
- Mechanical faults

2.6.26 Appliance motors and circuits

Evidence shall show an understanding of appliance motors and circuits to an extent indicated by the following aspects:

- a) Fundamental a.c. circuit principles
 - Components of a circuit – source, path, load and control
 - Notions of open circuit, closed circuit, and short circuits
- b) Circuit - basic configurations encompassing:

- Single source Series, parallel, and series-parallel and circuits configurations
- Relationship between voltage, current and impedance (Ohms law)
- Components of impedance in a circuit

Note:

Confined to basics of resistance, inductive reactance and capacitive reactance

c) Electromagnetic induction basics encompassing:

- Induction principles
- Motor action and generator action
- Transformer principles
- Risks associated with electromagnetic induction

d) Single phase supply and three phase supplies encompassing:

- safety testing and isolation of single and three phase circuits
- sine waves showing the nature of EMF and current in single and three phase supplies
- Star and Delta connections of a three phase a.c. supply

e) Electrical supply and distribution within a building or premises encompassing:

- purpose and typical arrangement of main switchboards and distribution boards
- arrangement of circuits
- methods and devices for protection against direct and indirect contact with conductive parts
- methods and device for protection against overload current and fault currents
- the need for earthing and methods of testing for sound earthing.

f) Operation, construction and applications of three phase induction motors encompassing:

- Methods for determining polarity magnetic flux in relation to current flow in straight conductors and solenoids
- circuit operating characteristics
- characteristics of the magnetic field produced by a three phase winding
- calculated speed of rotation of the rotating magnetic field
- basic principle of operation, construction and applications of a three phase induction motor
- three phase induction motor connections
- reversing the direction of rotation of a three phase induction motor
- equipment and methods for testing the motor winding resistance and insulation properties
- effects of incorrect wiring a three phase motor.

g) Operation, construction and applications of three phase motor starters encompassing:

- regulatory requirements for starting, control and protection of induction motors
- operating principle, construction and applications of motor starters
- main advantages and disadvantages of a motor starter
- motor starting circuit diagrams
- starter and three phase motor connections
- Method of testing and fault finding three phase motor starters.

h) Components and arrangement of three phase motor circuits encompassing:

- purpose of motor protection
- three phase motor protection devices and their applications
- construction and operating principle of thermal and magnetic motor protection
- connection of thermal overloads in a three phase motors, starters circuit
- Methods of testing and fault find three phase motor thermal overloads
- electrical features of motor protection fuses
- effects of under and over voltage on motor circuits
- effects of repetitive starting and /or reversing motors
- special requirements for motor protection, in high humidity or moist environments, high temperature areas and corrosive atmospheres

i) Construction, operation and applications of split phase and single phase motors and controls encompassing:

- principle of operation of a split phase motor and starters
- construction and basic characteristics of a split phase motor and starters
- typical applications of a split phase motor
- split phase motor and starter circuit diagrams
- reversing direction of rotation of split phase motor
- methods of testing a split phase motor to identify terminal connections.

j) Operating principles, construction and applications of capacitor and shaded pole, single phase motors and controls encompassing:

- types of single phase induction motors

Note.

Examples are capacitor start, capacitor start/induction run, permanently split capacitor, shaded pole

- the principle of operation of each motor type and associated control.
- operating characteristics and typical application of each motor and control.
- single phase induction motors motor and starter circuit diagrams
- reversing direction of rotation of single phase induction motors
- methods of testing a single phase induction motors to identify terminal connections.

k) Operating principles, construction and applications of series universal motors encompassing:

- principle of operation of a series universal and synchronous motor
- function of the basic parts of a series universal and synchronous motor
- operating characteristics and typical uses for a series universal and synchronous motor
- reversing direction of rotation of series universal and synchronous motor
- list the common series universal and synchronous motor faults and possible causes.

l) Speed control, protection devices and diagnostic testing of single phase induction motors encompassing:

- principle of speed control for single phase induction motors
- common faults in single phase induction motors and their control equipment
- protection devices used with single phase motors and their operation.

2.6.27.1 Electric heating appliances

Evidence shall show an understanding of electrical heating appliances to an extent indicated by the following aspects:

a) Heating principles and applications

Note.

Principles include resistance, induction and microwave.

b) Types of heating appliances, their operating principles and characteristics

c) Heating circuits and controls

d) Typical faults

2.6.27.2 Microwave ovens

Evidence shall show an understanding of microwave ovens to an extent indicated by the following aspects:

a) Microwave cooking basics encompassing:

- Properties of microwaves
- Biological effects of microwaves
- Fundamental microwave oven operations

b) Microwave oven performance encompassing:

- Radiation leakage

- Power output measurement
- Oven leakage safety system
- Magnetron tests and measurements
- Interlocks
- Thermal cut outs and thermostats
- Stirrer cooling and turntable systems

c) Power control systems encompassing:

- Hazards of microwaves and associated high voltages
- High/low power selection
- Duty cycle control systems
- Basic circuit diagrams
- New microwave oven technology such as inverter microwave ovens

d) Auto-cook facilities encompassing:

- Temperature control cooking systems
- Humidity sensor cooking systems
- Infrared sensor cooking systems
- Convection microwave oven systems

e) Service, fault finding and repair encompassing:

- Manufacturers' data
- Safety checks
- Operating sequence
- Typical fault symptoms
- Test equipment
- Fault identification
- Fault location using test equipment and service manuals
- Repairs techniques

2.6.28 Motor windings

Evidence shall show an understanding of motor windings to an extent indicated by the following aspects:

a) Principles and construction encompassing:

- direct-current machine types
- construction of direct current machine
- types of armature windings
- parallel circuits in armature windings

- value of generated e.m.f.

b) Direct current armature windings encompassing:

- terms used in armature winding
- effects of chording
- lap and wave windings
- progressive and retrogressive windings.

c) Simplex lap windings encompassing:

- simplex lap armature winding
- commutator pitch
- number and position of brushes
- characteristics of simplex lap windings
- equalising connections for armature windings
- applications for lap windings.

d) Simplex wave windings encompassing:

- simplex wave armature winding
- commutator pitch
- number and position of brushes
- dummy coils
- characteristics of simplex wave windings
- applications of wave windings
- comparison of lap and wave windings
- armature winding calculations.

e) Commutation and interpoles encompassing:

- principles of commutation
- conditions for sparkless commutation
- methods used to reduce sparking
- resistance commutation
- e.m.f. commutation
- interpoles or commutating poles
- advantages of interpoles.

f) Alternator windings encompassing:

- elementary single-phase stator winding
- elementary three-phase stator winding
- half-coil and whole-coil windings
- concentrated and distributed windings
- chain, lap and wave windings
- pole-pitch and coil-span
- half-coil winding for a three-phase alternator

- whole-coil stator winding for a three-phase alternator

g) Breadth factor and sinusoidal output encompassing:

- breadth factor
- e.m.f. equation for an alternator
- methods of obtaining sinusoidal wave form
- star and delta connection of alternator windings

h) Rating, cooling and regulation encompassing:

- rating of alternators
- cooling of alternators
- the voltage regulator

i) Testing techniques encompassing:

- continuity
- insulation testing
- use of 'growler'
- magnetic field testing

2.6.29 Coil winding basics

Evidence shall show an understanding of basic of coil winding to an extent indicated by the following aspects:

- a) Coil data
- b) Coil former types and construction/set up
- c) Coil winding machines
- d) Coil insulations.

2.6.30 Coil testing

Evidence shall show an understanding of coil testing to an extent indicated by the following aspects:

- a) Testing devices and their purpose
- b) Types of tests
- c) Testing techniques

2.6.31.1 Electrical machine winding basic

Evidence shall show an understanding of the basic techniques in insulating and placing coils for electrical static and rotating machines to an extent indicated by the following aspects:

- a) Electrical machine insulation processes
- b) Coil types
- c) Coil placement techniques

2.6.31.2 Low voltage three phase motor winding techniques

Evidence shall show an understanding of the techniques of winding three phase motors to an extent indicated by the following aspects:

- a) Electrical machine insulation types and applications
- b) Coil placement techniques
- c) Coil connection arrangements and terminations
- d) Winding insulation methods

2.6.31.3 Direct current motor winding techniques

Evidence shall show an understanding of the techniques of winding direct current motors to an extent indicated by the following aspects:

a) Critical details and measurements when stripping a stator encompassing:

- Winding types

Note.

Examples are wave winding and a lap winding with equalisers

- Winding diagram
- Tests carried out on steel bands removed from an armature

b) Procedures and precautions required when inspecting and/or re-using a commutator encompassing:

- Method of removing the armature leads from the risers of a TIG welded commutator.
- Dimension to be checked on a TIG welded commutator.
- Features of TIG welded and soft soldered commutators.
- Relationship between the positions of the slot a coil is in and the commutator segments it is connected to.
- Purpose of commutator wear ring.

c) Outline the procedures for checking the condition of a stripped core and commutator in preparation for rewind encompassing:

- Describe the sequence of events between the removal of an old winding and the start of rewinding.
- Describe the method of carrying out the core loss test, the effect this test has on the core and expected test results.
- Describe two methods of overcoming hot spots in an armature core.
- Detail the tests and checks made to a commutator before it can be reused.

d) Select the appropriate insulation for a particular application with reference to manufacturers' recommendations and standards encompassing:

- Conductor insulations available for use in d.c. formed coils, their dielectric strength and temperature rating.
- Various insulations used on the slot portion and overhang of a d.c. armature encompassing:

Note

Examples may include: B stage insulation, VPI insulation

- Properties, method of application and specific uses for the above insulations.

e) Calculations and insulation specifications for preparing coils and equalisers for rewinding with reference to manufacturers' specifications.

- Special characteristics of copper used in formed armature coils.
- Half coil length and the amount of copper required for a set of coils, given the dimensions, the voltage and winding pitch of an armature.
- Preparation of copper prior to insulating the coils and equalisers for armatures

Note:

Examples may include: commutators, TIG welded, soft soldered

- Insulation specification for each of the following impregnation systems given an armature, voltage rating, temperature rise and conductor size.
-

Note:

Examples may include; solvent based impregnating system, a VPI impregnating system

f) Procedures and precautions required for fitting the coils and equalisers to the armature, wedging, connecting and banding with reference to manufacturers' specifications.

- Method of insulating the overhang support rings.
 - Procedures required between the insulating of the support ring and the stage of fitting the temporary band.
 - Method of fitting a temporary band and its purpose.
 - Purpose of stoving a large armature after the fitting of the temporary band.
 - Method of making the joints.
-

Note:

Examples are: a soft soldered commutator, a TIG welded commutator

- Calculation of turns required for both glass and steel bands given the armature dimensions, copper size, mean length of turn and speed.
- Features and use of glass and steel bands

g) Materials, procedures, tests and precautions required during and after the impregnation of completed armature.

- Precautions to be taken when handling and using varnishes and resins.
 - Important features of an oven used to cure large impregnated machines.
 - Application and features of various impregnating materials
-

Note.

Examples are water based varnish, Xylol base varnish and 100% solids resin

- Method of carrying out a gel test on a resin and a viscosity test on a varnish
- Typical quality procedures carried out on an impregnating varnish.
- Procedure and precautions for carrying out the a hot dip impregnation and a VPI impregnation

h) Describe methods for preparing and testing a bare commutator.

- Describe the method of diamond turning a commutator.
- Describe the method of undercutting and de-burring a commutator.
- Detail the method of insulating the exposed Vee ring.
- Explain the method and purpose of seasoning a commutator.
- Procedures for Electrical testing procedures of a bare commutator.

i) Procedures and precautions to be followed when performing static electrical testing of a completed rewind according to Australian, British and IEC standards encompassing:

- Types and purpose of tests
- Testing safety precautions
- Testing procedures

Note.

Example of tests are repetitive surge test, polarisation index (PI) test, induction/growler test an electrical test on the steel bands cold resistance test and polarity test.

- Interpretation of test results
- Calculation of winding cold resistance and resistance across adjacent bars of a commutator.

2.6.31.4 High voltage three phase motor winding techniques

Evidence shall show an understanding of the techniques of winding high voltage three phase motors to an extent indicated by the following aspects:

a) Critical details and measurements when stripping a stator encompassing:

- Winding types

Note.

Example are hairpin wound stator and lap wound stator

- Winding diagram
- Wedges of a radially ventilated machine
- Factors to be considered when selecting cables for a stator.

b) Procedures for checking the condition of a stripped in preparation for rewind encompassing:

- Manufacturers' specifications.
- Sequence of events between the removal of the old winding and the start of rewinding.
- Core loss test, the effect this test may have on the core and expected test results
- Methods of overcoming hot spots in a stator core.
- Level of insulation required to insulate the steel bracing rings that support the overhang.
- Difference between the slot liners and packers of a 3.3kV and a 6.6 kV machine.

c) Procedures for the fitting of coils to core, wedging and bracing.

- Significance of the slot portion of coils for machines above 3.3 kV
- Method of inserting the coils of a ribbon winding into slots.
- Effects of undue mechanical stress on B stage insulated coils.
- Importance of coil pitch and why it is important.
- Sequence of events in fitting the first pole pitch group of coils in a lap winding
- Sequence of events in fitting the coils of a concentric winding
- Purpose and location of the excess packing in a slot.
- Difference between the wedges for a lap and hairpin winding.
- Method of fitting a wedge.
- Difference that may be encountered between the wedges for a radial ventilated and the wedges for an axially ventilated machine.
- Methods used to brace and strengthen the overhang of a lap winding and a hairpin winding

d) Procedures for making inter turn and inter coil connections on a hairpin winding and inter coil connections on a lap and bar winding encompassing:

- Sequence of events in making turn to turn connections, and insulating the turns of a lap winding

Note.

Connection methods include silver solder or brazing and soft solder

-
- Sequence of events, from hand forming the coil to final insulation, in making the turn to turn connections in a hairpin winding, using a welded joint.
 - Sequence of events in making the coil to coil connections in a bar winding.

e) Testing according to British and IEC standards.

Note.

Examples of testing are 3.3 kV B stage insulated winding test, 6.6 kV B stage insulated winding and VPI winding test.

f) Materials, procedures, tests and precautions required during and after the impregnation of completed windings according to Australian, British and IEC standards.

- Precautions to be taken when handling and using varnishes and resins.
- Important features of an oven used to cure large impregnated machines.
- Application and features of various impregnating materials

Note.

Examples are water based varnish, Xylol base varnish and 100% solids resin

-
- Method of carrying out a gel test on a resin and a viscosity test on a varnish
 - Typical quality procedures carried out on an impregnating varnish.
 - Procedure and precautions for carrying out the a hot dip impregnation, a flood coat impregnation and a VPI impregnation
 - Tests to be carried out after impregnation and bake on a 3.3kV B stage insulated winding, a 6.6 kV B stage insulated winding and a VPI winding

g) Winding to terminal connections according to British and IEC standards.

- Criteria for selection of winding to terminal cables

Note.

Examples are voltage rating, full load current and fault capacity.

-
- Common types of terminal boxes and their structure.

Note.

Example are phase segregated, phase separated and phase insulated

-
- Method of making the joint between winding and terminal cables and insulating such a joint.

h) Procedures and precautions to be followed when performing static electrical

testing of a completed rewind according to Australian, British and IEC standards encompassing:

- Types and purpose of tests
- Testing safety precautions
- Testing procedures

Note.

Examples of tests are repetitive surge test, loss tangent test, polarisation index (PI) test, cold resistance test and polarity test.

- Interpretation of test results
- Calculation of winding cold resistance and line and phase resistance

2.6.31.5 Electrical machines, mechanical components

Evidence shall show an understanding of the mechanical components of electrical machines to an extent indicated by the following aspects:

- a) Types of bearings used in electric motors:
- b) Bearing clearances.
- c) Techniques for removing and fitting bearings encompassing:
 - shafts
 - housings
- d) Handling and storage of bearings.
- e) Lubrication encompassing:
 - Safety and environment issues in handling and disposing of lubricants
 - Lubrication methods
- f) Calculation of bearing life.
- g) Bearing damage and remedial action
- h) Types of couplings, applications
- i) Fitting and aligning couplings
- j) Types of belts and their applications
- k) Fitting and aligning pulleys
- l) Machine cooling/ventilation methods and components

2.6.31.6 Electrical machines, performance monitoring

Evidence shall show an understanding of the performance monitoring of electrical

machines to an extent indicated by the following aspects:

- a) Methods of testing the condition of bearings.
- b) Methods of testing the condition of windings and terminal boxes.
- c) Methods of testing the condition of the coolers
- d) Problems likely to be created due to lack of maintenance on brush gear.
- e) Method of testing the general condition of a machine by vibration analysis
- f) Methods of checking the condition of couplings, pulleys, belts and the like.
- g) Determining machine operating efficiency

2.6.32 Field power and distribution systems

Evidence shall show an understanding of field power and distribution systems to an extent indicated by the following aspects:

- a) Types applications and components
- b) Regulator and safety requirements and standard
- c) Equipment installation and commissioning
- d) Testing requirements

2.6.33 Variable speed drives for a.c. motors

Evidence shall show an understanding of a.c. variable speed drive to an extent indicated by the following aspects:

- a) Methods and operating principles
- b) Installation requirements
- c) Filtering
- d) Performance characteristics
- e) Set up and commissioning
- f) Common faults: their symptoms and causes.

2.6.34 Variable speed drives for d.c. motors

Evidence shall show an understanding of d.c. variable speed drive to an extent indicated by the following aspects:

- a) Methods and operating principles
- b) Installation requirements
- c) Filtering
- d) Performance characteristics
- e) Set up and commissioning
- f) Common faults their symptoms and causes.

2.6.35 Servomechanism systems

Evidence shall show an understanding of servomechanism systems to an extent indicated by the following aspects:

- a) Servomechanism terminology and concepts encompassing:
 - null, error signal, feedback and reference signal
 - damping: under, over, critical
 - hunting
 - overshooting
 - deadband
 - response time
 - time lag
- b) Difference between an open loop and a closed loop system encompassing:
 - the operation of a servomechanism system to block diagram level identifying the components:
 - command transmitter
 - error detector
 - amplifier
 - summing point/network
 - servo
 - position feedback
 - rate feedback
 - acceleration feedback
 - modulator/demodulator
- c) Differences in operation between types of servomechanism systems encompassing:
 - a.c., d.c. and hybrid types
 - advantages and limitations
- d) Causes of hunting.

- e) Inspection, testing, and alignment of a servomechanism system
- f) Common faults their symptoms and causes.
- g) Programming and configuration of a PLC driven servo system

2.6.36 Synchronous machine diagnostics

Evidence shall show an understanding of synchronous machine diagnostics to an extent indicated by the following aspects:

- a) a.c. generators – construction, types and cooling encompassing:
 - construction of stator and rotor windings
 - rotor construction (cylindrical and salient pole)
 - advantages of rotating field construction
 - excitation methods
 - cooling methods
 - prime movers
- b) a.c. generators – operating principles and characteristics encompassing:
 - a.c. generator equivalent circuits (synchronous reactance and resistance components)
 - tests – open circuit, short circuit, stator impedance
 - voltage regulation, island generator's terminal voltage load power factor
 - determination of excitation voltage and load angle
- c) Synchronising a.c. generators encompassing:
 - conditions for synchronising (infinite bus)
 - methods for synchronising (lamp methods, synchroscope)
 - alternator load sharing, parallel operation
- d) a.c. generators power, torque and efficiency encompassing:
 - power input, input torque, speed
 - power losses
 - output power, load power factor, rotor angle, pu power
 - efficiency
 - performance chart interpretation
- e) Voltage regulation (AVR) encompassing:
 - need for AVR's
 - features of AVR's
 - effects of rotor inductance
 - connections of AVRs
 - operation of AVRs

f) a.c. generator operational stability encompassing:

- power output, VAR effects, rotor angle, excitation
- control of VAR (OLTC transformers)
- voltage dependant nature of stability
- critical clearance angle of a.c. generator
- stability limits

g) a.c. generator protection encompassing:

- restricted, unrestricted primary, back up and duplicated protection
- overcurrent, short circuit, differential, reverse power, load unbalance, rotor overload, loss-of-field, rotor earth fault, station earth fault, under frequency protection
- external fault protection

h) Induction generator encompassing:

- types operating principles, characteristics
- excitation methods
- losses and efficiency
- synchronising and paralleling

i) Three phase synchronous motors encompassing:

- construction – rotor, stator, windings
- excitation methods
- operating principles (equivalent circuits, synchronous impedance)
- hunting and stability limits
- power factor correction
- paralleling and synchronisation techniques
- starting methods
- braking methods

2.6.37 Induction motors diagnostics

Evidence shall show an understanding of induction motors diagnostics to an extent indicated by the following aspects:

a) Construction of polyphase induction motors encompassing:

- squirrel cage motors
- slip-ring motors

b) Operating principles of polyphase induction motors encompassing:

- rotating magnetic field torque slip
- MMF relationships

- Leakage fluxes

c) Speed-torque relationships in induction motors encompassing:

- maximum torque
- torque – slip relationships
- types of motor squirrel cages
- power flow in the motors
- power distribution
- torque units
- slip ring rotors

d) Induction motor performance testing encompassing:

- no-load tests
- locked rotor tests
- development of motor equivalent circuit from test results
- analysis of motor performance using circle diagrams

e) Induction motor starters encompassing:

- starting requirements
- type of starters
- starting torque
- starting dynamics
- static friction
- mechanical loads
- starting duration

f) Reduced voltage starting encompassing:

- starting dynamics
- change over conditions
- starting duration
- acceleration curves

g) Speed control of induction motors encompassing:

- constant torque, constant power concepts
- torque-flux-voltage relationships
- rotor resistance control
- stator impedance control
- variable frequency control (e.g. PAM, PWM, Flux vector control)

h) Braking of induction motors encompassing:

- electrical braking systems (plugging, d.c. dynamic, regenerative, capacitor-magnetic)
- mechanical braking systems (mechanical drum, demag, eddy current)

- i) Motor protection encompassing:
 - overload
 - earth fault
 - phase failure
- j) Motor selection encompassing:
 - selection criteria
 - RMS rating
- k) Induction motor maintenance/repair encompassing:
 - routine maintenance schedules
 - type of repairs (mechanical, electrical)
- l) Single phase induction motors encompassing:
 - construction
 - operating principles
 - speed-torque relationships
 - testing

2.6.38 Direct current machines diagnostics

Evidence shall show an understanding of direct current machines diagnostics to an extent indicated by the following aspects:

- a) Basic d.c. machine construction and operation encompassing:
 - application of d.c. machine
 - construction of d.c. machines
 - d.c. machine connections
 - insulation
 - ratings
 - cooling paths
 - bearings
 - general maintenance of d.c. machines
- b) Construction and use of lap and wave windings encompassing:
 - coils and elements
 - generated voltage equation for generator
 - generated voltage equation for motors
 - application of lap and wave windings
- c) Commutation process encompassing:
 - use of interpoles

- loading of machines
- brush shifting
- brush selection
- classes of brush grades

Note:

Examples include: natural graphite, hard carbon, electrographite, metal-graphite, metal-carbon, "treated" grades

- carbon brush contact characteristics
-

Note:

Examples include: specific resistance, thermal conductivity, density and porosity, elastic properties, contact properties

- carbon brush factors
-

Note:

Examples are: pressure, current, polarity, speed

- brush construction
-

Note:

Examples are: dimensions, tolerances, preferred sizes, surfaces, edges, bevels, flexible shunts, connection of flexible shunt to brush, insulation of flexible connections

- brush holders
-

Note:

Examples are: types, brush angles, trailing holders, reaction holders, top bevel angles, reversible rotation, cantilever holders, effective arc of contact, construction of brush holders, pressure mechanism

- mounting of brush holders and brushes
-

Note:

Examples are: clearances, brush angle, brush arm spacing, alignment, staggering, brush bedding, brush pressure

- brush operation
-

Note:

Examples are: temperature rise, number and size of brushes, current distribution between brushes, slotting brushes, polarity effects, arc of contact, materials for commutators, mica

- selection of brush grades
-

Note:

Examples are: machine data, current density, commutator peripheral speed, brush arc, pitch of segments, number of segments covered by brush, cooling surface

d) Armature reaction in d.c. machines

- effect of armature reaction on d.c. machine characteristics
- use of compensating winding

e) d.c. generators

- performance of generators supplying various loads
- voltage regulation as a percentage or per unit value
- operation in parallel

f) d.c. motors

- shape of motor speed/torque curves
- reversal of machines

g) Starting of d.c. motors

- types of d.c. motor starters in use
- d.c. motor protection

h) Speed regulation and speed control of d.c. motors

- methods in use
- effect on motor design and operation caused by the use of SCR
- speed control equipment

i) Braking of d.c. motors

- Plugging
- Dynamic
- Regenerative
- Mechanical

j) Losses and efficiency

k) Acceleration of d.c. motors and loads

- characteristics of typical loads
- matching loads to a suitable motor
- heating of windings
- derating of motors

l) Special d.c. motors construction, operation and applications

- permanent-magnet motors
- brushless motors (e.c. motors)
- coreless and moving coil motors
- linear motors
- printed circuit motor
- stepping motors
- voice-coil motors

m) Maintenance of d.c. machines

- routine maintenance
- breakdown repairs

n) types of faults

- brushes/brush gear problems

Note:

Examples are: sparking, excessive heating, excessive wear of brushes, commutator or slip rings, bad surface conditions, excessive maintenance, flexible burning, flexible corrosion, separation or grooving, blackening, copper picking, copper dragging, brush noise

o) adjustment of machines

- correct brush position
- machining and finishing of commutators.

2.6.39 Lubrication of lift components

Evidence shall show an understanding of lubrication of lift components to an extent indicated by the following aspects:

a) Purpose of lubrication encompassing:

- Corrosion protection,
- Friction reduction,
- Cooling,

b) Lubricant loss and loss estimation

c) Suitability Oils, Greases, Coolants, Rust preventative, Solvents

d) Selection of lubricant encompassing:

- Viscosity
- Types to suit device operation

e) Application methods and quantities encompassing:

- Hand, Grease guns,
- Oil cans,
- Pressure lubricators,
- Oil misters,
- Level indicators,
- Estimating quantities,
- Lubrication points
- Automatic lubricators

2.6.40 Lift systems, roping

Evidence shall show an understanding of lift systems roping to an extent indicated by the following aspects:

a) Single wrap encompassing:

- Hoisting
- Governor
- Tappet
- Compensator
- Selector

b) Multiple wrap encompassing:

- Hoisting

c) Types of ropes encompassing:

- Normal lay
- Langs lay

d) Rope attachments encompassing:

- Standards ends
- Splices
- Wedges sockets
- Talurit fitting
- Babbit sockets
- Secon fitting

2.6.41 Lift systems, rope inspection

Evidence shall show an understanding of lift systems rope inspection to an extent indicated by the following aspects:

a) Inspection of ropes encompassing:

- Requirements of Lift Code/enterprise
- Purpose
- Wear
- Broken strands
- Diameter
- Deformation
- Corrosion
- Lubrication

- Tension

b) Rope stretch encompassing:

- Requirements of Lift Code/enterprise
- Counterweight clearance
- Compensatory equipment

c) Inspection of rope attachments encompassing:

- Requirements of Lift Code/enterprise
- Rope anchor rods
- Castings, Springs
- Wedges
- Swaging
- Checking for fracturing
- Deformation
- Remedial action

d) Inspection of sheaves encompassing:

- Groove condition
- Riffing
- Ropes down in sheaves
- Maintenance records

2.6.42 Escalators, moving walk and tread way mechanics

Evidence shall show an understanding of escalators, moving walk and tread way mechanics to an extent indicated by the following aspects:

a) Escalators encompassing:

- Statutory and enterprise requirements: Lift Code, OHS, Emergency stop, Danger signage, Barriers and Running clearances
- Purpose of Controller, Safety devices, Chain/steps and Hand rail
- Techniques for repair of Steps/belts/pallets, Combs, Guards, Balustrades, Newel rollers, Balustrade lighting and hand rails
- Adjustments of Chains, Hand rail, Brake, Steps and Safety devices

b) Safe working procedures encompassing:

- Removing steps/pallets,
- Working in motor room/pit,
- Cleaning/lubricating,
- Guards
- Hand rails remove/refit

c) Installation and commissioning encompassing:

- Aligning,
- Testing,
- Handling
- Running clearances

d) Escalator types to suit applications

Note.

Factors include volume of people, Gradient and Multi floor use

e) Moving walks encompassing:

- Types; Continuous belts and palletised types
- Statutory requirements: OHS, Lift Code
- Comparison with escalator

f) Tread Ways encompassing:

- Belt and palletised types
- Statutory requirements, OHS, Lift Code

2.6.43 Lift systems, plumbing and setting out

Evidence shall show an understanding of plumbing and setting out to an extent indicated by the following aspects:

a) Single lift wells encompassing:

- Purpose
- Need for accuracy
- Modification of errors
- Use of template
- Use of plumb lines and weights
- Measuring and marking out lift wells
- Measuring and marking out machine room (where appropriate)
- Plumbing chart
- Identification of clearances
- Adjustment of templates
- Use of laser level

b) Multiple lift wells encompassing:

- Use of centre line/datum
- Use of survey information and layouts
- Setting of well templates
- Plumb charts analysis for three dimensional impact

- Corrective action
- Use of theodolite

c) Fixing devices and methods encompassing:

- Inserts
- Expansion anchors
- Chemically bonded anchors

2.6.44 Lift equipment alignment techniques

Evidence shall show an understanding of lift components – electrical/electronics to an extent indicated by the following aspects:

a) Equipment layout encompassing:

- Specifications
- Clearances
- 3D impact on layout
- Lift code

b) Alignment equipment encompassing:

- Gauges
- Straight edges
- Rail gauges
- Shims/packers
- Lasers

c) Machine room alignment encompassing:

- Machine and fixings
- Diverter sheave
- Governor and tensioning sheaves
- Counterweight centre lines
- Sheave and roping system

d) Lift car alignment encompassing:

- Superstructure
- Frames
- Doors

e) Lift well alignment encompassing:

- Guides and brackets
- Trimmer beams
- Buffers
- Landing doors and locks

- Compensators

f) Running clearances encompassing:

- Safety gear
- Car sill
- Door operator

g) Car operating devices encompassing:

- Slowdown switch
- Limits
- Inductors
- Door locks
- Vanes and Shaft information

h) Installation and aligning hydraulic equipment procedure encompassing:

- Ram/Cylinder
- Hydraulic Lines
- Bleeding Hydraulic system

2.6.45 Lift components – electrical/electronics

Evidence shall show an understanding of lift components – electrical/electronics to an extent indicated by the following aspects:

a) Traction lifts encompassing:

- Lift control circuits (relay logic only): floor selector circuitry,
- Machine room control (selector) and well control (transducer) circuitry

Note:

Examples are: direction slowing and stopping, re-levelling, door operator, acceleration, button, indicator/lantern, lights and emergency lights, travelling cables, key switch circuits, fans, main supply and power circuits

b) Safety circuits encompassing:

- Type, operation and actuation

Note

Examples are: landing door locks, car door locks, emergency stop, pit switch, car trap-door switch, fire service, car top switch, tappet switch, governor switch, and safety gear switch, reverse phase relay, phase failure relay and limit switches.

c) Maintenance, replacement and adjustment encompassing:

- Electrical and electronic lift components

Note:

Examples are: travelling cables, tachometers, selectors, encoders and transducers.

- Safety devices:
-

Note:

Examples are: overloads, circuit breakers, limit switches, terminal stopping, door protection, governors and safety gear/switches.

d) Electrical layout/drawings and special requirements encompassing:

- Lift code & AS/NZS 3000 requirements
- specific lift symbols
- conduits
- trailing cable
- troughing
- colour coding and labeling
- segregation LV/ELV
- telephone and communication cabling
- regulatory requirements and door lock wiring.

e) Safety drive adjustment encompassing:

- Emergency stop button
- speed governor
- reverse phase protection
- broken chain/step switch
- broken main drive switch
- drive access switch
- start pressure switch and landing guards/barriers.

f) Lift components – electronic encompassing:

- Encoders
- Transducers
- Electronic boards
- Selectors
- Rectifiers
- Capacitors
- Resistors
- Processor Board
- I/O board

g) Drives - types, construction and operation encompassing:

- Traction
 - Gearless types
-

Note:

Examples are: Speed/load characteristics, Efficiency, Application, Brakes, Electric

prime mover (motor types and control)

- Geared types
-

Note:

Examples are: Speed/load characteristics, Efficiency, Application, Brakes, Electric prime mover (motor types and control)

- Other types of lifts
-

Note:

Examples are: Drum, Rack and pinion, Chain, Screw

h) Fault finding encompassing:

- Visual inspection
- Performance checks and application of fault finding
- Principles

2.6.46 Lift systems – basic operations

Evidence shall show an understanding of lift systems – basic operations to an extent indicated by the following aspects:

a) Safety issues encompassing:

- Personal safety equipment
- Hazard identification and reporting
- Single and team manual handling
- Communication on site
- Emergency procedures

b) Access to and safe working practice encompassing:

- Machine room
- Top of car
- Lift pit

c) Statutory requirements encompassing:

- Lift Code
- Australian Standards

d) Escalators and moving walks encompassing:

Components

Note:

Examples are: Machine Brakes, Controllers, Safety devices, Balustrade lighting, Steps/pallets/belts, Hand rail, Drive chain, Truss, Track systems, Step/pallet chains, Rollers, Tension carriage, Hand rail earthing

e) Traction lift components

f) Types of lifts encompassing:

- Passenger
- Goods
- Service

g) Machine room equipment encompassing:

- Machine
- Controller
- Governor
- Floor selector

h) Well equipment encompassing:

- Guide rails
- Landing doors and locks
- Limit switches/operating devices
- Ropes
- Roping systems
- Counterweights

i) Pit equipment encompassing:

- Buffers
- Compensators
- Safety equipment

j) Car equipment encompassing:

- Frame
- Superstructure
- Door operator
- Travelling cable
- Buttons and indicators
- Communication devices
- Safety gear

2.6.47 Lift components - electro-mechanical

Evidence shall show an understanding of electro-mechanical lift components to an extent indicated by the following aspects:

a) Lift control circuits using relay logic encompassing:

- Button circuit
- Indicator/lantern circuit

- Key switch circuits
- Fans
- Mains supply
- Power circuits
- Floor selector circuitry
- Motor room control (selector)
- Well control (transducer)
- Directional circuitry
- Slowing and stopping circuitry
- Re-levelling circuitry
- Door operator circuitry
- Acceleration circuits

b) Safety circuits - type, operation and actuation encompassing:

- Landing door locks
- Car door locks
- Emergency stop
- Pit switch
- Car trap-door limit switch
- Fire service
- Car top switch
- Tappet switch
- Governor/switch
- Safety gear switch
- Reverse phase relay
- Phase failure relay
- Overloads
- Circuit breakers
- Limit switches
- Terminal stopping
- Door protection
- Circuit switches

c) Lift components – electronic encompassing:

- Encoders
- Transducers
- Electronic boards
- Selectors
- Rectifiers
- Capacitors
- Resistors

- Processor board
- I/O board

d) Lift components – electrical encompassing:

- Relays
- Tachos
- Limit switches
- Brushes
- Selectors
- Motor/generator
- Transformers
- Fuses
- Lamps
- Terminals

e) Electrical layout and special requirements encompassing:

- Lift Code and AS 3000 requirements
- Special lift symbols
- Conduits
- Travelling cable
- Troughing
- Colour coding and labelling
- Segregation LV/ELV
- Communication cabling
- Door lock wiring

f) Drives encompassing:

- Types
- Construction
- Operation

g) Traction encompassing:

- Speed/load characteristics
- Efficiency
- Application
- Brakes
- Electric prime mover (motor types and control)

h) Geared types encompassing:

- Speed/load characteristics
- Efficiency
- Application
- Brakes

- Electric prime mover (motor types and control)
- Drum

Note:

Examples are: Rack and pinion, chain

2.6.48 Electric lifts - mechanics

Evidence shall show an understanding of the mechanics of electrical lifts to an extent indicated by the following aspects:

a) Governors encompassing:

- Types

Note:

Examples are: Vertical shaft, Overspeed devices, Horizontal shaft

- Operation

Note:

Examples are: Testing procedures for each type of governor, Governor rope tension test

b) Safety gear encompassing:

- Types

Note:

Examples are: Type A instantaneous, Type B flexible guide clamp, Type C wedge clamp, Type D oil buffer

c) Release procedures for each type of safety gear/governor combination

d) Statutory requirements

e) Maintenance, replacement and adjustment of mechanical lift components encompassing:

- Door locks
- Air cords
- Selectors
- Bearings

Note:

Examples are: Roller, Sleeve, Guide shoes, Roller, Slipper

- Door guides
- Landing doors
- Car doors
- Tapes/chains

- Motor room equipment
- Well equipment
- Pit equipment

f) Brakes encompassing:

- Geared machine brakes
- Gearless machine brakes

g) Brake function and statutory requirements

h) Types of brake operation encompassing:

- Mechanical configurations

Note:

Examples are: External, Internal

-
- Electrical operations

Note:

Examples are: Stall motor, Solenoid, Hydraulic

i) Brake inspection and adjustment encompassing:

- Mechanical
- Electrical

j) Brake circuit operation encompassing:

- Brake circuitry

k) Manual release of brakes encompassing:

- Safe procedures
- Release devices

l) Statutory requirements

2.6.49 Electro-hydraulic lifts

Evidence shall show an understanding of electro-hydraulic lifts to an extent indicated by the following aspect:

a) Electrical circuitry

b) Pump motor, starter

c) Control components and operation encompassing:

- Governor switch
- Over travel limits
- Up, down solenoids
- Up, down limit switches

- Levelling switch
- Stop button
- Faulty components diagnosis

d) Hydraulic components

e) Hydraulic circuitry

f) Servicing

2.6.50 Electro-hydraulic lifts - mechanical operation

Evidence shall show an understanding of the mechanical operation of electro-hydraulic lifts to an extent indicated by the following aspect:

a) Principles of fluid power encompassing:

- Fluids
- Hydraulics
- Pascal's Law
- Safety considerations of fluids under pressure

b) Components encompassing:

- Pump
- Control of hydraulic pressure
- Solenoid valves
- Directional flow

Note:

Examples are: Pressure gauge

- Ram/cylinders
-

Note

Examples are: Single stage, Multi stage

- Oil cooler
- Oil reservoir
- Filters
- Seals
- Bleeding lines

c) General operation

d) Lift applications

e) Types of arrangements encompassing:

- Side acting
- Direct

- Suspended

f) Requirements of Lift Code/Standards encompassing:

- Viewing communication windows
- Labelling circuit breakers'
- Head room/top of car
- Pump installation under car
- Anti-creep devices
- Closing of landing doors

g) Emergency passenger release encompassing:

- Manual lowering
- OHS considerations
- communications

2.6.51 Emergency release procedures - trapped passengers

Evidence shall show an understanding of emergency release procedures for trapped passengers to an extent indicated by the following aspect:

a) OHS considerations encompassing:

- Enterprise requirements and procedures
- Passenger safety
- Moving under power
- Hand winding

b) Communication with passengers related to status of lift encompassing:

- Determining numbers and condition of passengers
- Direction of lift travel before stopping
- Fault indication
- Status of doors

c) Communication with passengers related to passenger safety and comfort encompassing:

- Warnings about using controls
- Warnings about standing near doors
- Information related to impending movement
- Information relating to opening of doors
- Reassurance as to safety of passengers
- Emergency medical support

•

2.2.07 Electrical installations and systems

2.7 Electrical installations and systems

2.7.1.1 Electrotechnology, building systems and materials

Evidence shall show an understanding of building systems and materials to an extent indicated by the following aspects:

- a) Methods, components and materials
- b) Process and sequence
- c) Cables and equipment in buildings

2.7.1.2 Electrical installations, wiring and accessories

Evidence shall show an understanding of the installation of wiring and accessories to an extent indicated by the following aspects:

- a) Standards, codes and requirements applicable to installing wiring and accessories.
- b) Techniques for installing wiring and accessories encompassing:
 - Application of accessories
 - Drawing-in and placing cables
 - Terminating cables and conductors
 - Maintenance of fire rating integrity.

2.7.1.3 Electrical wiring systems

Evidence shall show an understanding of electrical low voltage wiring systems to an extent indicated by the following aspects:

- a) TPI and TPS encompassing:
 - regulatory requirements for the installation of flat and circular TPS cables.
 - installation methods used for exposed circular TPS cable of a final subcircuit for lighting or a socket outlet or an appliance.
 - testing of the final subcircuit to ensure it complies with requirements and is safe to connect to the supply.
- b) Enclosures encompassing:
 - regulatory requirement for the installation of cable enclosures such as metallic and non-metallic conduit and trunking.

- installation methods used for TPI cable enclosed in conduit and trunking, of a final subcircuit for lighting or a socket outlet or an appliance.
- testing of the final subcircuit to ensure it complies with requirements and is safe to connect to the supply.

c) Fire related cables encompassing:

- regulatory requirements for the installation of fire related cable.
- installation methods used for fire related cable, of a final subcircuit for lighting or a socket outlet or an appliance.
- testing of the final subcircuit to ensure it complies with requirements and is safe to connect to the supply.

d) Armoured cable encompassing:

- regulatory requirements in relation to the installation of armoured cable.
- installation methods used for armoured cable of a final subcircuit for a socket outlet or appliance.
- testing of the final subcircuit to ensure it complies with requirements and is safe to connect to the supply.

e) Catenary supported cables and pendants encompassing:

- regulatory requirements for the installation of catenary supported cables and pendant-type socket outlets.
- installation methods used for catenary support cable system of a final subcircuit for a socket outlet or a tracking cable for an appliance.
- testing of the final subcircuit to ensure it complies with requirements and is safe to connect to the supply.

f) Aerial conductors encompassing:

- pole/post/strut selection
- conductor selection and spacing
- clearance requirements and safety measures

g) Underground wiring encompassing:

- categories, cables and enclosures
- depth laying, protection and other safety measures.

2.7.2 Electrical installations, equipment requirements

Evidence shall show an understanding of the installation of electrical equipment to an extent indicated by the following aspects:

a) Standards, codes and requirements applicable to installing electrical equipment.

Note:

Equipment includes switchgear and controlgear, motor starters and control devices, measuring and monitoring devices, luminaires and associated controls, heating

controls and the like.

b) Typical locations for various equipment

c) Terminal configuration for connection of phase, neutral and protective earthing conductors for each type of equipment

2.7.3 Electrical installations, safety principles and requirements

Evidence shall show an understanding of electrical protection for safety to an extent indicated by the following aspects:

a) Safety principle to which electrical systems in building and premises shall comply

b) Compliant methods for providing protection.

Note:

Methods include those for providing protection against direct and indirect contact; thermal effects; unwanted voltages; overcurrent; fault currents; overload; overvoltage; injury from mechanical movement

c) Requirements for installation design and selection of equipment.

Note:

1. Installation design includes compliant protection arrangements; correct functioning; compatibility with supply; estimation of maximum demands; voltage drop considerations; arrangement of circuits and the like

2.7.4.1 Electrical installations, protection methods and devices

Evidence shall show an understanding of electrical installations protection methods and devices to an extent indicated by the following aspects:

a) Electrical installation safety encompassing:

- effects on the human body of various levels of a.c. and d.c. current and duration of current flow for various current paths.
- risk of ignition of flammable materials due the thermal effects of current or electric arcs in normal service of an electrical installation.
- risk of injury from mechanical movement of electrically actuated equipment.

b) Protection against indirect contact encompassing:

- indirect contact with live parts of an electrical installation may occur.
- methods and devices that comply with the Wiring Rules for providing protection against indirect contact.

- components of the 'automatic disconnection of supply' method of protection against indirect contact.
- the terms 'touch voltage' and 'touch current'.
- the current path when a short circuit fault to exposed conductive parts of an appliance occurs.
- protection against indirect contact is by the use of Class II equipment and by electrical separation.

c) Earthing encompassing:

- the terms: earthed, earthed situation, equipotential bonding, multiple earthed neutral (MEN) system, main earthing conductor, protective earthing conductor, functional earthing.
- minimum size-earthing conductor for a range of active conductor sizes and materials.
- parts of an earthing system and explain the purpose of each.
- typical arrangement for a MEN earthing system.
- arrangements of protective earthing conductors that comply with the Wiring Rules.
- requirements for earthing in a range of installation situations.
- requirements for equipotential bonding in a range of installation situations.

d) Protection against overload and short circuit current encompassing:

- overload current or fault currents in an electrical installation.
- equivalent circuit of a fault loop identifying each impedance component and the electrical supply source.
- level of fault current possible at a given point in an installation from the fault-loop impedance and data from the electricity supplier.
- methods and devices that comply with the Wiring Rules for providing protection against the damaging effects of overload and fault current

e) Devices for automatic disconnection of supply encompassing:

- operating principles of thermal/magnet circuit breakers.
- operating principles of common types of fuses.
- operating principles of residual current devices (RCD).
- time/current curves tripping characteristics of various types of circuit breakers that comply with the requirements of the Wiring Rules.
- time/current curves fusing characteristics of various types of fuses that comply with the requirements of the Wiring Rules.
- time/current curves tripping characteristics of various types of RCDs that comply with the requirements of the Wiring Rules.
- factors in a fault loop that will affect the impedance of the circuit.
- maximum impedance of a fault loop to ensure operating of a protection device in compliance with the performance requirements of the Wiring Rules.

f) Protection against over voltage and under voltage encompassing:

- causes of over voltage and how this may affect the electrical system.
- methods for protection against over voltage.
- causes of under voltage and how this may affect the electrical system.
- methods for protection against under voltage.

2.7.4.2 Electrical installations, circuit arrangements and cable selection

Evidence shall show an understanding of electrical installations design and equipment selection techniques to an extent indicated by the following aspects:

a) Performance requirements – design consideration encompassing:

- harmful effect against which the design of an electrical installation must provide protection.
- acceptable performance standards of a correctly functioning electrical installation.
- supply characteristics that shall be determined when designing an electrical installation
- acceptable methods for determining the maximum demand in consumers mains and submains
- the Wiring Rules' requirements limiting voltage drop in an installation.
- reason for dividing electrical installations into circuits and the factors that shall determine their number and type.
- typical external factors that may damage an electrical installation and that shall be considered in the installations design.

b) Circuit arrangements encompassing:

- factors that shall be considered in determining the number and type of circuits required for an installation.
- daily and seasonal demand for lighting power, heating and other loads in a given installation.
- number and types of circuits required for a particular installation.
- a layout/schedule of circuits for given installations.

c) Factors affecting the suitability of wiring systems encompassing:

- wiring systems typically used with various construction methods and particular environment.
- installation conditions that may affect the current-carrying capacity of cables.
- external influences that may affect the current-carrying capacity and/or may cause damage to the wiring system.
- the Wiring Rules' requirements for selecting wiring systems for a range of circuits, installation conditions and construction methods into which the

wiring system is to be installed.

Note:

Wiring systems include cable enclosures, Underground wiring, Aerial wiring, Catenary support, Emergency systems, Busbar Trunking and Earth Sheath Return.

d) Selecting cables encompassing:

- maximum demand for the consumers main and submains for given installations up to 400 A per phase.
- current requirements for given final subcircuits.
- cable selection standards use to select conductor size based on the maximum current requirement while not exceeding voltage drop limitations or maximum fault loop impedance for a given circuit.

2.7.4.3 Electrical installations, advanced methods of cable and protection selection

Evidence shall show an understanding of advanced methods of cable and protection selection to an extent indicated by the following aspects:

a) Faults currents and protection encompassing:

- Methods of determining prospective fault current

Note.

Examples include measurement and calculation

- Protection requirements and methods
- Effects of voltage drop

b) Selection of cables encompassing:

- Short circuit performance limitations
- Effects of voltage drop

2.7.5.1 Electrical installations, testing and verification

Evidence shall show an understanding of electrical installations testing and verification to an extent indicated by the following aspects:

a) Legislated regulations encompassing:

- legislation and regulations that require installations and equipment to be tested to ensure they are safe.
- the person/bodies responsible for the various aspects of ensuring electrical installations are safe.
- results of tests that show an electrical installation is safe for connection to

the supply.

- results of periodic inspection and tests that show construction site wiring and equipment is safe to use.
- results of periodic inspection and tests that show electrical equipment are safe to use.

b) Testing installations encompassing:

- tests to ensure: insulation resistance is adequate; earth continuity is such that it will ensure the operation of protection devices under earth fault conditions; polarity of active/s and neutral for mains, submains and final subcircuits is correct; there is no transposition of earthing and neutral conductors; fault-loop impedance is sufficiently low; RCD for correct operation and sensitivity.
- functional tests to ensure active/s and neutral for the same circuit are clearly identified with their circuit protection device.
- tests that show all circuits and devices operate as intended.
- tests to determine the fault level at a particular point in an installation.

c) Documentation encompassing:

- results of tests conducted on an installation comply with requirements and ensure the installation is safe.
- documents of the results of testing an installation as required by the local supply authority.
- documents of periodic inspection and testing of construction site wiring and equipment in accordance with requirement.
- documents of periodic testing and inspection of electrical equipment including tagging requirements.

2.7.5.2 Electrical installations, testing and verification of special installations

Evidence shall show an understanding of testing and verification to an extent indicated by the following aspects:

a) Mandatory and optional testing and verification requirements applicable to special installations.

Note.

Special installations include those for caravan parks, construction and demolition sites, marinas, medical treatment areas and moveable premises and HV installation in consumer's premises

b) Testing techniques

c) Features of special installations that can be visually inspected

2.7.5.3 Fire protection installations, testing and verification methods

Evidence shall show an understanding of methods for testing and verifying compliance and functionality of fire protection installation to an extent indicated by the following aspects:

- a) Mandatory and optional testing and verification requirements applicable to fire protection installations.
- b) Testing techniques
- c) Features of fire protection installations that can be visually inspected

2.7.6 Electrical installations, emergency systems

Evidence shall show an understanding of electrical requirements for emergency systems to an extent indicated by the following aspects:

- a) Principles and practices of electrical emergency systems for electrical installations

Note:

Includes the use of relevant Australian Standards, Australian building code, and associated hazards

- b) Arrangement and requirements for fire and smoke control equipment
- c) Arrangement and requirements for emergency warning and intercommunications systems
- d) Arrangement and requirements for emergency evacuation lighting
- e) Arrangement and requirement for emergency power supplies

2.7.7 Electrical installations, special installation requirements

Evidence shall show an understanding of requirements for electrical installations in for marinas, moveable premises and caravan parks, medical treatment centres and construction and demolition sites to an extent indicated by the following aspects:

- a) Requirements for installation of wiring and equipment
- b) Compliant methods for providing protection
- c) Requirements for installation design and selection of equipment
- d) Mandatory testing and verification requirements

2.7.8 Electrical installations, hazardous areas

Evidence shall show an understanding of requirements for electrical installations in hazardous areas to an extent indicated by the following aspects:

a) Standards and requirements applicable to hazardous encompassing:

Note:

1. Standards may be Australian/ New Zealand or IEC as applicable to a workplace in which competency is demonstrated.
 2. Requirements include wiring and equipment permitted and not permitted and installation standards applicable to a particular explosion-protection technique.
-

b) Hazardous area verification dossier and its purpose.

c) Mandatory installation documentation required as a record of the installation process, including certification documentation.

Note:

Documentation includes zone designation drawings, equipment certification and as-installed drawing and installation modification approvals.

2.7.9.1 Electrical installations, single phase inspections

Evidence shall show an understanding of basic electrical inspection processes to an extent indicated by the following aspects:

a) Scope of inspection of single phase installations.

b) Processes for inspection of single supply arrangements, main switchboard and earthing

c) Actions and procedures for dealing with non-compliance defects.

2.7.9.2 Electrical installations, inspections and safety compliance audits

Evidence shall show an understanding of electrical inspection processes to an extent indicated by the following aspects:

a) Inspection types and their scope.

Note:

Examples include inspection of general electrical installations, special electrical installations, hazardous areas installations, safety audits and investigations.

b) Inspection procedures

c) Processes for confirming that performance standards have been met.

d) Actions and procedures for dealing with non-compliance defects.

2.7.10 Electrical installations, determination of demand

Evidence shall show an understanding of method for determining the demand in mains, submains and final subcircuits to an extent indicated by the following aspects:

- a) Acceptable methods for determining demand in mains and submains
- b) Applying calculation and assessment methods of determining demand in mains and submains.

2.7.11 Electrical installations, overcurrent protection

Evidence shall show an understanding of current protection to an extent indicated by the following aspects:

- a) Application of acceptable methods for determining prospective fault current.
- b) Relationship between prospective fault current and characteristics of protective devices.
- c) Relationship between overcurrent protections at various points in an electrical distribution system.

2.7.12 Electrical installations, overvoltage and undervoltage protection

Evidence shall show an understanding of overvoltage and undervoltage to an extent indicated by the following aspects:

- a) Application of acceptable methods for determining the need for overvoltage and undervoltage protection
- b) Methods and devices providing overvoltage and undervoltage protection

2.7.13 Electrical installations, programmable logic controller requirements

Evidence shall show an understanding of requirements for the installation of programmable logic controller to an extent indicated by the following aspects:

- a) Performance for safety requirements and regulations encompassing:
 - Protection against mechanical movement

- environmental limitations/protection

Note.

Safety requirements are describe in Australia/New Zealand Standard (e.g. AS/NZS 3000:2000) and adopted IEC Standards.

b) Regulations and manufacturer's installation requirements encompassing:

- physical positioning of CPU and I/O racks
- routing signal/power cables
- signal/power earthing requirements

c) Selection of related control equipment and devices

2.7.14 Procedures and processes for responding to reported electrical incidents

Evidence shall show an understanding of procedures and processes for responding to reported electrical incidents to an extent indicated by the following aspects:

a) Reporting requirements of the electricity legislation for electrical accidents on customer's premises.

b) Responsible for investigating electrical accidents on customer's premises.

c) Reporting procedures of electrical accidents on consumer's premises and distributor's assets.

d) Actions to be taken when an electrical incident causes loss of life, personal injury or property damage.

e) Initial task of an investigator of an electrical incident.

f) Extent of evidence needed to be gathered from the site of an electrical incident.

2.7.15 Causes and consequence of unsafe and misuse of electrical installations and equipment.

Evidence shall show an understanding of causes and consequence of unsafe and misuse of electrical installations and equipment to an extent indicated by the following aspects:

a) Conditions and actions that could result in death, injury of property damage from an electrical cause encompassing:

- Non-compliance defects of an electrical installation.

Note.

Compliance cover requirements set by regulations and is typical those specified by the Wiring Rules, Service Rules and Building Code.

- Connection or use of unsuitable (not approved) electrical equipment and appliances.
- Failure to follow safe working procedures.
- Deliberate misuse.
- Unacceptable rise in potential of exposed and extraneous conductive parts.

b) Causes of rise in potential of exposed and extraneous conductive parts encompassing:

- High impedance in the main or service neutral conductor of an MEN system.
- Earth faults.
- High impedance in the protective earthing under fault conditions.
- Ineffective equipotential bonding under fault conditions.
- Ineffective protective device under fault conditions.

c) Effects and consequences of current through the human body.

d) Electrical sources of fire in building and premises.

2.2.08 Electrical principles

2.8 Electrical principles

2.8.1.1 Basic electrical principles

Evidence shall show an understanding of electrical safety and principles to an extent indicated by the following aspects:

a) Hazards encountered in an electrical environment and safety procedures for dealing with them encompassing:

- Types of hazards

Note

Hazards include electrical shock, fire from an electrical source, chemical hazards and fall hazards.

- Factors indicating general unsafe work practices and conditions.
- Safety practices in the use of common tools and plant.

b) Rescue techniques and first aid treatment of an electric shock victim encompassing

- Methods to rescue an electrical shock victim in contact with live equipment or conductors.
- Accepted first aid treatment for burns, bleeding and shock.
- Procedures for conducting EAR and CPR.

c) Procedures for dealing with fires and hazardous chemicals associated with electrical equipment encompassing:

- Selection and use of different types of equipment used to fight fires associated with electrical equipment.
- Procedures for dealing with a fire associated with electrical equipment.
- Procedures for dealing with PCBs.

d) Basic circuit components and state the function of each.

- Sources of electrical supply
- Control switches
- Types and functions of resistive consuming devices.
- Basic circuit components symbols used in electrical diagrams.

e) Connection of basic electrical circuits and measurement of circuit parameters encompassing:

- Connection of components that make up a single-source single-load circuit.
- Relationship between voltage and current in such circuits
- Consequences of a short-circuit and an open-circuit.

f) Determining the voltage, current and resistance encompassing:

- Calculation methods.
- Measurement methods.

g) Cable and conductor terminations to Australian/New Zealand standards encompassing:

- Types of terminations.
- Cable conductor preparation.
- Prepare conductor for termination.
- Termination method

Note.

Conductor terminations include soldered and pressure types.

2.8.1.2 Fundamental electrical principles

Evidence shall show an understanding of electrical principles to an extent indicated by the following aspects:

a) Basic Electrical Concepts encompassing:

- electrotechnology industry
- static and current electricity
- production of electricity by renewable and non renewable energy sources
- transportation of electricity from the source to the load via the transmission

and distribution systems

- utilisation of electricity by the various loads

basic calculations involving quantity of electricity, velocity and speed with relationship to the generation and transportation of electricity.

a) Basic Electrical Circuit encompassing:

- symbols used to represent an electrical energy source, a load, a switch and a circuit protection device in a circuit diagram
- purpose of each component in the circuit
- effects of an open-circuit, a closed-circuit and a short-circuit
- multiple and sub-multiple units

b) Ohm's Law encompassing:

- basic d.c. single path circuit.
- voltage and currents levels in a basic d.c. single path circuit.
- effects of an open-circuit, a closed-circuit and a short-circuit on a basic d.c. single path relationship between voltage and current from measured values in a simple circuit
- determining voltage, current and resistance in a circuit given any two of these quantities
- graphical relationships of voltage, current and resistance
- relationship between voltage, current and resistance

c) Electrical Power encompassing:

- relationship between force, power, work and energy
- power dissipated in circuit from voltage, current and resistance values
- power ratings of devices
- measurement electrical power in a d.c. circuit
- effects of power rating of various resistors

d) Effects of electrical current encompassing:

- physiological effects of current and the fundamental principles (listed in AS/NZS 3000) for protection against the this effect
- basic principles by which electric current can result in the production of heat; the production of magnetic fields; a chemical reaction
- typical uses of the effects of current
- mechanisms by which metals corrode
- fundamental principles (listed in AS/NZS3000) for protection against the damaging effects of current

e) EMF Sources energy sources and conversion electrical energy encompassing:

- basic principles of producing a emf from the interaction of a moving conductor in a magnetic field.
- basic principles of producing an emf from the heating of one junction of a thermocouple.
- basic principles of producing a emf by the application of sun light falling on

- the surface of photovoltaic cells
 - basic principles of generating a emf when a mechanical force is applied to a crystal (piezo electric effect)
 - principles of producing a electrical current from primary, secondary and fuel cells
 - input, output, efficiency or losses of electrical systems and machines
 - effect of losses in electrical wiring and machines
 - principle of conservation of energy
- f) Resistors encompassing:
- features of fixed and variable resistor types and typical applications
 - identification of fixed and variable resistors
 - various types of fixed resistors used in the Electro technology Industry. e.g. wire-wound, carbon film, tapped resistors.
 - various types of variable resistors used in the Electro technology Industry e.g. adjustable resistors: potentiometer and rheostat; light dependent resistor (LDR); voltage dependent resistor (VDR) and temperature dependent resistor (NTC, PTC).
 - characteristics of temperature, voltage and light dependent resistors and typical applications of each
 - power ratings of a resistor.
 - power loss (heat) occurring in a conductor.
 - resistance of a colour coded resistor from colour code tables and confirm the value by measurement.
 - measurement of resistance of a range of variable' resistors under varying conditions of light, voltage, temperature conditions.
 - specifying a resistor for a particular application.
- g) Series circuits encompassing:
- circuit diagram of a single-source d.c. 'series' circuit.
 - Identification of the major components of a 'series' circuit: power supply; loads; connecting leads and switch
 - applications where 'series' circuits are used in the Electro technology industry.
 - characteristics of a 'series' circuit - connection of loads, current path, voltage drops, power dissipation and affects of an open circuit in a 'series' circuit.
 - the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities
 - relationship between voltage drops and resistance in a simple voltage divider network.
 - setting up and connecting a single-source series dc circuit
 - measurement of resistance, voltage and current values in a single source series circuit

- effect of an open-circuit on a series connected circuit

2.8.1.3 Electrotechnical principles

Evidence shall show an understanding of electrotechnical principles to an extent indicated by the following aspects:

a) Resistance encompassing:

- relationship between voltage, current and resistance and the power dissipated in a circuit
- value of voltage, current and resistance in a circuit given any two of these quantities
- the factors of length, cross-sectional area and material effect the resistance of conductors
- effects of temperature change on the resistance of various conducting materials
- features of fixed and variable resistor types and typical applications
- characteristics of temperature, voltage and light dependent resistors and typical applications of each

b) Series circuits encompassing:

- measurement of resistance, voltage and current values in a single source series circuit
- the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities
- relationship between the voltage drops around a circuit and the applied voltage

c) Parallel circuits encompassing:

- measurement of resistance, voltage and current values in a single-source parallel circuit
- the voltage, current, resistance or power dissipated from measured or given values of any of these quantities
- relationship between currents entering a junction and currents leaving a junction

d) Series/parallel circuits encompassing:

- measurement of resistance, voltage and current values in a single-source series / parallel circuit
- the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities

e) Measurement of electrical quantities encompassing:

- operating characteristics of analogue and digital meters
- selecting an appropriate meter in terms of units to be measured, range,

loading effect and accuracy for a given application

f) Capacitance/Capacitors encompassing:

- definition of capacitance and explain how a capacitor is charged
- the units by which capacitance is measured
- relationship between capacitance, voltage and charge
- behaviour of a series d.c. circuit containing resistance and capacitance components
- factors which determine the capacitance of a capacitor and explain how these factors are present in all circuits to some extent

g) Magnetism and electromagnetism encompassing:

- field patterns around given permanent magnets
- magnetic field patterns around a straight current carrying conductor and a solenoid
- direction in which the magnetic field around a straight current carrying conductor

h) Electromagnetic induction encompassing:

- factors required to induce an emf in a conductor

i) Sinusoidal alternating voltage and current encompassing:

- how a sinusoidal voltage is generated in a single turn coil rotated in a uniform magnetic field
- definition of the terms 'period', 'maximum value', 'peak-to-peak value', 'instantaneous value', 'average value' and 'root-mean-square (r.m.s.) value' in relation to a sinusoidal waveform
- instantaneous value of induced voltage of a generated sinusoidal waveform
- root-mean-square (r.m.s.) value and frequency of a sinusoidal waveform from values of peak voltage and period

j) Test equipment encompassing:

- operating principles of a CRO including block diagram of functional areas
- set up, calibration and use of an oscilloscope to measure d.c and a.c. voltages and frequency
- measurement of the instantaneous, peak, peak-to-peak values and the period of sinusoidal and other common waveforms provided by a signal generator
- calibration and limitation of CRO probes
- use of signal generator as a voltage source

k) Phase relationships in a.c. circuits encompassing:

- phasor representation of graphical waveforms
- 'in-phase', 'out-of-phase', 'phase angle', 'lead', and 'lag'
- convention for representing voltage, current and the reference quantity in a phasor diagram

- phasor diagrams to show the relationship between two or more a.c. values of voltage and/or current

l) Single-source resistive a.c. circuits of various frequencies encompassing:

- single-source a.c. circuit and taking resistance, voltage and current measurements
- voltage, current, resistances or power dissipated from measured or given values of any two of these quantities

m) Inductance in a.c. circuits encompassing:

- concept of inductance, self-inductance and mutual inductance. (in terms of storage of magnetic energy)
- factors affecting inductance and how the unit of inductance is derived
- value of induced voltage in a given circuit
- how a series d.c. circuit containing resistance and inductance behaves
- 'inductive reactance'
- inductive reactance of a given inductor and show the relationship between inductive reactance and frequency
- applying Ohm's law to determine voltage, current or inductive reactance in a purely inductive a.c. circuit given any two of these quantities
- examples of inductive components in circuits and systems and describe their effect on the phase relationship between voltage and current

n) Capacitance in a.c. circuits encompassing:

- capacitive reactance of a given capacitor and the relationship between capacitive reactance and frequency
- applying Ohm's law to determine voltage, current or capacitive reactance in a purely capacitive a.c. circuit given any two of these quantities
- examples of capacitive components in electronic circuits and systems and describe their effect on the phase relationship between voltage and current

p) Impedance in a.c. circuits encompassing:

- definition of 'impedance'
- impedance of series, parallel and series-parallel circuits and draw diagrams showing the relationship between resistive, inductive and capacitive components
- single-source a.c. circuit with resistance, voltage and current measurements
- determination of the voltage, current or impedance from measured or given values of any two of these quantities
- using phasor diagrams to solve problems and show the relationship between voltages and currents in a.c. circuits

2.8.1.4 Circuits principles

Evidence shall show an understanding of circuit principles to an extent indicated by the following aspects:

a) Basic circuit configurations

Note:

Examples of circuit configurations are single source a.c. and d.c. circuits, series, parallel and series-parallel circuits.

b) The relationship between variable parameter in electrical /electronic circuits

Note:

Variables parameters are voltage, current, resistance/impedance, inductance, capacitance and reactance.

c) Behaviour of electrical /electronic circuits for various and variable parameters.

Note:

Examples include single source circuits, series, parallel and series-parallel circuit configurations with various values of voltage, current, resistance/impedance, inductance, capacitance and reactance circuits typical of an electrotechnology disciplines.

2.8.2.1 Direct current circuit principles

Evidence shall show an understanding of electrical principles to an extent indicated by the following aspects:

a) Parallel circuits encompassing:

- schematic diagram of a single-source d.c. 'parallel' circuit.
- major components of a 'parallel' circuit (power supply, loads, connecting leads and switch)
- applications where 'parallel' circuits are used in the Electrotechnology industry.
- characteristics of a 'parallel' circuit. (load connection, current paths, voltage drops, power dissipation, affects of an open circuit in a 'parallel' circuit).
- relationship between currents entering a junction and currents leaving a junction
- relationship between branch currents and resistances in a two branch current divider network.
- calculation of the total resistance of a 'parallel' circuit.
- calculation of the total current of a 'parallel' circuit.
- Calculation of the total voltage and the individual voltage drops of a 'parallel' circuit.
- setting up and connecting a single-source d.c. parallel circuit
- resistance, voltage and current measurements in a single-source parallel

circuit

- voltage, current, resistance or power dissipated from measured values of any of these quantities

b) Series/parallel circuits encompassing:

- schematic diagram of a single-source d.c. 'series/parallel' circuit.
- major components of a 'series/parallel' circuit (power supply, loads, connecting leads and switch)
- applications where 'series/parallel' circuits are used in the Electrotechnology industry.
- characteristics of a 'series/parallel' circuit. (load connection, current paths, voltage drops, power dissipation, affects of an open circuit in a 'series/parallel' circuit).
- relationship between voltages, currents and resistances in a bridge network.
- calculation of the total resistance of a 'series/parallel' circuit.
- calculation of the total current of a 'series/parallel' circuit.
- calculation of the total voltage and the individual voltage drops of a 'series/parallel' circuit.
- setting up and connecting a single-source d.c. series/ parallel circuit
- resistance, voltage and current measurements in a single-source d.c. series / parallel circuit
- the voltage, current, resistances or power dissipated from measured values of any two of these quantities

c) Factors affecting resistance encompassing:

- four factors that affect the resistance of a conductor (type of material, length, cross-sectional area and temperature)
- affect the change in the *type of material* (resistivity) has on the resistance of a conductor.
- affect the change in '*length*' has on the resistance of a conductor.
- affect the change in 'cross-sectional area' has on the resistance of a conductor.
- effects of temperature change on the resistance of various conducting materials
- meaning of the terms - Positive Temperature Coefficient (PTC) and Negative Temperature Coefficient (NTC)
- effects of resistance on the current-carrying capacity and voltage drop in cables.
- calculation of the resistance of a conductor from factors such as conductor length, cross-sectional area, resistivity and changes in temperature
- using digital and analogue ohmmeter to measure the change in resistance of different types of conductive materials (copper, aluminium, nichrome, tungsten) when those materials undergo a change in type of material length, cross-sectional area and temperature.

f) Effects of meters in a circuit encompassing:

- selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application.
- measuring resistance using direct, volt-ammeter and bridge methods.
- instruments used in the field to measure voltage, current, resistance and insulation resistance and the typical circumstances in which they are used.
- hazards involved in using electrical instruments and the safety control measures that should be taken.
- operating characteristics of analogue and digital meters.
- correct techniques to read the scale of an analogue meters and how to reduce the 'parallax' error.
- types of voltmeters used in the Electrotechnology industry – bench type, clamp meter, Multimeter, etc.
- purpose and characteristics (internal resistance, range, loading effect and accuracy) of a voltmeter.
- types of voltage indicator testers. e.g. LED, neon, solenoid, volt-stick, series tester, etc. and explain the purpose of each voltage indicator tester.
- operation of various voltage indicator testers.
- Explain the advantages and disadvantages of each voltage indicator tester.
- List the various types of ammeters used in the Electrotechnology industry – bench, clamp meter, multimeter, etc.
- Explain the purpose of an ammeter and the correct connection (series) of an ammeter into a circuit.
- Explain the reasons why the internal resistance of an ammeter must be extremely low and the dangers and consequences of connecting an ammeter in parallel and/or wrong polarity.
- Select an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application
- Connect an analogue/digital voltmeter into a circuit ensuring the polarities are correct and take various voltage readings.
- Demonstrate the loading effect of various voltmeters when measuring voltage across various loads.
- Use a variety of voltage indicator testers to detect the presence of various voltage levels.
- Connect an analogue/digital ammeter into a circuit ensuring the polarities are correct and take various current readings.

c) Resistance Measurement encompassing:

- Identification of instruments used in the field to measure resistance (including insulation resistance) and the typical circumstances in which they are used.
- the purpose of an Insulation Resistance (IR) Tester.
- the parts and functions of various analogue and digital IR Tester (selector

range switch, zero ohms adjustment, battery check function, scale and connecting leads).

- reasons why the supply must be isolated prior to using the IR tester.
- where and why the continuity test would be used in an electrical installation.
- where and why the insulation resistance test would be used in an electrical installation.
- the voltage ranges of an IR tester and where each range may be used. e.g. 250 V d.c, 500 V d.c & 1000 V d.c
- the AS/NZS3000 Wiring Rules requirements – continuity test and insulation resistance test.
- the purpose of regular IR tester calibration.
- the correct methods of storing the IR tester after use
- carry out a calibration check on a IR Tester
- measurement of low values of resistance using an IR tester continuity functions.
- measurement of high values of resistance using an IR tester insulation resistance function.
- the volt-ammeter (short shunt and long shunt) methods of measuring resistance.
- calculation of resistance values using voltmeter and ammeter reading (long and short shunt connections)
- measurement of resistance using volt-ammeter methods

g) Capacitors and Capacitance encompassing:

- basic construction of standard capacitor, highlighting the: plates, dielectric and connecting leads
- different types of dielectric material and each dielectric's relative permittivity.
- identification of various types of capacitors commonly used in the Electrotechnology industry (*Fixed value capacitors* -Stacked plate, Rolled, Electrolytic, Ceramic, Mica and *Variable value capacitors* – tuning and trimmer)
- circuit symbol of various types of capacitors: standard; variable, trimmer and polarised
- terms: Capacitance (C), Electric charge (Q) and Energy (W)
- unit of: Capacitance (Farad), Electric charge (Coulomb) and Energy (Joule)
- factors affecting capacitance (the effective area of the plates, the distance between the plates and the type of dielectric) and explain how these factors are present in all circuits to some extent.
- how a capacitor is charged in a d.c. circuit.
- behaviour of a series d.c. circuit containing resistance and capacitance components. - charge and discharge curves
- the term '*Time Constant*' and its relationship to the charging and discharging

of a capacitor.

- calculation of quantities from given information: Capacitance ($Q = VC$); Energy ($W = \frac{1}{2}CV^2$); Voltage ($V = Q/C$)
- calculation one time constant as well as the time taken to fully charge and discharge a given capacitor. ($\tau = RC$)
- connection of a series d.c. circuit containing capacitance and resistor to determine the time constant of the circuit

h) Capacitors in Series and Parallel encompassing:

- hazards involved in working with capacitance effects and the safety control measures that should be taken.
- safe handling and the correct methods of discharging various size capacitors
- dangers of a charged capacitor and the consequences of discharging a capacitor through a person
- factors which determine the capacitance of a capacitor and explain how these factors are present in all circuits to some extent.
- effects of capacitors connected in parallel by calculating their equivalent capacitance.
- effects on the total capacitance of capacitors connected in series by calculating their equivalent capacitance.
- Connecting capacitors in series and/or parallel configurations to achieve various capacitance values.
- common faults in capacitors.
- testing of capacitors to determine serviceability.
- application of capacitors in the Electrotechnology industry.

2.8.2.2 Alternating current principles - power

Evidence shall show an understanding of alternating currents principles used in power circuits to an extent indicated by the following aspects:

a) Sinusoidal alternating voltage and current encompassing:

- Generation of a sinusoidal voltage with a single turn coil rotated in a uniform magnetic field.
- the terms 'period', 'maximum value', 'peak-to-peak value', 'instantaneous value', 'average value', 'root-mean-square (r.m.s.) value', 'crest factor' and 'form factor' in relation to a sinusoidal waveform.
- the instantaneous value of induced voltage of a generated sinusoidal waveform.
- measurement of the instantaneous, peak, peak-to-peak values and the period of a sinusoidal waveform.

- the root-mean-square (r.m.s.) value and frequency of a sinusoidal waveform.
- phase relationship between two or more sinusoidal waveforms.

b) Phasors encompassing:

- the terms 'in-phase', 'out-of-phase', 'phase angle', 'lead', and 'lag'.
- the phase angle between two or more alternating quantities from a given sinusoidal waveform diagram.
- convention for representing voltage, current and the reference quantity in a phasor diagram.
- phasor diagrams two or more a.c. values of voltage and/or current.

c) Resistance in a.c. circuits encompassing:

- connection of a single-source a.c. circuit to take resistance, voltage and current measurements.
- the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities.
- the relationship between voltage drops and current in a resistive a.c. circuit.

d) Inductance in a.c. circuits encompassing:

- definition of 'inductive reactance'.
- the inductive reactance of a given inductor and show the relationship between inductive reactance and frequency.
- equivalent inductive reactance in an a.c. circuit or any part of a circuit.
- application of Ohm's Law to determine voltage, current or inductive reactance in a purely inductive a.c. circuit given any two of these quantities.
- examples of inductive components in power circuits and systems and describe their effect on the phase relationship between voltage and current.
- the comparative current limiting characteristics of inductors and resistors.

e) Capacitance in a.c. circuits encompassing:

- definition of 'capacitive reactance'.
- the capacitive reactance of a given capacitor and the relationship between capacitive reactance and frequency.
- equivalent capacitive reactance in an a.c. circuit or any part of a circuit.
- application of Ohm's Law to determine voltage, current or capacitive reactance in a purely capacitive a.c. circuit given any two of these quantities.
- examples of capacitive components in power circuits and systems and describe their effect on the phase relationship between voltage and current.

f) Impedance encompassing:

- definition of 'impedance'.
- impedance of series, parallel and series-parallel circuits and diagrams showing the relationship between resistive, inductive and capacitive components (impedance triangle).
- connection of a single-source a.c. circuit and take resistance, voltage and

current measurements.

- voltage, current or impedance values from measured or given values of any two of these quantities.
- phasor diagram usage to solve problems and show the relationship between voltages and currents in a.c. circuits.

g) Resonance encompassing:

- conditions in a circuit that produce resonance.
- the relationship between resonance and frequency.
- the effect on the current of series resonance and parallel resonance conditions.
- applications where resonance is applied

h) Power and power factor encompassing:

- difference between true power, apparent power and reactive power and the units.
- definition of the term "power factor".
- the effects of low power factor.
- local and AS/NZS 3000 requirements regarding the power factor of an installation and power factor improvement equipment.

i) Multiphase systems encompassing:

- features of a multiphase system.
- voltages generated by single and multiphase alternators.
- reasons for the adoption of three-phases for power systems.

j) Three-phase principles encompassing:

- Generation of three-phases in a single alternator.
- r.m.s. value of voltage generated in each phase.
- the relationship between the phase voltages generated in a three-phase alternator and the conventions for identifying each.
- the term "phase sequence" (also, referred to as "phase rotation").
- determination of the phase sequence of a three-phase supply.

k) Three-phase star-connections encompassing:

- connection of three-phase star system.
- the phase relationship between line and phase voltages and line and phase currents of a star-connected system.
- the r.m.s. value of line and phase voltage given any one of these quantities.
- the r.m.s. value of line and phase current given any one of these quantities.
- the terms "balanced load" and "unbalanced load".
- example of balanced and unbalanced loads in typical power systems.

l) Three-phase four wire systems encompassing:

- purpose of the neutral conductor in a three-phase four wire systems.

- effects of high impedance in the neutral conductor of a three-phase four wire system supplying an unbalanced load where MEN earthing are employed.
- the value and phase relationship of neutral current in an unbalanced three-phase four wire systems given line currents and power factors.
- the AS/NZS 3000 requirements regarding neutral conductors.

m) Three-phase delta-connections encompassing:

- connection of three-phase delta system.
- phase relationship between line and phase voltages and line and phase currents of a delta-connected system.
- the r.m.s. value of line and phase voltage given any one of these quantities.
- the r.m.s. value of line and phase current given any one of these quantities.
- example of delta-connection loads in typical power systems.

n) Interconnected star and delta systems encompassing:

- relationship between line and phase voltages and line and phase currents in a system with a star-connected supply device and a delta-connected load.
- relationship between line and phase voltages and line and phase currents in a system with a delta-connected supply device and a star-connected load.

o) Energy and power requirements of a.c. systems encompassing:

- the purposes for measuring power, energy, power factor and maximum demand of a.c. power systems and loads.
- methods used to measure power, energy power factor and maximum demand.
- power factor improvement of a three-phase installation.

p) Harmonics encompassing:

- the term "harmonic" in relation to the sinusoidal waveform of an a.c. power system.
- sources in a.c. systems that produce harmonics.
- problems that may arise in a.c. circuits as a result of harmonics and how these are overcome.

2.8.3 Power factor

Evidence shall show an understanding of power factor to an extent indicated by the following aspects:

- a) Effects of low power factor on control-gear, switchgear and circuit cables.
- b) Requirements for maintaining a high power factor.
- c) Fundamentals of methods used to improve power factor.
- d) Actions and conditions that cause lower power factor

2.8.4 Three phase circuits

Evidence shall show an understanding of three phase circuits to an extent indicated by the following aspects:

- a) Star and delta circuit configurations
- b) Relationship between line and phase voltages and between line and phase currents.
- c) Relationship between line voltage, line current and power.
- d) Balanced and unbalanced four wire systems.
- e) Consequences of high impedance in the neutral conductor where multiple-earthed-neutral (MEN) is used.

2.8.5 Magnetism

Evidence shall show an understanding of magnetism to an extent indicated by the following aspects:

- a) Concept of magnetism
- b) Magnetic field patterns and magnetic screening
- c) Applications of permanent magnets
- d) Concepts of electromagnetism
- e) Magnetic characteristics of material
- f) Magnetic field around a straight conductor and a solenoid carrying current.
- g) Factors affecting the force between adjacent current-carrying conductors, calculate the force, and state its direction.

2.8.6 Electromagnetic principles

Evidence shall show an understanding of electromagnetic principles to an extent indicated by the following aspects:

- a) Magnetism encompassing:
 - field patterns around given permanent magnets.
 - magnetic induction and its effects.
 - principles of magnetic shielding and its application.
 - Classification of magnetic materials.
 - typical applications of permanent magnets.

b) Electromagnetism encompassing:

- magnetic field patterns around a straight current carrying conductor and a solenoid.
- direction in which the magnetic field around a straight current carrying conductor.
- direction of the north pole of a solenoid.
- factors effecting the force and direction between adjacent current-carrying conductors.

c) Magnetic quantities encompassing:

- magnetic terms and units for magnetomotive force, reluctance, magnetic flux, magnetising force and flux density.
- property of permeability and the meaning of actual and relative permeability.
- values of magnetomotive force, magnetising force, flux density, permeability and reluctance in given magnetic circuits.

d) Magnetisation curve encompassing:

- the terms "saturation", "hysteresis" and "losses" in relation to magnetic materials and circuits.
- magnetic characteristics of various materials from magnetisation curves, permeability curves and hysteresis loops.
- magnetic losses and the resulting effects on the performance of electrical machines.

e) Electromagnetic induction encompassing:

- factors required to induce an emf in a conductor.
- Faraday's Law.
- direction of induced voltage in a moving conductor in a magnetic field.
- relationship between the forces acting on a closed conductor when an emf is induced in it. (Lenz's law).

f) Inductance and inductors encompassing:

- concept of inductance, self-inductance and mutual inductance. (in terms of storage of magnetic energy).
- factors affecting inductance and how the unit of inductance is derived.
- inductance of a solenoid given necessary physical data.
- value of induced voltage in a given circuit.
- growth/decay of current in an inductor and determine the time constant of a series L-R circuit.
- Types of inductors

g) Application of electromagnetic principles encompassing:

- principles of operation and applications of magnetism, electromagnetism and induction.

- hazards associated with induced voltages.
- situations where the effects of inductance and electromagnetism has an adverse effect.

h) Rotating machine construction and operating principles encompassing:

- main components of a rotating machine.
- voltage generated and back emf induced in the "armature" conductors of a machine.
- motor effect produced by an electric current, including the development of torque in a motor and opposing torque in a generator.
- induced voltage in a conductors, force on a conductor and torque of various machines.

i) Generators encompassing:

- circuit arrangement and connection of various types of generators.
- common methods of excitation used for generators.
- methods used to regulate the output voltage of generators.
- effects of load on a generator.
- applications of generators.

j) Machines encompassing:

- circuit arrangements and connections of various common motors.
- performance of motors from measured values.
- effects of load on a motor.

k) Specialty machines encompassing:

- tachogenerator – construction, operation and applications.
- servomotors – construction, operation and applications.
- stepper motors – construction, operation and applications.
- EC motors – construction, operation and applications.

2.8.7 Harmonic fundamentals

Evidence shall show an understanding of harmonics in power circuits to an extent indicated by the following aspects:

- a) Nature of harmonics and effect on a sine wave.
- b) Consequences of harmonics on cables and electrical apparatus
- c) Causes of harmonics in modern electrical systems
- d) Method of reducing harmonics

2.8.8 Electrotechnology science and materials

Evidence shall show an understanding of electrotechnology science and materials to an extent indicated by the following aspects:

a) Trade calculations encompassing:

- mathematical techniques
- relevant calculations
- linear measurement, areas, volumes, ratios

b) Engineering mechanics encompassing:

- base physical quantities
- concepts, principles, S.I. units, their applications in
- engineering calculations in relation to physical quantities and
- associated formulae
- mass, velocity, acceleration, force, weight, density, angles
- energy/work/power
- moments/torque
- centre of gravity
- mechanical advantage
- levers
- pulley blocks
- efficiency
- friction
- vectors
- resolution of forces
- forces in strung conductors
- forces on poles and towers
- determination of sag
- pressure/stress
- elementary fluid mechanics

c) Engineering materials encompassing:

- classification
- ferrous and non-ferrous metals
- steels, alloys,
- properties
- tensile strength
- temperature and expansion in metals
- stress and strain
- ductility

- applications
- corrosion
- galvanic corrosion
- hardwoods and soft woods

2.8.9.1 Circuit analysis

Evidence shall show an understanding of circuit analysis to an extent indicated by the following aspects:

- a) Voltage and current Laws
- b) Circuit components
- c) Types of circuits

Note:

Types include RL, RC and RLC circuits; polyphase circuits; magnetically coupled circuits and two port networks

- d) Circuit analysis techniques application and use

Note:

Techniques include Nodal and mesh analysis; superposition; Thevenin and Norton equivalents; maximum power transfer; complex frequency; Laplace transforms; and Fourier transforms;

- e) Use of software tools for analysing circuits.

2.8.9.2 Electrical power circuit analysis

Evidence shall show an understanding of electrical power circuit analysis to an extent indicated by the following aspects:

- a) Superposition theorem
- b) Kirchhoff's laws
- c) Mesh analysis
- d) Thevenin's & Norton's theorems
- e) Maximum power transfer theorem
- f) Complex impedance
- g) Frequency domain
- h) Transients

2.8.9.3 Polyphase power circuit analysis

Evidence shall show an understanding of polyphase circuit analysis to an extent indicated by the following aspects:

- a) Complex power 1ϕ and 3ϕ
- b) Balanced, unbalanced 3ϕ
- c) Impedance of 3ϕ loads
- d) Measurement in 3ϕ circuits
- e) Line voltage drops
- f) Neutral current
- g) Fault currents
 - symmetrical
 - asymmetrical

2.8.10.1 Engineering maths fundamentals

Evidence shall show an understanding of engineering maths fundamentals to an extent indicated by the following aspects:

- a) SI Units, scientific and engineering notation, significant figures and accuracy encompassing:
 - Conversion between decimal notation, scientific notation and engineering notation
- b) Evaluation of expressions using a calculator
- c) Substitution in algebraic formulas
- d) Simplification of algebraic formulas encompassing:
 - Addition of like terms
 - Removal of brackets
 - Multiplying and dividing terms
 - Algebraic fractions
- e) Applying the laws of indices
- f) Simplification of expressions involving square roots
- g) Present and interpret data encompassing:
 - building tables of values
 - building graphs
 - reading graphs

h) Solving right-angled triangles encompassing:

i) Pythagoras' Theorem

- trig ratios

2.8.10.2 Engineering maths

Evidence shall show an understanding of engineering maths to an extent indicated by the following aspects:

a) Transposition encompassing:

- fractional expressions
- exponential and logarithmic expressions
- trigonometric expressions

b) Estimations, errors and approximations encompassing:

- Errors in measurement
- Maximum probable error
- Significant figures
- Estimations and approximations

c) Quadratic functions encompassing:

- Graphs of quadratic functions represented by parabolas and the significance of the leading coefficient.
- Zeros represented graphically.
- Solution of quadratic equations by factoring and the quadratic formula.
- Solution of simultaneous linear and quadratic equations algebraically and geometrically.

d) Exponential Functions:

- characteristics and
- applications in engineering

e) Logarithmic Functions :

- characteristics and
- applications in engineering

f) Trigonometric Functions:

- characteristics and
- applications in engineering

g) Methods for solving simultaneous equations encompassing:

- determinants

- Cramer's rule

h) Complex numbers encompassing:

- polar to rectangular conversion
- rectangular to polar conversion

i) Matrices

j) Vectors encompassing:

- Geometrical representation,
- Addition and scalar multiplication,

2.8.10.3 Advanced engineering maths

Evidence shall show an understanding of advanced engineering maths to an extent indicated by the following aspects:

a) Differentiation Calculus encompassing:

- Integration, integration by parts,
- Numerical methods,
- Partial and total differentiation.

b) Linear Algebra encompassing:

- Matrices and inverse matrices;
- Linear mapping,
- Determinants,
- Solution of linear equations.

c) Vectors encompassing:

- Geometrical representation,
- Addition and scalar multiplication,
- Dot and cross products,
- Equations of lines and planes.

d) Variables encompassing:

- Graphs, level curves and surfaces
- Partial derivatives; chain rule; directional derivative;
- Maxima and minima.

e) Sequences and Series encompassing:

- Algebraic and Fourier series, convergence; Taylor's Theorem
- Power series manipulation.

f) Differential Equations encompassing:

- First order and separable linear equations
- Second order linear equations.
- Partial differential equations.
- Numerical Techniques.

g) Number encompassing:

- Integer, irrational and complex numbers.
- Number systems.
- Arithmetic operations.
- Accuracy and stability.

h) Statistics encompassing:

- Assembly, representation and analysis of data.
- Fitting distributions to data.
- Non-parametric statistics.
- Tests of significance for means, variances and extreme values.
- Correlation

2.8.10.4 Engineering mathematics with calculus

Evidence shall show an understanding of engineering mathematics with calculus to an extent indicated by the following aspect:

a) Differential Calculus encompassing:

- Basic concepts

Note.

Concepts shall be limited to definition of the derivative of a function as the slope of a tangent line (the gradient of a curve); limits; basic examples from 1st principles; Notation and Results of derivative of $k.f(ax + b)$ where $f(x)=x$ to the power of n , $\sin x$, $\cos x$, $\tan x$, e to the power of x , $\ln x$.

-
- Rules

Note.

Examples are derivative of sum and difference; product rule; quotient rule; chain rule (function of a function), limited to two rules for any given function.

The 2nd derivative

-
- Applications

Note.

Examples are equations of tangents and normals; stationary points; turning points;

and curve sketching; rates of change; rectilinear motion

- Verbally formulated problems involving related rates and maxima: minima

b) Integral Calculus

- Integration as the inverse operation to differentiation
-

Note.

Examples are results of the integral of $k \cdot f(ax + b)$ where $f(x) = x$ to the power of n , $\sin x$, $\cos x$, $\sec^2 x$, e to the power of x

The method of substitution

The definite integral

- Applications
-

Note.

Examples are areas between curves; rectilinear motion including displacement from acceleration and distance travelled; voltage and current relationship in capacitors and inductors and the like

c) Differential Equations encompassing:

- First order and separable linear equations

2.8.11 Power engineering computations

Evidence shall show an understanding of electrical computations to an extent indicated by the following aspects:

a) Graph functions and applications encompassing:

- linear, non linear
- parabolic
- hyperbolic
- logarithmic
- exponential

b) Complex numbers encompassing:

- Polar form
- Rectangular form

c) Simultaneous equations

d) Quadratic equations

e) Phasor diagrams

f) Star-delta transformations

2.8.12 Electrical concepts and applications

Evidence shall show an understanding of electrical concepts to an extent indicated by the following aspects:

- a) Electrical supply and distribution within a building or premises
- b) Arrangement of circuits
- c) Protection for safety requirements and their practice
- d) Difference between alternating and direct current
- e) Measurement and calculation of voltage, current, resistance and power in practical circuits.
- f) Concepts and applications of magnetism and electromagnetic induction
- g) Transformer operating principles and their application
- h) Hazards associated with electrical systems and apparatus.

2.8.13 Parts and component selection

Evidence shall show an understanding of electrotechnology, parts and component selection to an extent indicated by the following aspects:

- a) Part and component identification encompassing:
 - Type, number and ratings of a range of typical components used in the electrotechnology and engineering industries
- b) Information about parts and components encompassing:
 - Catalogues
 - Computer access
 - Alternative parts
 - Telephone inquiry

Note: Examples of part identification and access may include: part codes, manufacturers and manufacturers supply outlets; availability and delivery times; price, including discounts, tax and delivery costs.

- c) Ordering procedures encompassing:
 - Customer approval
 - Supplier requirements
 - In-house requirements
- d) Receiving/dispatching procedures
 - Supplier requirements
 - In-house requirements

- Handling and storage

2.8.14.1 Electrotechnology calculations

Evidence shall show an understanding of Electrotechnology calculations to an extent indicated by the following aspects:

a) Perform basic mathematical operations including fractions, decimals, and scientific notation encompassing:

- Solve problems involving fractions.
- Express numbers as multiples and sub-multiples.
- Without the aid of a calculator estimate the result of a calculation involving mathematical operations verifying answers with a calculator.
- Estimate the result of a problem involving fractions.
- Convert fractions to decimal numbers.
- Convert decimal numbers into scientific notation.

b) Using graphs and tables show the relationship between two variables encompassing:

- Describe the different types of graphs and tables used in Electrotechnology.
- Identify dependent and independent variables.
- Derive equations from graphs and tables.
- Draw graphs involving two variables.
- Interpret graphical presentations.

c) Transpose a given equation for any variable in equation encompassing:

- Transpose an equation in order to calculate an unknown value.
- Transpose an equation involving several variables

Note:

Examples are series/parallel resistors.

- Transpose an equation involving parentheses.

d) Apply trigonometry to problem solving encompassing:

- Use trigonometric ratios to solve practical problems
- Apply Pythagoras' theorem to practical problems
- Solve problems using the sine and cosine rules
- Determine the sine and cosine of angles up to 720°

e) Resolve vectors/phasors given any combination of magnitude and direction encompassing:

- Describe the use of vectors/phasors in electrotechnology situations
- Define a vector/phasor

- Draw a vector/phasor diagram.
- Resolve a vector/phasor into horizontal and vertical components
- Determine a resultant using a vector/phasor polygon.

f) Solve electrotechnology calculations systematically encompassing:

- Analyse word problems and identify data
- Convert relevant data to SI Unit format
- Insert SI Unit data into relevant equations and obtain solution

2.8.14.2 Electrotechnology science

Evidence shall show an understanding of Electrotechnology science to an extent indicated by the following aspects:

a) Components

- resistors
- fixed

Note:

Examples are composition and wire wound

- variable
-

Note:

Examples are rheostats, potentiometers and trimmers

- non-linear
-

Note:

Examples are thermistors, VDRs and LDRs

- capacitors
 - fixed
-

Note:

Examples are ceramic, plastic and electrolytic

- variable, trimmers
 - magnetic
 - transformers
-

Note:

Examples are AF, RF and power

- chokes
- relays
- contactors

b) Basic physics

- conductors
- definition
- common types
- typical applications
- insulators
- definition
- common types
- typical applications
- semiconductors
- definition
- common types
- typical applications
- current flow
- direction

Note:

Examples are electron/conventional

- unit
- effects of current flow
- voltage
- source

Note:

Examples are electromagnetic, chemical, heat and pressure

- unit
- resistance
- factors effecting

Note:

Examples are material, length, csa and temperature

- effect on circuit
- colour code
- preferred values
- power rating
- Ohms law
- electrical Units

Note:

Examples include sub and multiple

- volt, ampere, Ohm and Watt

- power in electrical circuits
- $P = IV$ only
- introductory circuit symbols

c) Effects of electric current

- heating
- light
- magnetic
- chemical
- physiological

d) Circuits

- series and parallel (three resistive elements max.)
- V,I,R and P relationships
- use lab experiments to validate theory

e) Protection

- purpose
- fuses
- circuit breaking
- safety interlocks
- earthing – personnel safety

2.8.14.3 Electrotechnology Numeracy Diagnostic Assessment Methods

Evidence shall show an understanding of electrotechnology numeracy diagnostic assessment methods to an extent indicated by the following aspects:

a) Electrotechnology Numeracy Diagnostic Test encompassing:

- Decimals
- Fractions and Indices
- Percentages
- Graphs
- Multiples and Sub Multiples
- Ratios and Proportions
- Transposition
- Areas and Volumes
- Trigonometry and Pythagoras' Theorem
- Construction of Angles and Triangles

b) Recommendation of Remedial Action

- Action plan for remedial action

- Other support agencies
- Failure to follow action plan
- Monitoring of remedial action of learner

2.8.14.4 Electrotechnology Literacy Diagnostic Assessment Methods

Evidence shall show an understanding of electrotechnology literacy diagnostic assessment methods to an extent indicated by the following aspects:

a) Electrotechnology Literacy Diagnostic Test encompassing:

- Reading Comprehension
- Spelling
- Sentence Construction (Syntax)
- Grammar

b) Recommendation of Remedial Action

- Action plan for remedial action
- Other support agencies
- Failure to follow action plan

c) Communicating with suppliers and clients

2.8.15.1 Applied mathematical concepts

Evidence shall show an understanding of applied mathematical concepts to an extent indicated by the following aspects:

a) Mathematical linear measurement in engineering situations encompassing:

- Precision and error in mathematical computations and
- Displaying mathematical outcomes in the correct format using the appropriate significant figures and in scientific notation
- Perimeters of plane figures, polygons and the perimeter of shapes involving arcs
- Pythagoras' theorem to engineering situations

b) Mathematical spatial measurement in engineering situations encompassing:

- Areas of combined shapes
- Volume and surface areas of solids

c) Right triangle trigonometry in engineering problem solving encompassing:

- Problems using the six trigonometrical ratios

- Problems involving compass bearings and angles of elevation/depression
 - Trigonometrical concepts in problems involving inclined planes, vectors and forces and electrical sinusoidal waveforms
- d) Sine and cosine rules in practical applications encompassing:
- Sine rule to solve unknown dimensions/angles in triangles
 - Cosine rule to solve unknown dimensions/angles in triangles
- e) Mathematical concepts in basic surveying and computation of areas encompassing:
- Mathematical concepts for radial and triangulation surveys
 - Simpson's Rule in engineering applications
- f) Basic algebra in engineering calculations encompassing:
- Basic operations involving substitutions, additions, removal of brackets, multiplication and divisions
 - Solving linear equations
 - Transportation in non-linear equations
- g) Linear graphical techniques in engineering problem solving encompassing:
- Graphing linear functions
 - Deriving equations from graphs and tables
 - Solving simulations equations algebraically and graphically
 - The *best line of fit* graphically and determine equation
- h) Mathematical computations involving polynomials encompassing:
- Adding, subtracting and multiplying polynomials
 - Factorising trinomials
 - Solving quadratic equation
- i) Mathematical computations involving quadratic graphs encompassing:
- Graphs of quadratic functions
 - Maxima and minima
 - Graphical solutions of quadratic equations
 - Properties of a parabola
 - Applications of parabolas in engineering applications
- j) Trigonometry and graphical techniques in engineering outcomes encompassing:
- Graphs of trigonometric functions e.g.: $V = V_m \sin \theta$, $I = I_m \cos \theta$
 - Addition of equations such as: $v \sin \theta + u \sin(\theta + \phi)$ graphically
 - Simpson's Rule to determine the average and root mean square values of a sinusoidal waveform
- k) Statistical data presentation encompassing:
- Appropriate presentation of frequency tables, histograms, polygons, stem

and leaf plots

- Advantages of different visual presentations

l) Appropriate sampling techniques for gathering data encompassing:

- Design of surveys and census
- Sample data using correct technique

m) Use of the measures of central tendency encompassing:

- Estimation of percentiles and deciles from cumulative frequency polygons (ogives)
- Interpreting data from tables and graphs including interpolation and extrapolation
- Analysing misleading graphs

n) Measures of dispersion in statistical presentations encompassing:

- Box-and-whisker graphs
- Measures of dispersion using variance and standard deviation
- Standardised scores including Z-scores

o) Correlation and regression techniques encompassing:

- Interpreting scatter plots
- Correlation coefficients
- Calculate the regression equation and use for prediction purposes

p) Elementary probability theory encompassing:

- Probabilities in everyday situations
- Counting techniques: factorials; permutations; combinations

q) Pascal's Triangle and the Normal Curve encompassing:

- Pascal's triangle
- Characteristics of the normal curve
- Standard Deviation and applications to everyday occurrences
- Probabilities using the normal curve

2.8.15.2 Applied physics concepts

Evidence shall show an understanding of applied physics concepts to an extent indicated by the following aspects:

a) Motion in two dimensions encompassing:

- vertical and horizontal components of velocity
- determination of the vertical component of velocity
- resolution of velocity into components
- time of flight, range, effect of air resistance

- centripetal acceleration, force causing the centripetal acceleration
- Newton's law of universal gravitation
- satellites in circular orbits
- Momentum in two dimensions

Note:

Examples are: vector form of Newton's second law of motion, Newton's second law of motion in terms of momentum, law of conservation of momentum

b) Electricity and magnetism encompassing:

- Electric fields

Note:

Examples are: Coulomb's law, principle of superposition, electric field, pictorial representation of electric fields, superposition of electric fields, electric field due to one or two charged plates, electric fields and conductors, electric field inside a hollow conductor, electric fields near sharp points

- The motion of charges particles in electric fields

Note:

Examples are: electric, potential difference, acceleration in a constant electric field, motion of a charged particle in a constant electric field

- Magnetic fields

Note:

Examples are: magnetic fields and their pictorial representation, magnetic force on a current-carrying conductor

- The motion of charges particles in magnetic fields

Note:

Examples are: force on a charged particle in a magnetic field, motion of a charged particle at right angles to a magnetic field

c) Light and matter

- Electromagnetic waves

Note:

Examples are: characteristics of electromagnetic waves, speed, frequency and wavelength

- The interference of light

Note:

Examples are: coherent wave sources, interference, two-source interference, diffraction, two-slit interference, transmission diffraction gratings, speckle

- Photons

Note:

Examples are: photons, the photoelectric effect, x-rays

- Wave behaviour of particles
-

Note:

Examples are: wave behaviour of particles, experimental evidence for wave behaviour of particles

d) Atoms and nuclei

- The structure of the atom
-

Note:

Examples are: line emission spectrum, energy levels in atoms, spectrum of atomic hydrogen, ionization energy, continuous spectrum, line absorption spectrum, fluorescence, stimulated emission

- The structure of the nucleus
-

Note:

Examples are: composition of nuclei, the nucleon force, isotopes, mass defect and binding energy, conservation laws in nuclear reactions

- Radioactivity
-

Note:

Examples are: stable and unstable nuclei, types of decay of unstable nuclei, alpha decay, beta minus decay, beta plus decay, half-life and activity

- Nuclear fission and fusion
-

Note:

Examples are: spontaneous and induced nuclear fission, chain reaction

e) Skills

- Experimental skills
-

Note:

Examples are: purpose and variables, procedure, observation, presentation, interpretation

- Investigation design skills
-

Note:

Examples are: designing and investigation, evaluating and investigation

- Information skills
-

Note:

Examples are: planning an information search, searching for information, evaluating information

- Communication skills
-

Note:

Examples are: oral communication, written communication, evaluation of oral and written communications

2.8.15.3 Fault current calculations

Evidence shall show an understanding of calculating fault current to an extent indicated by the following aspects:

- a) The Calculation of Fault Currents
- b) The calculation/determination of positive, negative and zero sequence impedances.
- c) Determination of fault current breaking and let-through energy capacities of protection devices.
- d) The influence of fault/arc impedances.
- e) Impedances operative for phase-to-phase and phase-to-earth faults.
- f) Calculation of fault currents for phase-to-phase and phase-to-earth faults.
- g) Approximation calculations by selecting the components with the major impedance.

2.2.09 Electronic principles and applications

2.9 Electronic principles and applications

2.9.1.1 Electronic component basics

Evidence shall show an understanding of the electronic components to an extent indicated by the following aspects:

- a) Types of components

Note.

Examples of types are resistors, inductors, capacitors, diodes, transistor, integrated circuits, printed circuit boards, sub-assemblies, and mounting/enclosing, connection and termination hardware.

- b) The physical features and primary characteristic of components.

Note.

- 1. Features include shape, size and connections
 - 2. Characteristics include parameter and power ratings and polarity.
-

- c) Methods of identifying and marking of component ratings.

d) Identifying and handling static sensitive components.

2.9.1.2 Electronic component parameters and selection methods

Evidence shall show an understanding of selecting electronic component to an extent indicated by the following aspects:

- a) Circuit/apparatus parameters and specification
- b) Component specifications and their implication in a given circuit.
- c) Sources of components and technical data.

2.9.1.3 Single phase rectifiers

Evidence shall show an understanding of single phase rectifiers to an extent indicated by the following aspects:

- a) Features and characteristic of rectifiers under load and no-load characteristics with and without capacitor filter.

Note:

Example include circuit configuration, filters, input and output wave forms, relationship between input and output voltages and ripple frequency and output voltage under load conditions

- b) Faults in single phase rectifiers
- c) Typical applications of single phase rectifiers

2.9.1.4.1 Frequency dependent circuit principles

Evidence shall show an understanding of frequency dependent circuit principles to an extent indicated by the following aspects:

- a) Sinusoidal alternating voltage and current encompassing:
 - How a sinusoidal voltage is generated in a single turn coil rotated in a uniform magnetic field
 - Definition of the terms 'period', 'maximum value', 'peak-to-peak value', 'instantaneous value', 'average value', and 'root-mean-square value' in relation to a sinusoidal waveform
 - Instantaneous value of induced voltage of a generated sinusoidal waveform
 - Root-mean-square value and frequency of a sinusoidal waveform from values of peak voltage and period
 - Phase relationship between two or more sinusoidal waveforms from a given

diagram of measurements

- Sketches and names of common waveforms used in electronic circuitry

b) Test equipment encompassing:

- Operating principles of a CRO including block diagram of functional areas
- Set up, calibration and use of an oscilloscope to measure d.c. and a.c. voltages and frequency
- Measurement of the instantaneous, peak, peak-to-peak values and the period of sinusoidal and other common waveforms provided by a single generator
- Calibration and limitation of CRO probes
- Use of signal generator as a voltage source
- Analogue and digital a.c. measuring instruments including true root-mean-square reading instruments

c) Phase relationships in a.c. circuits encompassing:

- Phasor representation of graphical waveforms
- 'in-phase', 'out-phase', 'phase angle', 'lead' and 'lag'
- Convention for representing voltage, current and the reference quantity in a phasor diagram
- Show the relationship between two or more a.c. values of voltage and/or current

Note:

Examples that may be used include phasor diagrams

d) Single-source resistive a.c. circuits of various frequencies encompassing:

- Single source a.c. circuit and taking resistance, voltage and current measurements
- Voltage, current, resistances or power dissipated from measured or given values of any two of these quantities
- Relationship between voltage drops and current in resistance a.c. circuit

e) Inductance in a.c. circuits encompassing:

- Principles of inductance
- Units by which inductance is measured
- How a series d.c. circuit containing resistance and inductance behaves
- Factors that determine inductance
- 'Inductive reactance'
- Inductive reactance of a given inductor and show the relationship between inductive reactance and frequency
- Applying Ohm's Law to determine voltage, current or inductive reactance in a purely inductive a.c. circuit given in any two of these quantities
- Examples of inductive components in circuits and systems and describe their effect on the phase relationship between voltage and current

- Comparison of the current limiting characteristics of inductors and resistors

f) Capacitance in a.c. circuits encompassing:

- ‘capacitive reactance’
- capacitive reactance of a given capacitor and the relationship between capacitive reactance and frequency
- series and parallel circuit rules to determine the equivalent capacitive reactance in an a.c. circuit or any part of a circuit
- applying Ohm’s law to determine voltage, current or capacitive reactance in a purely capacitive a.c. circuit given any two of these quantities
- examples of capacitive components in electronic circuits and systems and describe their effect on the phase relationship between voltage and current

g) Impedance in a.c. circuits encompassing:

- Definition of ‘impedance’
- Impedance of series, parallel and series-parallel circuits and draw diagrams showing the relationship between resistive, inductive and capacitive components (impedance triangle)
- Single-source a.c. circuit with resistance, voltage and current measurements
- Determination of the voltage, current or impedance from measured or given values of any two of these quantities
- Using phasor diagrams to solve problems and show the relationship between voltages and currents in a.c. circuits
- True, apparent, reactive power and power factor

h) Ideal transformer encompassing:

- Step-up, step-down, turns ratios, voltage and current ratios
- Construction and operating principles
- Double wound and autotransformer types, multi-tap types
- Types of cores, applications
- VA rating

2.9.1.4.2 Filters and resonance

Evidence shall show an understanding of filters and resonance to an extent indicated by the following aspects:

a) Resonance encompassing:

- Conditions in a circuit that produce resonance
- Relationship between resonance and frequency
- Effect on the current of series resonance and parallel resonance conditions
- The ‘Q’ of a coil and its relevance
- Bandwidth and half power points in a resonant circuit

- ‘Selectivity’

b) Filters encompassing:

- Circuits for operation of the following filter circuits: high pass, low pass, band pass, band stop
- Operation and frequency response of the above circuit types
- Bandwidth, attenuation, roll off, order of filter
- Measurements and calculations relating to filters

c) Curves showing the behaviour of various types of filter circuits

2.9.1.5 Basic electronic principles

Evidence shall show an understanding of basic electronic principles to an extent indicated by the following aspects:

a) Fundamental concepts

- insulators and conductors
- basic electrical units and engineering prefixes
- voltage, current and resistance
- Ohm’s Law
- electrical power
- digital and analogue multimeters

b) Alternating Currents and Waveforms

- waveforms (sine and square wave)
- the AC mains supply
- electrical safety
- fuses
- lamps and indicators

c) Electromagnetic Waves and Signals

- electromagnetic waves
- the Radio Frequency spectrum
- wave propagation
- signals and bandwidth
- transmission lines and antennas
- harmonics

d) Capacitance and inductance

- inductors and capacitors

e) Electromagnetic Interference

- electrical noise

- induced currents and voltages
- cross-talk
- electromagnetic Interference

f) Batteries

- types of battery
- battery capacity
- care of batteries

g) Techniques in the use of analogue and digital multimeters

Note:

Example is broad overview of electronics theory applicable to commonplace electronic and computer equipment servicing and support tasks, and includes general appreciation of the topics and concepts rather than rigorous theoretical calculations and designs

2.9.1.6 Basic digital principles

Evidence shall show an understanding of basic digital principles to an extent indicated by the following aspects:

a) Analogue versus digital

- digital waveforms

b) Number systems

- binary
- hexadecimal
- binary addition and subtraction
- number system conversions

c) Codes

- ASCII
- ANSI
- error detecting codes
 - - parity
 - - check sums
 - - CRC
- error correction

d) Basic logic

- AND, OR, NOT, XOR
- truth tables

e) Data manipulation

- clocks and data rates
- basic storage cell
- registers
- ripple counter (binary counting)
- shift register (serial to parallel conversion)
- multiplexer and de-multiplexer
- bus architecture
- - encoding / decoding
- - addressing methods

f) Analogue to digital conversion

g) Digital to analogue conversion

Note:

Examples include a broad overview of digital electronics theory applicable to everyday computer servicing and support tasks and encompasses topics and concepts and is not for in depth theoretical calculations and designs. Also there are no specific logic gates or logic levels involved.

2.9.2 Multiphase rectifiers

Evidence shall show an understanding of the characteristics and applications of multiphase phase half-wave and full-wave rectifiers to an extent indicated by the following aspects:

a) Features and characteristic of rectifiers under load and no-load characteristics with and without capacitor filter.

Note:

Example include circuit configuration, filters, input and output wave forms, relationship between input and output voltages and ripple frequency and output voltage under load conditions.

b) Faults in multiphase rectifiers

c) Typical applications of multiphase rectifiers

2.9.3.1 Voltage regulators

Evidence shall show an understanding of the characteristics and applications of linear and non-linear voltage regulators to an extent indicated by the following aspects:

a) The purpose of voltage regulation

b) The features and characteristics of series, shunt and three terminal regulators.

Note

Example of features and characteristics are circuit configuration, regulating action and over-current and voltage limiting methods.

c) The features and characteristics of switching regulators.

Note:

Example include regulator components, step-up, step-down, voltage-inverting and converting configurations, regulating action and forms of protection.

d) Faults in linear and non-linear regulators

e) Typical applications of voltage regulators

2.9.3.2 Inverters

Evidence shall show an understanding of the characteristics and applications of inverters to an extent indicated by the following aspects:

a) Features and characteristic of inverters under load and no-load characteristics.

Note:

Example include circuit configuration, input and output wave forms, relationship between input and output voltages and output voltage under load conditions.

b) Faults in inverters

c) Typical applications of inverters

2.9.3.3 Electronic switching

Evidence shall show an understanding of the characteristics and applications of electronic switching to an extent indicated by the following aspects:

a) Devices and used for electronic switching and their switching characteristic

b) Circuit configuration and switch-on, switch-off conditions

c) Faults in electronic switching devices/circuits

d) Typical applications of electronic switching

2.9.4.1 Digital electronic fundamentals

Evidence shall show an understanding of the characteristics and applications of the fundamentals of digital electronics to an extent indicated by the following aspects:

- a) Comparison of analogue and digital signals
- b) Conversion between hexadecimal, binary and decimal number systems
- c) Precautions when handling electronic devices due to electrostatic discharge
- d) Basic operation and characteristics of current logic devices.
Note: examples are: logic gates, mux's, counters, etc
- e) Techniques for the analysis of simple digital systems encompassing:
understanding of timing diagrams, prediction of the output state of logic devices for various input combinations, interfacing between logic families, etc
- f) Comparison of the operation and characteristics of current display devices
Note: examples are: LEDs, LCDs, etc.

Basic operation and characteristics of current A/D and D/A converters

2.9.4.2 Digital signal processing

Evidence shall show an understanding of the digital signal processing and applications to an extent indicated by the following aspects:

a) DSP applications encompassing:

- block diagram of a DSP system.
- DSP applications:

Note.

Examples are Audio-response equalization, Echo-cancelling on telephone lines, Tracking filters for radio communications, Loudspeaker testing, Voice compression and the like.

b) Way in which the sampling process changes the signal encompassing:

- Shannon's Sampling Theorem.
- quantisation noise introduced by A/D and D/A signal-conversion in a given DSP system.
- spectrum of a sampled signal.
- response required for the input anti-alias filter.
- response required for the output reconstruction filter, including $\sin(x)/x$ compensation.

c) Impulse response of a linear-phase filter encompassing:

- frequency-response (amplitude and phase) for low-pass (LP), bandpass (BP) or high-pass (HP) filter.
- impulse-response for LP, BP or HP filters
- approximate number of impulse-response coefficients needed in a Finite Impulse Response (FIR) filter

- unwindowed impulse-response for a linear-phase LP, BP or HP filter.
- von Hann ('Hanning') or Hamming window
- impulse-response coefficients for LP, BP and HP filters.

d) FIR filter encompassing:

- process of convolution.
- standard expression for discrete convolution.
- DSP system and convolution.
- DSP system to implement a FIR filter.

e) Adaptive filter encompassing:

- practical applications for adaptive filters.
- number of taps needed on an adaptive filter for a given application.
- DSP system and implementation of adaptive filter.

f) Architecture of a specific DSP chip encompassing:

- features of the DSP chip that contributes to a high processing speed.
- function of all registers in the DSP chip.
- circuit diagrams showing how the DSP chip is interfaced to EPROM, RAM, an A/D converter and a D/A converter.
- chip synchronises and signal-sampling.
- execution time for processing for FIR filter.

g) Modifying assembly code programming for DSPs

i) Input and output analog filters encompassing:

- input anti-alias filter using standard switched-capacitor filters.
- output reconstruction filter using standard switched-capacitor filter.
- circuit diagram showing how the filters interface to the DSP system.
- j) Simple IIR filters
- k) High order IIR filters

2.9.4.3 Digital signal processing development

Evidence shall show an understanding of the digital signal processing development technologies to an extent indicated by the following aspects:

a) Infinite Impulse Response (IIR) filter encompassing:

- pole-zero placement method to obtain coefficients for a simple first-order and second-order low-pass and band-pass IIR filter.
- direct-form realisation of a simple IIR filter suitable for $\sin(x)/x$ compensation.
- DSP system

b) High-order IIR filter encompassing:

- filter design package to obtain the coefficients for a high-order IIR filter
- high-order IIR filter would be realised using a cascade or a parallel combination of first-order or second-order IIR filter blocks.
- effect of coefficient quantisation errors and calculation rounding-off errors on filter performance.
- IIR filters and symmetrical FIR filters

c) Discrete Fourier Transform (DFT) to a signal encompassing:

- discrete correlation.
- signal-detection.
- correlation used to generate DFT.
- window-function when generating the DFT.

d) Concept of complex signals encompassing:

- positive-frequency and a negative frequency signal.
- exponential and polar form of sinusoidal signal and a complex sinusoidal signal.
- spectra of a general signal having equal real and imaginary components. (An "analytic" or "quadrature" signal).
- analytic signals simplification filtering operations

e) Fast Fourier Transform (FFT) encompassing:

- Decimation in Time FFT, and the "twiddle factor".
- sample-frequency and number of signal samples needed for a FFT.
- FFT routine.

f) FIR filtering using FFT encompassing:

- overlap, save method of implementing a long FIR filter using the FFT and the inverse FFT.
- limitations on the stored frequency-response coefficients and the resulting impulse-response.

g) Data-rate conversion encompassing:

- data-rate conversion (decimation) simplification of the anti-alias filter requirement
- data-rate conversion (interpolation) of the DSP system simplification the reconstruction-filter requirement and reduces the need for $\sin(x)/x$ compensation.

h) Modulation and de-modulation techniques encompassing:

- Spectra where real signals and analytic (quadrature) signals are modulated by a sinusoidal function.
- amplitude-modulated signal
- single-sideband signal

- i) Digital processing steps in practical DSP applications
- j) Currently available DSP support chips

2.9.4.4 Digital applications

Evidence shall show an understanding of the digital applications to an extent indicated by the following aspects:

- Design techniques encompassing: equation writing, reduction, propagation delay calculation used in the design of complex combinatorial logic circuits (as a minimum a three levels, four input circuit).
- The design of complex sequential logic circuits (as a minimum a three levels sequential circuit) using current techniques.
Note: examples are equation writing, reduction, propagation delay calculation, etc.
- Selection of current types of oscillators based on their characteristics and operation.
- Selection of current memory and storage devices based on their characteristics and operation.
Note: examples are: flash, I2C, etc
- Selection of an A to D and/or D to A converter for use in a digital application based on their characteristics and operation.

2.9.5.1 Micro programming fundamentals

Evidence shall show an understanding of the characteristics and applications of microcontrollers/microprocessors to an extent indicated by the following aspects:

- a) Memory organisation, operation and addressing methods
- b) Programmer's model encompassing:
 - register structure
 - instruction register/decoder
 - arithmetic logic unit (ALU)
 - accumulator and flags
 - instruction cycle timing
 - control lines
 - stack pointer
 - index register
- c) System clock circuits fetch and execute encompassing:
 - timing cycle

- timing relationship to system clock
 - logic levels of system buses for each clock period of an instruction cycle
- d) Input/output port programming
- e) Structured assembly programming
-

2.9.5.2 Microcontroller fundamentals

Evidence shall show an understanding of microcontroller fundamentals to an extent indicated by the following aspects:

- a) Microcontroller architecture
- b) Program storage types
- c) Data storage types
- d) I/O Ports: analogue/ digital
- e) Integrated Peripherals: timers, interrupts etc
- f) Control circuitry: system clock, reset etc
- g) Industry standard programming environment

2.9.6 Operational amplifiers

Evidence shall show an understanding of the fundamental principles of amplifiers characteristics and the applications of operational amplifiers to an extent indicated by the following aspects:

- a) The purpose and application of amplifiers
- b) The basic characteristics of small signal amplifiers.

Note:

Features and characteristics include input and output impedance, current and voltage gain and bandwidth

-
- c) Various operational amplifier circuit configurations and where they are used.
 - d) Measures and calculated values of gain and output voltage for various operational amplifier configurations

Note:

Circuit configurations include inverting, non-inverting, voltage follower, summing, comparators and Schmitt trigger differential configurations

2.9.7.1 Single phase power control

Evidence shall show an understanding of the characteristics and applications of single phase power control to an extent indicated by the following aspects:

a) Types of electronic devices, their operating principles and characteristics

Note.

Examples are SCRs, Triacs power transistors and the like.

b) Applications, circuit configuration and operating parameters

Note.

Examples of applications are applications solid state switches, lighting dimmers, single phase motor speed and efficiency control and the like.

c) Typical faults, their symptoms and cause.

d) Testing procedures and test points

2.9.7.2 Polyphase power control

Evidence shall show an understanding of the characteristics and applications of single phase power control to an extent indicated by the following aspects:

a) Applications, circuit configuration and operating parameters

Note.

Examples of applications are applications polyphase rectifiers, inverters, voltage and frequency control polyphase phase motor speed and efficiency control and the like.

b) Typical faults, their symptoms and cause.

c) Testing procedures and test points

2.9.8 Amplifier fundamentals

Evidence shall show an understanding of amplifier fundamentals to an extent indicated by the following aspects:

a) The purpose and application of amplifiers

b) The basic characteristics of small signal amplifiers.

Note:

Features and characteristics include input and output impedance, current and voltage gain and bandwidth

- c) Various operational amplifier circuit configurations and where they are used.
- d) Measures and calculated values of gain and output voltage for various operational amplifier configurations
- Note:
Circuit configurations include inverting, non-inverting, voltage follower, summing, comparators and Schmitt trigger differential configurations

2.9.9.1 Single-stage amplifiers

Evidence shall show an understanding of advanced amplifiers to an extent indicated by the following aspects:

- a) Determination of d.c. bias conditions for a single-stage amplifier
- b) Determine the small signal terminal characteristics of single-stage amplifiers
- c) Effects of coupling and by-pass capacitors in single-stage amplifiers

2.9.9.2 Amplifier applications

Evidence shall show an understanding of amplifier applications to an extent indicated by the following aspects:

- a) Operation of multistage amplifiers
- b) Effects of component values and frequency response
- c) Identification of components which comprise the negative feedback loop in multistage amplifiers
- d) Effect of negative feedback on amplifier parameters
- e) Predictable effects on the output voltage when amplifiers are subjected to control signal overdrive, bias faults and amplifying device faults

2.9.9.3 Microwave amplifiers

Evidence shall show an understanding of microwave amplifiers to an extent indicated by the following aspects:

- a) Applications and operational constraints
- b) Operating principles and parameters
- c) Amplifier components and circuit configuration
- d) Amplifier faults, symptoms and causes

2.9.10 Reserved

2.9.11 Linear and switch mode power supplies

Evidence shall show an understanding of linear and switched mode power supplies to an extent indicated by the following aspects:

- a) Operation and characteristics of switched mode power supplies
- b) Isolation requirements and circuitry
- c) Operation of step-down and step-up regulators
- d) DC to DC converters
- e) Operation of variable frequency and pulse width modulated regulation techniques
- f) Radiation suppression circuitry
- g) Diagnostic procedures to isolate faults

2.9.12 Electronic fault finding

Evidence shall show an understanding of electronic fault finding techniques to an extent indicated by the following aspects:

- a) Factors to consider in clarifying the nature of a fault encompassing:
 - Initial fault report
 - Confirmation of symptoms of the fault
 - Comparison of symptoms with normal operation
- b) Effect to cause reasoning — assumptions of possible causes
- c) Methods for testing assumptions encompassing:
 - Visual inspection
 - Sectional testing
 - Split-half tests
 - Component isolation
- d) Dealing with intermittent faults

Note:

Typical causes of intermittent faults are vibration, shock, changes in temperature

and electromagnetic interference.

2.9.13 Measurement circuits and applications

Evidence shall show an understanding of measurement circuits and applications to an extent indicated by the following aspects:

- a) Principles of measurement
- b) Circuit components and configurations
- c) Applications of measurement circuits

2.9.14 Fundamentals of calibration

Evidence shall show an understanding of fundamentals of calibration to an extent indicated by the following aspects:

- a) Calibration processes
- b) Need for calibration
- c) Metrology standards
- d) Traceability
- e) Electrical measuring instruments and devices
- f) High order frequency references
- g) Counters
- h) Signal and function generators

2.9.15 Audio and video component functional controls

Evidence shall show an understanding of the functional controls of audio and video components to an extent indicated by the following aspects:

- a) Types of components and their functional controls
- b) Function set up procedures
- c) Testing

2.9.16.1 Sound reproduction fundamentals

Evidence shall show an understanding of sound reproduction fundamentals to an

extent indicated by the following aspects:

- a) Sound wave propagation
- b) Timbre of sound
- c) Effects of other medium of sound waves
- d) Characteristics of the human ear
- e) Difference between mono and stereo
- f) Surround sound principles

2.9.16.2 Acoustics, spatial treatment and sound reproduction

Evidence shall show an understanding of acoustics, spatial treatment and sound reproduction to an extent indicated by the following aspects:

- a) Effects of room dimensions, spatial shape and surface textures on acoustics
- b) Ideal acoustic for specific purposes

Note.

Examples of specific purposes are speech, solo or small group music, rock music orchestral music, choral music, cinema and the like.

- c) Measuring room response
- d) Speaker placement and room response
- e) Room treatment methods to improve acoustic response
- f) Active methods to improve acoustic response

2.9.17.1 Audio reproduction, electronic components

Evidence shall show an understanding of electronic components for sound reproduction to an extent indicated by the following aspects:

- a) Preamplifiers amplifier encompassing:
 - Function in the reproduction chain
 - Typical circuit arrangements
- b) Power and integrated amplifiers encompassing:
 - Function in the reproduction chain
 - Typical circuit arrangements
- c) Graphic equalizers encompassing:
 - Function in the reproduction chain

- Typical circuit arrangements

d) Component interconnections

2.9.17.2 Audio component repair basics

Evidence shall show an understanding of the basics of audio component repair to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Common faults, their symptoms and cause.
- c) Fault location procedures and testing points
- d) Device adjustments

Note.

Examples of audio components are preamplifiers amplifier, power and integrated amplifiers, graphic equalizers and the like.

2.9.18 Audio reproduction, speaker fundamentals

Evidence shall show an understanding of speaker fundamentals to an extent indicated by the following aspects:

- a) Types of speaker drives and their operating mechanism
- b) Speaker cabinet characteristics
- c) Purpose and circuit arrangement of typical cross-over networks
- d) Speaker connections

2.9.19 Audio/video recording and replay components repair basics

Evidence shall show an understanding of basic repairs to electronic components for audio/video recording and replay to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Common faults, their symptoms and cause.
- c) Fault location procedures and testing points
- d) Device adjustments

Note.

Examples of audio/video recording and replay components are audio cassette player/recorders, compact disk players, video cassette player/recorder, digital

versatile disk and super audio compact players.

2.9.20 Business equipment operational functions

Evidence shall show an understanding of business equipment electronic components to an extent indicated by the following aspects:

- a) Type of business machines and their application.
- b) Default and user choice functions.
- c) Setting up procedures.

2.9.21 Business equipment components

Evidence shall show an understanding of business equipment electronic components to an extent indicated by the following aspects:

- a) Operating principles of components encompassing:
 - Stepper and pulse motors
 - Relays and Solenoids
 - Clutches

Note.

Examples are magnetic, spring, tight and loose slip, friction, one way spring and torque – limited clutch

- Tacho sensors
 - Chains and gearing
 - Pulleys and belt drives
 - Vacuum feeds
 - Feed rollers
 - Separation pads
- b) Equipment maintenance encompassing:
 - Anti static brushes
 - Conductive/non conductive greases
 - Correct use of oil
 - c) Transducers types and application encompassing:
 - Linear position and velocity
 - Angular position measurement
 - Angular velocity measurement
 - Temperature sensors

- Humidity sensors
- Current sensors
- Piezo sensors

d) Temperature sensors and applications encompassing:

- Thermocouples
- Resistance temperature detectors (RTD)
- Thermistors
- Bimetal temperature sensors

e) Optoelectronics devices and applications encompassing:

- Photoresistors
- Photodiodes
- Phototransistors
- LASCR
- Photovoltaic devices
- Optocouplers
- Laser

f) Operation of input accessories encompassing:

- paper trays
- high capacity bins
- document feeders
- duplex unit
- manual bypass
- coin boxes
- card readers
- raster image processing unit
- Toners and cartridges

g) Operation of output accessories encompassing:

- sorters
- staplers
- collators
- folders
- stackers

2.9.22 Gaming machine systems and equipment overview

Evidence shall show an understanding of gaming machine systems and equipment to an extent indicated by the following aspects:

- a) Gaming industry terminology
- b) Functions and specifications of the machine and its components
- c) Types of gaming machines
- d) Operational features of different machines and systems

2.9.23.1 Gaming machine equipment adjustment and maintenance

Evidence shall show an understanding of gaming equipment adjustment and maintenance to an extent indicated by the following aspects:

- a) Machine access and security encompassing:
 - master reset procedures,
 - opening and closing doors,
 - period reset procedures,
 - use of audit and reset key
- b) Adjustments and clearances encompassing:
 - Coin/note jams
 - Hopper to coin chute
 - Screens
 - Touch screen calibration
- c) Removals, installs and checks encompassing:
 - Bank note acceptors,
 - Card readers
 - Coin comparators,
 - Divertor
 - Drop doors
 - Hopper
 - Lighting
 - Machine positioning and mounting
 - Printer paper roll feeding
 - Switches
- d) Attendant screens and functions

2.9.23.2 Gaming machine fault finding

Evidence shall show an understanding of finding faults in gaming machines to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Common faults, their symptoms and cause.
- c) Fault location procedures and testing points
- d) Device adjustments

2.9.24 Cathode ray tube displays

Evidence shall show an understanding of cathode ray tube displays to an extent indicated by the following aspects:

- a) Operation and characteristics of various types of cathode-ray tubes including delta, in-line and precision in-line
- b) Voltages, statics and x-rays around CRTs
- c) Set up and adjustment techniques
- d) Rear and front projection TV systems
- e) Typical faults

2.9.25 Plasma displays

Evidence shall show an understanding of plasma displays and their circuit control operation to an extent indicated by the following aspects:

- a) Advantages of flat panel displays (over conventional CRT's, Raster geometry etc)
- b) Theory of plasma gas discharge and phosphor excitation
- c) Scanning techniques (column/row addressing
- d) Luminance/colour aspects (the need to re-address pixels to control light output
- e) Gamma correction considerations. (reversal of the gamma correction that is carried out at the TV studio to compensate for the non-linearity of light output of a conventional CRT)
- f) Plasma flat panel construction (and handling)

2.9.26.1 Liquid crystal displays

Evidence shall show an understanding of liquid crystal displays and the control circuit operation to an extent indicated by the following aspects:

- a) Principles of transmissive LCD displays (as opposed to reflective types)

- b) Light polarisation. (polarisation twisting characteristics of liquid crystal and the need for polarisation filters in display panel)
- c) Voltage/current requirements and need for electric field
- d) Fluorescent back light (need for high frequency operation and power requirements)
- e) Scanning techniques (colour/row addressing and thin film transistors)
- f) Light attenuation (caused by the many layers/filters the back light has to pass through)
- g) Construction and handling

2.9.26.2 Display circuit diagnostics

Evidence shall show an understanding of display circuit diagnostics to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Factors effecting system performance
- c) Typical faults, their symptoms and cause.
- d) Fault diagnosis procedures and testing
- e) Sub-system adjustments

2.9.27 Digital versatile disc (DVD) and compact disc (CD)

Evidence shall show an understanding of DVDs and CDs to an extent indicated by the following aspects:

- a) Operational principles and standards of digital signal processing
- b) Standards and features of DVDs and CDs
- c) Operation and adjustment of DVDs and CDs, as well as
 - Transport mechanisms
 - Laser alignment/tracking
 - Servo system description, operation and adjustment of servo loops
 - System control of player
 - On screen display including service mode set-up on adjustment

2.9.28 Hand held remote control units

Evidence shall show an understanding of hand held remote control units to an

extent indicated by the following aspects:

- a) Remote control requirements, specifications, multiple systems, code formats, bit sync, system address, commands, timing (clock accuracy), modulation system, infrared system, transmission errors, methods used to reduce battery power, key scanning and displays
- b) Data monitoring points, timing and amplitude specifications, triggering of serial data, data/graticule alignment, identify and decode start bits, system address bits, command bits, stop bits, load and other bits
- c) Remote control measurements, battery voltage range, battery stand-by current, battery transmit current. DC voltage and waveforms on IC pins. Frequencies
- d) System controller requirements including remote, local, main housekeeping.
- e) Methods of inter-chip data communications

2.9.29 Television scanning and deflection

Evidence shall show an understanding of television scanning and deflection to an extent indicated by the following aspects:

- a) Operation of a synchronised separator, synchronised horizontal oscillator and drive stages, horizontal transistor output stage
- b) Operation of and repair to vertical deflection circuitry
- c) Operation of Raster correction circuits

2.9.30 Television chrominance and luminance

Evidence shall show an understanding of television chrominance and luminance to an extent indicated by the following aspects:

- a) Chrominance and luminance signal processing at the transmitter
- b) Luminance signal process in the receiver including video buffer, traps and filters, video amplifiers, video output stages, brightness and contrast circuits
- c) Chrominance signal processing in the receiver including, chroma decoder, sub-carrier regeneration, chroma signal processing, final matrix output.

2.9.31.1 Television and video reception

Evidence shall show an understanding of television reception signals and decoding to an extent indicated by the following aspects:

- a) Broadcast systems
- b) Basic operation of a TV cameras
- c) Basic operation of a TV receiver including tubes and displays and operating components
- d) Reception aerials and arrays
- e) Operation of a video cassette recorder including tape recording, helical scanning, mechanical principles and adjustments, electronic principles and adjustments, servo control loops

2.9.31.2 Power supplies for TVs and VCRs

Evidence shall show an understanding of power supplies for TV and VCR to an extent indicated by the following aspects:

- a) components providing RFI suppression protection, rectification and filtering in a typical TV power supply.
- b) safe working procedures to test the power supply circuitry of a typical "hot chassis" television receiver.
- c) The operation of series regulated power supplies as used in typical TV receiver/monitors and VCRs.
- d) Subsystem arrangements and the operating principles of series and shunt type TV/VCR SMPS.
- e) The operation of the SMPS control circuits in a TV/VCR.
- f) The operation of typical self-oscillating TV/VCR SMPS circuits.
- g) Techniques for locating and repairing faults in a defective SMPS in a typical TV/monitor or VCR.

2.9.31.3 Television RF stages

Evidence shall show an understanding of television RF stages to an extent indicated by the following aspects:

- a) The operation of tuners found in typical TV receivers.
- b) Techniques for locating and repairing faulty components in VST and FST tuning systems in typical TV receivers or VCRs.
- c) Techniques for locating and repairing faults in typical vision IF circuits.
- d) The operation of and fault find a typical TV synchronous demodulator circuit.
- e) AGC circuits in typical TV receivers encompassing:

- Operation
- Fault finding techniques.

2.9.32.1 Camcorders and digital cameras

Evidence shall show an understanding of camcorders and digital cameras to an extent indicated by the following aspects:

- a) Operation of camera circuits
- b) Recording media, standards and formats
- c) Pick up tubes and charge coupled devices
- d) Operation of optical transducers, lenses
- e) Colour separation techniques and signal processing
- f) Charge coupled devices
- g) Mechanics and adjustments
- h) Power supplies and batteries
- i) MPEG capability

2.9.32.2 Camera circuits diagnostics

Evidence shall show an understanding of camera circuit diagnosis to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Environment factors effecting system performance
- c) Typical faults, their symptoms and cause.
- d) Fault diagnosis procedures and testing
- e) Sub-system adjustments

2.9.33 Video cassette recorder

Evidence shall show an understanding of video cassette recorders to an extent indicated by the following aspects:

- a) Operation and practical application of chrominance processing principles
- b) System control sections, typical analogue and digital servo systems
- c) Circuit operation involving high fidelity, tracking, picture storage, still pictures

d) Locate faults in the following sections: mechanical, luminance, chroma, servo control, system control, timer and display control, sound, RF and power supply

2.9.34.1 Digital television receivers

Evidence shall show an understanding of digital television receivers to an extent indicated by the following aspects:

a) Integrated Receiver Decoder IRD (The Set Top Box) encompassing:

- sub-system components (i.e. functional blocks) and their operating parameters
- Basic diagnostic tests

b) Channel decoders encompassing:

- Method used to determining the analogue to digital converter (ADC) sampling rate.
- Function of the Forward Error Correction (FEC) unit and Reed Solomon (RS) and Viterbi plus interleaving.
- Purpose of the OFDM modulator.
- Principle of operation of an OFDM demodulator and hierarchical (de) modulation.
- Principles of operation of a QPSK demodulator.
- Perform measurements and diagnostic test points in a typical IRD channel decoder.

c) Conditional access encompassing:

- Purpose of a conditional access module (CAM).
- Access descrambler unit sub-system components (i.e. functional blocks) and their operating parameters
- Function of the component parts of conditional access descrambler unit.
- Purpose of a conditional access module 'smart card'.
- Single chip set top box sub-system components (i.e. functional blocks) and their operating parameters

d) Repair and maintenance of digital television signal decoding circuitry. encompassing:

- Correct operation of the transport stream processor with reference to typical input and output signal.
- Testing techniques to determine correct operation of the video decoder, audio decoder and PAL encoder
- Testing techniques to determine identify faulty data streams.
- Pin connections of a SCART socket.
- Operation of a typical UHF modulator.

- List precautions to be observed when performing tests on functional and non-functional units.
- Identify and replace faulty components in malfunctioning units.
- Perform functional testing after repair.

2.9.34.2 Digital television principles

Evidence shall show an understanding of digital television principles to an extent indicated by the following aspects:

a) Describe the basic techniques used to process an analogue signal for integration in a digital broadcasting system encompassing:

- Basic technique of sampling an analogue waveform and assigning quantisation levels to those samples for both video and audio.
- Calculation of the number of pixel's per line and the sampling rate for a range of typical DTV aspect ratios.
- Typical sampling rates for Standard Definition Digital Television (SDTV) and High Definition Digital Television (HDTV) broadcasts.
- Range of different sampling structures used to sample luminance and colour difference signals.
- Determination of the total bit rate required for a required sampling rate.
- Factors limiting digital television picture quality.
- Minimum MPEG video requirements for HDTV and SDTV.
- Factors that create the need for video data compression.

b) Describe the process used to prepare video data for integration encompassing:

- Major methods used to compress video data.
- How a complete picture frame is assembled from samples, blocks, macroblocks and slices.
- Meaning of the terms DCT coefficients, temporal frequency, and spatial frequency, temporal and spatial redundancy.
- Purpose of the Discrete Cosine Transfer (DCT) processor in the processing of video data compression.
- Relationship between spatial frequencies, DCT coefficients and quantisation levels in the DCT block.
- Compression techniques used to code quantised DCT coefficients.
- How Run Length Coding (RLC) is used to group DCT values into a series of values.
- How Variable Length Coding (VLC or Huffman coding) processes each DCT value according to probability.

c) Describe the role of the DCT coder encompassing:

- Sub-system components (i.e. functional blocks) and their operating

parameters of a DCT coder.

- Typical construction of a Group of Pictures (GOP).
- Individual frames in a GOP sequence that uses forward prediction and bi-directional prediction.
- Purpose of differential coding.
- Structure of a video Packetised Elementary Stream (PES).
- Types of information included in the PES.

2.9.34.3 Advanced digital television principles

Evidence shall show an understanding of advanced digital television principles to an extent indicated by the following aspects:

a) Audio component encompassing:

- Audio Encoding
- Audio Masking
- Audio sub band encoding

b) Dolby AC-3

c) MPEG-2 System Layer encompassing:

- PES Packet Construction
- Time Stamps
- Programme Clock Reference (PCR)
- Transport Packet Header
- Programme Specific Information (PSI)

d) Channel Encoding

- Forward Error Correction (FEC)
- Bit Error Rate (BER)
- Puncturing

e) Interleaving.

f) Modulation

- Phase Shift Keying (PSK)
- Quadrature Amplitude Modulation (QAM)
- Orthogonal Frequency Division Multiplexing (OFDM)
- Coded Orthogonal Frequency Division Multiplexing (COFDM)

g) Hierarchical Modulation.

- Terrestrial Channel Encoder
- Satellite Channel Encoder

- Carrier to Noise Ratio (C/N)

h) Single Frequency Networks

- Guard Interval
- Megaframes

2.9.35 Micro computer systems

Evidence shall show an understanding of micro computer systems to an extent indicated by the following aspects:

- a) Function of block diagrams related to programmable peripheral interface, programmable interval timer, universal asynchronous receiver transmitter, programmable interrupt controller, programmable memory access controller, bus controllers, floppy disk controller, cathode ray tube controller
- b) Function of pins on common micro processor peripheral ICs
- c) Software for initialisation
- d) Use of the operational mode
- e) Interfacing of IC peripherals

2.9.36 Fire detection and warning system and apparatus fundamentals

Evidence shall show an understanding of fire detection and warning systems to an extent indicated by the following aspects:

- a) Purpose of fire alarm and warning systems.
- b) Purpose and operating principles of fire detection and warning systems.
- c) Operating principles and characteristic of the various types of fire alarm detectors.
- d) Operating principles and characteristic of the various warning system components
- e) Effective and ineffective locations for fire detection devices and common causes of false alarms.
- f) Warning devices and their operating parameters
- g) Common operational requirements and types of control and indicating equipment.
- h) Common operation and types of field data gathering equipment
- i) Common operation and interface connections to other systems.
- j) Purpose and interface requirements to smoke hazard management system

2.9.37 Fire alarm routine testing

Evidence shall show an understanding of fire alarm and warning system routine testing to an extent indicated by the following aspects:

- a) Types and uses of test equipment
- b) Fire alarm and warning system components and their location
- c) Periodic testing requirements to meet manufacturer's and standards requirements

2.9.38 Tape recorders

Evidence shall show an understanding of tape recorders to an extent indicated by the following aspects:

- a) Processors involved with magnetic analogue tape recording
- b) Components and circuitry associated with tape transport, erasure and record bias, recording, play back and noise reduction
- c) Warn or faulty tape transport components and circuits
- d) Inspection of head condition using a microscope and the effects on the output caused by head-wear and oxide build-up

2.9.39 AM and FM tuners

Evidence shall show an understanding of AM and FM tuners to an extent indicated by the following aspects:

- a) Superheterodyne receivers
- b) Operational characteristics and techniques used in AM and FM receivers
- c) Frequency modulation, stereo encoding and de-coding used in commercial FM transmissions
- d) Amplitude modulation and de-modulation used in commercial AM transmissions
- e) RF signal requirements for AM tuners
- f) RF signal requirements for stereo FM tuners

2.9.40 Integrated audio systems

Evidence shall show an understanding of integrated audio systems to an extent

indicated by the following aspects:

- a) Types of audio control and switching devices
- b) Types of surround sound systems
- c) Operation of system control circuits, including the remote device

2.9.41.1 Security systems installation basics

Evidence shall show an understanding of security systems installation to an extent indicated by the following aspects:

a) Circuit arrangements encompassing:

- range of typical resistor values used in alarm systems
- reasons for End Line Resistor (ELR) systems in ELR circuits, balanced bridge circuits and the two resistor ELR
- wiring of a single EOL resistor to provide a sealed condition
- wiring of a detector with split EOL resistors to provide a sealed condition
- how zone doubling can be accomplished through the use of dual EOL resistors
- effects of open circuits and short circuits on alarm inputs

b) Construction and operating principles and application of mechanical detectors

Note.

Example are magnets, vibration (hammer type, ball & pin type), switches, pressure mats, trip wires, window tape, and the like

c) Construction and operating principles and application of electro-mechanical detectors

Note

Example are single twin type, beam fence, missing pulse system, glass break, smoke, ultra sonic, optical fibre, strain system, resistance circuit and the like

d) Operating requirements and application of passive infra-red detectors encompassing:

Note.

Examples are barrier lens, dual corridor lens, long range lens, and wide angle lens.

- Problems associated with PIR sensors
- Area of coverage and fields of a range of sensors

e) Relays encompassing:

- use of NC and NO relays
- show how a transistor "pulls down" current when used as a switch

- wiring diagram for a relay connected to an open collector output on an alarm panel
- typical uses for a relay type output

f) Control panels encompassing:

- features of commonly used panels
- operation of programmable and non-programmable panels
- sound sources used with security alarms
- power sources used with security systems
- panel to base communication systems
- Locks commonly used in the security industry

2.9.41.2 Security systems installation faults

Evidence shall show an understanding of security systems installation to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Factors effecting system performance
- c) Typical faults, their symptoms and cause.

Note.

Faults include circuit, hardware and software faults

- d) Fault diagnosis procedures and testing

Note.

Faults confined to circuit and hardware faults and basic programming faults

- e) System adjustments

2.9.42 Audio and video system set up

Evidence shall show an understanding of setting up audio and video systems to an extent indicated by the following aspects:

- a) Audio components in a system
- b) Video components in a system
- c) Component connection arrangements
- d) Set up options and procedures

2.9.43 Video systems installation

Evidence shall show an understanding of video systems installation to an extent indicated by the following aspects:

- a) Installation and set-up of digital TV reception equipment
- b) Installation and set-up of DVD machines
- c) Operating requirements of remote control units

2.9.44 Consumer video equipment

Evidence shall show an understanding of consumer video equipment to an extent indicated by the following aspects:

- a) Operation principle

Note.

Examples of video equipment are VCRs, DVDs, desktop boxes camcorders and hand held micro controllers

- b) Fault-finding to sub system (functional blocks) level

2.9.45.1 Audio electronics

Evidence shall show an understanding of audio electronics to an extent indicated by the following aspects:

- a) Interpretation of circuit diagrams of audio amplifiers
- b) Adjustment and testing of the power output stage of an amplifier
- c) Specifications and measurements associated with voltage and power amplifiers
- d) Connections and phasing of equipment
- e) System control circuits

2.9.45.2 Recording and replay apparatus diagnostics

Evidence shall show an understanding of diagnosing recording and replay apparatus to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Factors effecting system performance

- c) Typical faults, their symptoms and cause.
- d) Fault diagnosis procedures and testing
- e) Sub-system adjustments

2.9.46 Professional audio electronics

Evidence shall show an understanding of professional audio electronics to an extent indicated by the following aspects:

- a) Complex audio systems used for live sound or theatre application
- b) Connections and phasing of equipment
- c) Optimum signal levels for the acoustic environment
- d) Connection and adjustment of signal processing units
- e) Tuning, adjustment and diagnosis of systems

2.9.47 Loud speakers and microphones

Evidence shall show an understanding of loud speakers and microphones to an extent indicated by the following aspects:

- a) Loud speaker construction and applications
- b) Operation of circuits and cross over networks
- c) Optimum layout of speaker systems
- d) Principle and operation of microphones

2.9.48 Digital audio

Evidence shall show an understanding of digital audio to an extent indicated by the following aspects:

- a) Fundamentals of digital audio systems
- b) Signal processing within the encoding of a system
- c) Error checking techniques in the encoder process
- d) Modulation used in the encoding process
- e) The process for decoding digital audio signals to produce analogue stereo output
- f) Features and operation of compact disk players

2.9.49 Computer monitors

Evidence shall show an understanding of computer monitors to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Monitor driver software and configuration
- c) Monitor calibration principles
- d) Common faults, their symptoms and cause.
- e) Fault location procedures and testing points
- f) Monitor adjustments

2.9.50 Commercial audio/video systems commissioning process

Evidence shall show an understanding of commissioning commercial audio/video systems to an extent indicated by the following aspects:

- a) Purpose of commissioning
- b) Commissioning planning and documentation
- c) Initial tests and adjustments
- d) Commissioning procedures

2.9.51 Camcorders

Evidence shall show an understanding of camcorders to an extent indicated by the following aspects:

- a) Operation, tape standards and formats used in camcorders
- b) Operation of optical transducers and lens systems
- c) Alignment of monochrome camera tubes
- d) Colour separation techniques and single tube colour camera signal processing
- e) Charge coupled device signal processing
- f) Mechanics of camcorders

2.9.52 Digital versatile disk processors

Evidence shall show an understanding of digital versatile disk processors to an

extent indicated by the following aspects:

- a) Operating principles, characteristics, features and standards of DVD players
- b) Components and adjustment of DVD players

2.9.53 Compact disk players

Evidence shall show an understanding of compact disk players to an extent indicated by the following aspects:

- a) Characteristics of optical digital recording
- b) Components of CD players
- c) Operation of servo loops
- d) Digital signal processing
- e) System control sections of a CD

2.9.54 VCR basic principles

Evidence shall show an understanding of VCR basic principles to an extent indicated by the following aspects:

- a) Installation and operation of a VCR
- b) Techniques used in magnetic tape recording
- c) Helical scanning process and FM magnetic recording principles
- d) Adjustment and replacement of components within mechanical sections
- e) Luminance signal processing stages
- f) Operation of electronic systems

2.9.55 VCR fault finding

Evidence shall show an understanding of VCR fault finding to an extent indicated by the following aspects:

- a) Faulty component location in the sections of a VCR encompassing:
 - Mechanical components
 - luminance components
 - chroma components
 - servo control sections

- system control sections
- timer and display sections
- power supply sections
- sound sections
- RF sections

2.9.56 VCR advanced principles

Evidence shall show an understanding of VCR advanced principles to an extent indicated by the following aspects:

- a) The operation of the chrominance processing in practical circuits
- b) Control sections operated by microprocessors
- c) The operation of analogue and digital servo systems

2.9.57.1 Introduction to television

Evidence shall show an understanding of introduction to television to an extent indicated by the following aspects:

- a) Fundamentals of the Australian broadcast television system in block diagram form
- b) Functions of a television camera using block diagrams
- c) Functions of a television receiver using block diagrams
- d) Principles and operations of picture tubes
- e) The principles of the Australian PAL colour television process
- f) Television receiver aerials

2.9.57.2 Television receiver repair basics

Evidence shall show an understanding of the basics of television receiver repair to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Common faults, their symptoms and cause.
- c) Fault location procedures and testing points
- d) Device adjustments

2.9.58 TV RF signal stages

Evidence shall show an understanding of TV RF signal stages to an extent indicated by the following aspects:

- a) Block diagrams and specifications for frequency, bandwidth and local or fringe signal levels
- b) VHF, UHF connections, tuner, vision IF, AGC, AFC, inter-carrier sound IF, stereo sound IF, stereo sound decoder
- c) VHF and UHF vision and stereo sound signal frequencies and amplitudes
- d) Specifications of VHF and UHF television, FM radio antennae, polarity of transmitted signals, baluns, diplexers, filters, cable and cable loss, mast head amplifiers, isolation with directional coupling techniques, splitters and combiners, distribution amplifiers, tee off units, signal strength meters and measurements, insertion loss measurements, interface problems and symptoms
- e) VHF/UHF varicap tuner, basic methods of band switching, basic methods of fine frequency tuning by varicaps
- f) Receiver tuner IF specifications
- g) Basics of saw filter, synchronous AM and FM demodulators, AGC response graphs, gated displayed amplified AGC with tuner delay, optimum inter-carrier sound IF
- h) Measurement techniques for RF and IF sensitivity, AGC dynamic range, AFC range, stage gain
- i) Specifications of stereo sound system, sub-carrier frequencies modulation levels, amplitudes, bandwidth

2.9.59 Closed circuit televisions

Evidence shall show an understanding of closed circuit televisions to an extent indicated by the following aspects:

- a) Application CCTV systems encompassing:
 - Sub-system components (i.e. functional blocks) and their function
- b) Television principles encompassing:
 - Sub-system components (i.e. functional blocks) and their function
 - Video signals
- c) CCTV cameras encompassing:
 - Types of cameras
 - Sub-system components (i.e. functional blocks) and their operating parameters

d) Camera lens encompassing:

- Types of lenses and their characteristics
- Application of various types
- Setting up

e) Monitors and recording devices

- Types and application
- Analogue and digital recording devices and their application

f) Installation and mounting encompassing:

- Consideration in locating and mounting CCTV camera and auxiliary equipment

Note.

1. Examples are need for sealed and heated housings, IP rating required, methods for overcoming earth (ground) loops, need for lightning protection.
 2. Examples of auxiliary equipment are in-line video amplifiers/ equalizers and video distribution amplifiers
-

2.9.60 Electronic security systems fundamentals

Evidence shall show an understanding of electronic security systems to an extent indicated by the following aspects:

- a) Type of detectors and their operating principles
- b) Relay connections to an open collector output on an alarm panel
- c) Design principles of a security system
- d) Impact of building structures on system design
- e) Types of security panels and their communication system
- f) Use of CCTV
- g) Locking devices
- h) Security lighting

2.9.61 Advanced electronic security systems

Evidence shall show an understanding of advanced electronic security systems to an extent indicated by the following aspects:

- a) Connection of input and output devices to detectors and control panels
- b) Procedures to perform hardware and software upgrades

c) Types of code pads and commands required to operate the system

2.9.62 Security video monitoring and recording

Evidence shall show an understanding of security video monitoring and recording to an extent indicated by the following aspects:

- a) Principles of television systems
- b) Multiplexing techniques
- c) Multiplex display and recording of CCTV
- d) Digital encoding techniques
- e) Video distribution and transmission techniques
- f) Microprocessor based CCTV systems
- g) Factors affecting picture quality

2.9.63 Direct current power supplies

Evidence shall show an understanding of DC power supplies to an extent indicated by the following aspects:

- a) Operating principles and application of DC power supplies
- b) Output waveforms of various rectification circuits
- c) Ripple an output DC voltage for capacitive power supply filter circuits
- d) Operation of a Zener diode shunt voltage regulator
- e) Selection of 3 terminal regulators from data sheets

2.9.64 Application of electronic devices

Evidence shall show an understanding of application of electronic devices to an extent indicated by the following aspects:

- a) Characteristics of discrete components
- b) Amplify types and characteristics
- c) Interface devices and their applications
- d) Comparable devices and their applications

2.9.65 Regulated power supplies

Evidence shall show an understanding of regulated power supplies to an extent indicated by the following aspects:

- a) Purpose and benefits of different types of regulated power supplies
- b) Operation of different types of regulated power supplies
- c) Voltage current waveforms at different points within a power supply
- d) Regulator types operation and characteristics
- e) Linear regulators using integrated circuits
- f) Emerging technologies

2.9.66 Switching power supplies

Evidence shall show an understanding of switching power supplies to an extent indicated by the following aspects:

- a) Operation of inverter and converter circuits
- b) Characteristics of saturable core solid state inverter circuits, transformer inverter/converter circuits and single transistor inverter/converter circuits

2.9.67 Feedback filters and oscillators

Evidence shall show an understanding of feedback filters and oscillators to an extent indicated by the following aspects:

- a) Operation of open and closed looped systems and differences between positive and negative feedback
- b) Characteristics of a voltage amplifier when negative feedback is applied
- c) Estimated measure the gain of an amplifier
- d) Purpose of filters in an electronic system
- e) Common types of filters, their characteristics and application
- f) Operation of oscillators
- g) Purpose of oscillators
- h) Conditions for sustained oscillation
- i) Operation of phase shift oscillators
- j) The operation and characteristics of a Colpitts oscillator
- k) Conditions that cause instability in amplifier circuits

2.9.68 Filters and resonance

Evidence shall show an understanding of filters and resonance to an extent indicated by the following aspects:

- a) Conditions that create resonance in electronic circuits
- b) Circuit conditions and features of a parallel resonant circuit
- c) Circuit conditions for RLC circuits operating above and below resonant frequency
- d) The relationship between Q-bandwidth and resonant frequency
- e) Capacitive/resistive filters principles and characteristics of operation
- f) Characteristics and operation of low pass filters, band stop filters and band pass filters

2.9.69 Digital subsystems

Evidence shall show an understanding of digital subsystems to an extent indicated by the following aspects:

a) Digital to analogue conversion encompassing:

- typical applications
- D/A performance characteristics
- D/A converter circuitry
- D/A converter specifications

Note.

Examples are resolution, accuracy, offset error, setting time, monotonicity.

- integrated circuit D/A converter

b) Analogue to digital conversion encompassing:

- typical applications
- A/D performance characteristics
- types of A/D converters (ADC)

Note.

Examples are . digital ramp ADC, successive-approximation ADC, simultaneous (flash) ADC, dual slope ADC.

- integrated circuit A/D converter

c) Interface chips and techniques encompassing:

- logic interface circuits

Note.

Examples are level translations, driving a load (sink and source) from a logic circuit, transistor switches, relays, opto input and output isolation, driver IC's.

- sensor interfacing

d) Programmable logic devices encompassing:

- applications
 - types
-

Note.

Examples are programmable logic array (PLA), programmable array logic (PAL), and erasable PLDs,

- circuit architecture and operation
- programming requirements

2.9.70 Automatic data capture

Evidence shall show an understanding of automatic data capture to an extent indicated by the following aspects:

- a) Forms of automatic data capture, advantages and disadvantages
- b) Selection of barcodes from standards
- c) Suitability of automatic data capture equipment including readers, printers, ancillary devices and radio frequency for various applications
- d) Interfacing issues between systems involving different hardware and software
- e) Functional design and construction of a simple system

2.9.71.1 Biometric devices

Evidence shall show an understanding of biometric devices to an extent indicated by the following aspects:

- a) Biometrics techniques and processes including definitions, terminology, advantages, disadvantages and applications
-

Note.

Includes basic principles of database design, software techniques, classifier combination, feature extraction, feature enhancement, chain code methods, image analysis, biometric transforms, matching techniques, verification and identification, biometric tools, statistical measures of biometrics

- b) Biometric device tools, software and testing techniques

c) Physical interaction with biometric devices including operation and installation of biometric devices examples are iris scanners, hand scanners voice recognition apparatus, facial recognition devices and like equipment

d) Legal aspects of biometrics

- Australian laws impacting on biometrics security and privacy legislation.
- Australian standards

2.9.71.2 Biometrics Equipment Techniques and Applications

Evidence shall show an understanding of biometrics equipment techniques and applications to an extent indicated by the following aspects:

a) Technology applications used in forensics, genetics, civil and commercial environments and government departments for verification of identities, encompassing:

- Fingerprint matching
- Palm Print
- Hand Geometry
- Face Verification
- Iris Recognition
- Retina Scan

Note.

Examples of biometrics equipment technology used including scanning and digitizing of samples, enhancement of captured data, feature extraction, classification, matching, searching and manual verification

b) Technical principles, parameters, and processes underpinning each of the above technologies in identity recognition

c) Typical selection, evaluation and testing criterion and methods of biometrics equipment, encompassing:

- comparative features of selection, evaluation and testing methods of various classes of equipment
- vendor claims, product suitability and product specifications

2.9.71.3 Biometric Systems Techniques and Applications

Evidence shall show an understanding of biometric systems techniques and applications to an extent indicated by the following aspects:

a) Complex biometric systems technology applications used in forensics, genetics, civil and commercial environments,, government departments and defence for

verification of identities, encompassing:

- Voice Recognition
- Speech Recognition
- Handwriting Analysis
- Signature Verification
- DNA Technology
- Multi-biometrics

Note.

Examples of biometrics system technologies used including voice recognition interfacing components and hardware, speech extraction and evaluate speech recognition system performance, handwriting digitizers tablets, hardware and software used in signature verification, DNA technology in biometric systems,

b) Technical principles, parameters, and processes underpinning each biometric system technology in identity and verification recognition

c) Typical selection, evaluation and testing criterion and methods of biometrics systems, encompassing:

- comparative features of selection, evaluation and testing methods of various biometrics systems
- vendor claims, product suitability and product specifications

2.9.71.4 Biometrics and Security

Evidence shall show an understanding of biometric and security to an extent indicated by the following aspects:

a) Compliance requirements for implementing security on personal computers and computer networks

b) Compliance requirements for securing voice over the internet

c) Compliance requirements for assuring IT network security and capital planning measures encompassing:

- security risks versus investment risks,
- investment management life cycle
- capital management and investment control
- alternatives and budget analyses of IT security

d) Security implementation encompassing:

- biometrics in law and relationship with legislation
- trusted networks, cryptography and data security characteristics
- advanced authentication, digital certificates and digital signatures
- cost comparison and evaluative analysis

e) Laws, standards and compliance guidelines encompassing:

- international
- national
- local
- codes
- institutional

f) Preparing and selecting a vendor encompassing:

- client needs analysis
- project parameters according to business needs analysis
- project goals and criteria
- tender process management
- project monitoring and evaluation

g) Deployment principles for rollout of Biometrics system(s) encompassing:

- scalability and manageability
- trailing and testing
- commissioning
- compliance documentation

2.9.72 Custom electronic installations, testing and verification methods

Evidence shall show an understanding of testing and verifying compliance of custom electronic installations to an extent indicated by the following aspects:

- a) Compliance and quality control testing and verification requirements.
- b) Testing techniques.
- c) Features of custom electronics installations that can be visually inspected

2.9.73 Operational concepts of business machines

Evidence shall show an understanding of operational concepts of business machines to an extent indicated by the following aspects:

- a) Purpose and function of common business machines
- b) Operation, adjustment and maintenance of photocopiers, facsimile machines, printers and PCs
- c) The electronic communications and connections between business machines
- d) Hazardous materials used in the office and handling procedures

2.9.74.1 Electro-mechanics of business machines

Evidence shall show an understanding of electro-mechanics of business machines to an extent indicated by the following aspects:

- a) The operating features of electric motors, relays and solenoids, clutches and tachometers
- b) Function and operation of feed mechanisms, drive-trains and cleaning processors

2.9.74.2 Business machine transducers

Evidence shall show an understanding of business machine transducers to an extent indicated by the following aspects:

a) Function of transducers encompassing:

- Linear position & velocity
- Angular position measurement
- Angular velocity measurement
- Temperature sensors
- Humidity sensors
- Current sensors
- Piezo sensors

b) Temperature sensors types, operating principles and applications

Note.

Examples are thermocouples, resistance temperature detectors (RTD), thermistors, bimetal temperature sensors and the like.

c) Optoelectronics device types, operating principles and applications

Note.

Examples are. photo resistors, photodiodes, phototransistors, LASCR, photovoltaic devices, optocouplers, lasers and the like.

2.9.74.3 Photocopier operating principles

Evidence shall show an understanding of photocopier operating principles to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) operating parameters
- b) Analogue copying processes encompassing:
 - image scanning process

- development process
- transfer process
- cleaning process
- fusing process
- process control/compensation techniques

c) Digital copying processes encompassing:

- image scanning process
- image capture process
- image storage techniques
- image manipulation process

d) Paper feed and transportation encompassing:

- Paper types
- Paper handling
- Methods of paper feed
- Paper transportation

e) Maintenance procedures encompassing:

- adjustment for correct operation
- Replacement of consumable items
- Cleaning procedures

2.9.75.1 High volume business machine functions and faults

Evidence shall show an understanding of high volume business machine functions and faults to an extent indicated by the following aspects:

a) The operating features of electric motors, relays and solenoids, clutches and tachometers

b) Function and operation of feed mechanisms, drive-trains and cleaning processors

c) Input accessories, their function and operating principle encompassing:

- paper trays
- high capacity bins
- document feeders
- duplex unit
- manual bypass
- coin boxes
- card readers
- raster image processing unit

d) Output accessories, their function and operating principle encompassing:

- sorters
- staplers
- collators
- folders
- stackers

2.9.75.2 Colour photocopiers operating principles

Evidence shall show an understanding of colour photocopier operating principles to an extent indicated by the following aspects:

a) Principles of colour and colour separation encompassing:

- Effects of light on the eye
- Colour principles
- Colour separation
- Colour mixing processes
- Colour Wheel

b) Colour separation in colour photocopying encompassing:

- Three scan process
- Four scan process
- Under colour removal

c) Principles of colour photocopying

- Reflected light paths
- Block diagrams of photocopiers
- Principles of operation

d) Scanning processes of colour photocopiers encompassing:

- CCD
- Pre amps
- Auto gain
- Image Processing Unit
- Laser unit
- Exposure processes

e) Printing processes of colour photocopiers encompassing:

- Laser diode unit
- Polygon mirrors
- Laser synchronising and detector encompassing:
- Cylindrical lens

f) Routine maintenance and servicing encompassing:

- Optics
- Paper feeds
- Developer unit
- Drum unit
- Belts and rollers
- Fusing unit

2.9.75.3 Facsimile machine operating principles

Evidence shall show an understanding of facsimile machine operating principles to an extent indicated by the following aspects:

a) Sub-system components (i.e. functional blocks) operating parameters encompassing:

- CCITT standards
- analogue and digital transmissions
- transmission process
- phases of facsimile calls

b) Scanning operations encompassing:

- single photosensor
- CCD Operations
- area image sensors
- lighting systems
- optical systems

c) Signal processing encompassing:

- picture reduction
- modems

d) Printing processes encompassing:

- thermal
- plain paper
- carbon transfer
- ink jet

e) Dialling parameters encompassing:

- pulse (decadic) dialling
- DTMF
- manual dial
- blind dial, line and dial detect
- redial and listen to dial

f) Coding systems encompassing:

- data compression
- Modified Hauffman (MH) systems
- Modified Read (MR) systems
- Modified Modified Read (MMR) systems
- "K" factor
- Error Correction Modes (ECM)

g) Operational principles encompassing:

- transmission
- reception
- copying

h) Installation, operation, maintenance and servicing procedures encompassing:

- disassembly and assembly
- consumable replacement
- cleaning
- fault identification
- machine faults
- line faults

i) Facsimile services encompassing:

- faxstream
- duet

2.9.76 Microwave heating

Evidence shall show an understanding of microwave heating to an extent indicated by the following aspects:

a) Propagation of electromagnetic waves through the atmosphere, microwave frequency bands

b) Microwave heating devices encompassing:

- Components
- Operating parameters and constraints
- Measurements, test equipment and testing techniques

c) EMI/EMC, generation, suppression and reduction.

2.9.77 Electronic components and system, industrial applications

Evidence shall show an understanding of industrial applications of electronic components and systems to an extent indicated by the following aspects:

a) Semiconductor devices encompassing:

- Australian Standard symbols for each device.

Note: The devices should include P-N junction diodes, schottky rectifier diodes, zener diodes, LED, BJT and MOSFET. transistors (switching), SCRs, triacs, diacs, 3-terminal regulators.

- basic operating principle for each device.
- typical applications for each device.

b) Single and three-phase rectifiers, filters and voltage regulators encompassing:

- Australian Standard circuit symbol for each rectifier/filter/three terminal voltage regulator type.
- operating principles of each rectifier/filter/regulator circuit.
- input and output voltage values and waveforms for each circuit.

c) Electronic Inverters encompassing:

- block diagram representation of an inverter.
- operating principles of an inverter.
- common types of inverters.
- safety precautions for low voltage inverter systems.

d) Power control devices and circuits encompassing:

- Australian Standard symbols for each device.
- *Note:* The devices should include SCRs, triacs, GTOs, diacs and UJT.
- basic operating principle for each device.
- typical applications for each device.

Note: The applications should include solid state relays, leading and trailing edge dimmers, heating controls.

e) Programmable Relays encompassing:

- advantages of programmable relays over electromagnetic relay circuit control.
- applications for programmable relays.
- block diagram representation of a programmable relays and basic operating principles.
- input and output connections to a programmable relays and output types.
- basic programming consisting of inputs, outputs and timers.

f) Typical applications of devices

g) Common faults and their symptom

2.9.78 Common security scenarios and solutions

Evidence shall show an understanding of common security scenarios and solutions to an extent indicated by the following aspects:

- a) Alternative access arrangement
- b) Intrusion protection and monitoring options
- c) Available technologies
- d) Integration with other systems

2.9.79.1 Fire protection technologies

Evidence shall show an understanding of fire protection technologies to an extent indicated by the following aspects:

- a) Life and safety concerns for fire protection.
- b) Basic principles of combustion
- c) Bi-products of combustion that can be detected
- d) Basic principles of fire behaviour within and enclosure
- e) Types of fire protection systems and the difference between automatic and passive systems and wet and dry systems.

2.9.79.2 Fire protection systems, commissioning process

Evidence shall show an understanding of the commissioning process of fire protection systems to an extent indicated by the following aspects:

- a) Purpose of commissioning
- b) Commissioning planning and documentation
- c) Initial tests and adjustments
- d) Commissioning procedures

2.9.79.3 Fire protection systems faults

Evidence shall show an understanding of locating faults in fire protection systems to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Factors effecting system performance
- c) Typical faults, their symptoms and cause.
- d) Fault diagnosis procedures and testing
- e) Sub-system adjustments

2.9.80 Video and display set up

Evidence shall show an understanding of video and display set up to an extent indicated by the following aspects:

- a) Projectors encompassing:
 - Aspect ratio
 - Screen size
 - Orientation
 - Throw distance, vertical elevation and horizontal orientation
- b) Direct view monitors adjustments

2.9.81 Audio/video control equipment

Evidence shall show an understanding of audio/video control equipment to an extent indicated by the following aspects:

- a) Types of control devices and their operating principles
- b) Control equipment arrangement in an audio/video system

2.9.82 Introduction to optics

Evidence shall show an understanding of optics to an extent indicated by the following aspects:

- a) Optical concepts and parameters
- b) Applications of optical technology
- c) Optical communications encompassing:
 - Optical fibre cable structures and applications
 - Single and multi mode
 - Transmitter and receiver components

- d) Optical fibre cable termination practices
- e) Predicted applications

2.9.83 General electronic apparatus repair basics

Evidence shall show an understanding of general electronic apparatus repair basics to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Common faults, their symptoms and cause.
- c) Fault location procedures and testing points
- d) Device adjustments

Note.

Examples of general electronic apparatus are data capture devices, security panels, fire protection panels, industrial control apparatus, instrumentation electronics and any apparatus not specifically covered under other clauses but for which there is a service manual and circuit diagrams.

2.9.84 Advanced analogue electronics

Evidence shall show an understanding of advanced analogue electronics to an extent indicated by the following aspects:

- a) Differential amplifiers of suitable characteristics to meet system objective encompassing:
 - differential gain, common mode rejection ratio and the required CMRR
 - variable gain input stage
 - connections for an instrumentation amplifier to meet given objectives.
- b) Audio frequency integrator working to given specifications encompassing:
 - ideal integrator
 - practical difficulty with the ideal circuit
 - common applications of the integrator.
- c) Operational amplifier circuits encompassing:
 - use of d.c. offset and capacitive blocking and Norton amplifiers powered by a single supply
 - operation of single-supply inverting and noninverting amplifiers employing DC offset bias at the input and blocking capacitors
 - operation of a high input resistance unity gain

- circuit symbol of the Norton (input current difference) amplifier
- areas of use for single-supply amplifiers.

d) Comparator circuits (open loop, limited swing and hysteresis) using operational amplifiers encompassing:

- ideal op-amp comparator
- typical uses of the comparator.
- comparators with limited (i) negative swing and (ii) both positive negative swing
- hysteresis comparator with positive resistor divider feedback and calculate the input switching voltages.
- desirable properties of an operational amplifier for use as comparator and the characteristics of comparator op amps.

e) Amplifiers with given piecewise linear transfer characteristics

f) Operation and building precision of half-wave and fullwave rectifiers encompassing:

- precision two-diode half-wave rectifier
- typical applications of precision rectifiers.

g) Operation of and build a sine - triangle – square function generator encompassing:

- block diagram of a sine-triangle-square signal generator using an integrator, comparator and sine-wave shaper.
- waveforms at various points in the circuit.
- frequency range and setting of frequency changes.
- function generators and oscillators.

h) Audio-frequency low-pass, high-pass and band-pass filters to meet given objectives encompassing:

- frequency response of low-pass, high-pass, low-Q band-pass, high-Q bandpass, notch and all-pass filters and define pass-band, stop-band and rate of roll-off.
- main features in the amplitude and phase plots of Butterworth, Chebyshev, Cauer-Elliptic and Bessel filter responses.
- pros and cons of active and passive filters.
- non-unity gain Sallen-Key low-pass filter.
- Types of active filters available in IC form:

Note.

Examples are Variable filter, Switched Capacitor Filters and digital (sampled data) filters.

- Low-Q (i.e. cascade of lowpass and high-pass) and/or narrow bandpass filters.

2.9.85 Advanced power amplifiers

Evidence shall show an understanding of advanced power amplifiers to an extent indicated by the following aspects:

a) Analysing the performance of power amplifiers encompassing:

- Power amps.
- minimum power, voltage and current rating of an output transistor.
- aspects of heat transfer related to heat sinking.
- Common forms of distortion encountered in power amplifiers.
- techniques for overcoming common forms of distortion.

b) Classes of power amplifiers and indicate typical maximum efficiencies for each class encompassing:

- conduction, angle, output power and efficiency of a power amp.
- typical and/or maximum efficiencies of each class of power Amp.
- d.c and/or a.c load line,
- output power and efficiency of a large signal amplifier

c) Operation of each class and type of power amplifier circuit encompassing:

- load line operation.
- Class A – direct, RC, transformer coupled. Class B – Complementary symmetry, drivers, single supply/duel supply. Class C and Class D.
- measure the characteristics of a fully integrated operational power Amplifiers.

2.9.86 Audio system advanced diagnostic techniques

Evidence shall show an understanding of advanced audio system diagnostic techniques to an extent indicated by the following aspects:

a) Perception and measurement of sound

b) Acoustics and equalisation

c) Sound recording and reproduction technologies

d) Audio component testing, measurements and adjustments

Note.

Examples of tests are frequency response for given loads, small signal test, distortion measurement, noise measurement, frequency versus distortion, intermodulation spectrum, spectral-decay plots, acoustic cross-over, anechoic response, lateral and vertical response and the like.

2.9.87 Photonic principles and applications

Evidence shall show an understanding of photonic principles and applications to an extent indicated by the following aspects:

a) Photonic principles

- Measurements on the optical devices that are used in a basic fibre optic link
- Optical devices making up an optical fibre link
- The interconnection of optical devices that make up a one way optical fibre link
- The construction of an LED optical light source
- The electrical and optical parameters of LASERs
- LED and LASER light sources
- PN photodiodes and phototransistors
- The electrical and optical parameter
- The basic capability of optical technology involving energy transfer, communications, sensing, miniaturisation and signal processing

b) The environmental advantages and impacts of optical technology

- The nature and importance of innovation
- The triple bottom line of business: economic, social and environmental as it relates to optical technology
- Scenario development using a variety of expressive methods to explore alternatives.
- Information networking
- Medical applications.
- Teleworking applications.
- Education applications
- Opportunities in the optical industry in Australia
- Innovations in business using optical technology
- Innovations in the provision of infrastructure in Australia

c) Basic geometric optics

d) Introduction to photonic components

e) The basic concepts of optical transmission encompassing:

- 'Atmospheric' and 'guided' optical transmission systems
- Fibre 'guided' systems compared to 'atmospheric' systems

f) Photonic components and component technologies encompassing:

- Differentiate between 'passive' and 'active' photonic components
- Identify and describe optical component technologies

g) Photonic components and their roles in photonic devices encompassing:

- Operational concepts of components and devices,
- Active versus passive devices
- Available photonic devices and their constituent components
- Photonic device operation

h) Operating principles of optical couplers and their characteristics encompassing:

- Optical couplers.
- Loss
- Number of ports
- Directionality
- Wavelength selectivity
- 'T' and 'Y' couplers
- '1-to-N' or 'Tree' couplers
- Star couplers
- Wavelength selective couplers
- Bulk and micro-optic technologies
- Fused fibre technology
- Planar waveguides technology
- Fibre-grating technology

i) Components for WDM systems encompassing:

- Passive and active components for WDM systems
- Filters (Interference and Absorption)
- Bulk optical gratings
- Arrayed waveguides
- Attenuators
- Line and Band filters
- Equalising filters
- Fixed and Tunable filters
- Optical Isolators (including Faraday Effect)
- Dispersion compensators
- Multiplexers or combiners
- Demultiplexers or splitters
- Routers
- Add/Drop multiplexers
- Interconnection techniques used between optical components used in each optical
- Devices

j) Operational principles of key photonic devices encompassing:

- The difference between multimode and single mode fibre,
- Attenuation,

- Dispersion
- Spontaneous and stimulated emission of light

2.9.88 Principles of signal conditioning

Evidence shall show an understanding of principles of signal conditioning to an extent indicated by the following aspects:

- a) Sensors and transducers: static and dynamic characteristics
- b) Sensor types encompassing:
 - strain and force
 - thermocouples
 - displacement, location, proximity
 - motion
 - light and radiation
 - pressure
- c) Signal amplification techniques encompassing:
 - isolation and filtering

2.9.89 Analogue integrated circuits

Evidence shall show an understanding of analogue integrated circuits to an extent indicated by the following aspects:

- a) Power ICs
- b) PLL circuits
- c) Timer circuits
- d) Function and waveform generators
- e) Op amp pulse oscillators

2.9.90 RF amplifiers

Evidence shall show an understanding of RF amplifiers to an extent indicated by the following aspects:

- a) Frequency response of amplifiers
- b) Gain levelling techniques
- c) Tuned amplifiers

d) Techniques for impedance matching

Note.

Examples are use of S parameters and Smith charts.

e) RF Power amplifiers

f) Stripline circuit techniques

2.9.91 Printed circuit board design techniques

Evidence shall show an understanding of printed circuit board design techniques to an extent indicated by the following aspects:

- a) Printed circuit board materials and processes
- b) Factors influencing design
- c) Design tools and software
- d) Design standards

2.9.92 Vacuum tube amplifiers

Evidence shall show an understanding of vacuum tube amplifiers to an extent indicated by the following aspects:

a) Vacuum tubes encompassing:

- history
- construction
- principles of thermionic emission
- advantages and disadvantages compared with solid state devices
- applications

b) Vacuum diodes encompassing:

- schematic symbol
- terminals
- operation and typical voltages
- rectifier circuits
- typical devices and part numbers

c) Triodes, tetrodes, and pentodes encompassing:

- schematic symbols
- terminals
- operation and typical voltages

- bias requirements
- AC parameters

d) Small signal valve amplifier stages encompassing:

- typical devices and part numbers
- typical configurations
- quiescent conditions
- AC conditions: gain, input impedance, bandwidth

e) Valve power amplifier stages encompassing:

- typical devices and part numbers
- typical push-pull configurations
- output transformer
- reflected impedance
- parallel output arrangements
- quiescent conditions
- AC conditions
- output power

f) Complete valve amplifiers encompassing:

- preamp stages
- coupling methods
- gain and master volume controls
- clean and "dirty" channels
- channel mixing
- valve tone controls
- spring reverb systems
- tremolo circuits
- effect sends
- foot switches
- differential amplifier
- phase splitter
- push-pull output configurations
- output transformer
- output impedance selection
- speaker connections
- local and global feedback arrangements

g) Valve amplifier troubleshooting and servicing encompassing:

- safety considerations: high voltages, heat and glass
- testing procedures and importance of testing with a load
- troubleshooting techniques

- typical faults
- locating and replacing faulty components

2.9.93 Electronic musical instruments

Evidence shall show an understanding of electronic musical instruments to an extent indicated by the following aspects:

- a) Electric guitar and bass wiring systems
- b) Active pickups
- c) Effects pedals and racks encompassing:
 - principles of operation
 - basic circuits
- d) Electric keyboards, basic operation and circuits
- e) Troubleshooting and repairing musician instruments

2.2.10 Electronic communications technology

2.10 Electronic communications technology

2.10.1.1 Electronic communications, principles

Evidence shall show an understanding of principles of an electronic communications system to an extent indicated by the following aspects:

- a) Requirements of a basic communications system

Note.

Examples are satellites, data communications, navigation, telecommunications, noise etc

- b) Antennae and electromagnetic wave propagation
 - c) Reason for modulation
 - d) Amplitude and frequency modulation, difference, advantages and disadvantages
 - e) Simple transmitter and receiver circuits
-

Note.

Block diagram level

- f) Optical communications principles

2.10.1.2 Electronic signals and systems

Evidence shall show an understanding of electronic signals and system to an extent indicated by the following aspects:

- a) Signal types and their application
- b) Functional blocks in electronic communication systems
- c) Basic methods of signal generation, conditioning and transmission

2.10.1.3 Electronic communications, technologies

Evidence shall show an understanding of technologies in electronic communications to an extent indicated by the following aspects:

- a) Concepts of a communication system encompassing:
 - function of a block.
 - radio wave.
 - frequency bands of a radio wave in free space.
 - signal transmission media

Note.

Examples are metal line, radio terrestrial to terrestrial, radio terrestrial to satellite to terrestrial, wave guide, optical fibre and the like

- effects of noise on communication system output.
 - internal and external sources of noise.
- b) Characteristics of signals in both the time and frequency domains encompassing:
 - signals forms in time and frequency domain:
 - periodic complex waveforms
 - Fourier analysis
 - c) Modulated signals in the time and frequency domain encompassing:
 - process of amplitude modulation (AM).
 - bandwidth of an AM
 - modulation index.
 - total power in an AM wave for one or more modulating tones
 - power rate of AM transmitters
 - modulation index using a CRO.
 - Amplitude modulator circuits.
 - d) Demodulation of signals and baseband signal encompassing:

- diode detector.
 - operation of an AM demodulator
 - non-linear mixing and filtering or frequency down conversion
 - single sideband (SSB).
 - baseband output frequency
 - Frequency Modulation (FM)
 - limiting of FM signals and noise suppression.
- e) Time and frequency division multiplexing encompassing:
- frequency division multiplexing (FDM).
 - hierarchy of FDM as applied to telephony and broadcast stereo.
 - time division multiplexing (TDM).
 - hierarchy of TDM.
- f) Concepts and characteristics of a superheterodyne receiver system encompassing:
- crystal set circuit operation.
 - TRF receiver circuit.
 - disadvantages of a TRF receiver.
 - block diagram of a single conversion superheterodyne receiver.
 - shortcomings of the TRF
- g) Operation of transmitters encompassing:
- Amplitude Modulation (AM).
 - modulation technique (high or low level) and function of each block
 - single sideband (SSB) and function of each block.
 - frequency modulation (FM) and function of each block
- h) Concepts of digital encoding of baseband signals encompassing:
- analogue signals quantised and digital form.
 - sampling analogue signals.
 - pulse-code modulation (PCM).
 - quantisation as applied to PCM.
 - quantisation noise as applied to PCM.
 - commanding of PCM signals.
 - PCM encoding.
 - advantages that digital signals such as PCM
- i) Sources and effects of noise in a communication system encompassing:
- S/N ratio in communication systems.
 - noise figure, noise factor and noise equivalent temperature

2.10.2 Electronic communications, transmission principles

Evidence shall show an understanding of transmission principles to an extent indicated by the following aspects:

- a) Principles and operation of transmitters
- b) Types of transmitters, their features and characteristics
- c) Tuning, adjusting and testing.

2.10.3 Electronic communications, modulation

Evidence shall show an understanding of modulation in electronic communications to an extent indicated by the following aspects:

- a) Amplitude modulation including concepts, phasor representation, envelope, depth, power in sidebands, over modulation and splatter
- b) Sideband modulation and de-modulation techniques including single, double and vestigial types and frequency representation
- c) Frequency and phase modulation

2.10.4 Electronic communications, modulation circuits

Evidence shall show an understanding of modulation to an extent indicated by the following aspects:

- a) Amplitude modulation concepts

Note.

Examples include basic amplitude modulation fundamentals, phasor representation of carrier and sidebands, phase on modulation envelope, index and percentage modulation depth, power in carrier and sidebands, over modulation and "splatter"

- b) Sideband modulation terminology and techniques.

Note.

Examples include double-sideband (DSB), single-sideband (SSB), vestigial-sideband (VSB), frequency domain representation, double-sideband signal (DSB), single-sideband signal (SSB), demodulation requirements for DSB and SSB

- c) Frequency and phase modulation

Note.

Examples include, time and frequency domain representation, amplitude and frequency distribution of sidebands, frequency modulation (FM) production, phase modulation (PM) production, equivalent FM and PM – audio processing

- d) NBPM Armstrong method of producing (phasor description)

2.10.5 Electronic communications, receivers

Evidence shall show an understanding of receivers to an extent indicated by the following aspects:

- a) Receiver principles, types, construction and applications
- b) Polarisation
- c) Mixers
- d) Intermediate frequency amplification
- e) Demodulation
- f) Receiver systems, types and characteristics

2.10.6 Electronic communications, transmitters

Evidence shall show an understanding of transmitters to an extent indicated by the following aspects:

- a) Transmitter fundamentals
- b) Transmitter configuration
- c) Oscillators and oscillator circuits
- d) Frequency synthesisers
- e) Amplifier types and circuits
- f) Impedance matching networks
- g) Typical transmitter circuits

2.10.7 Electronic communications, digital techniques

Evidence shall show an understanding of digital communication techniques to an extent indicated by the following aspects:

- a) Data rates
- b) Current data communications standards
- c) Modulation schemes used in digital transmission
- d) Power levels and interference
- e) Error handling
- f) Applications like for example: USB, Ethernet, ADSL and BDSL, or any other

current applications

2.10.8 Electronic communications, transmission lines

Evidence shall show an understanding of transmission lines to an extent indicated by the following aspects:

- a) Time domain reflectometry measurements
- b) Radio frequency characteristics of transmission lines
- c) Losses in transmission lines
- d) Radiation characteristics of antennae
- e) Directional antennae
- f) Antennae matching
- g) UHF and microwave antennae

2.10.9 Electronic communications, antennas and wave propagation

Evidence shall show an understanding of basic antenna and antennae systems and wave propagation to an extent indicated by the following aspects:

- a) Antenna fundamentals

Note.

Examples include the characteristics of radio waves, antenna operation, antenna reciprocity and the basic antenna.

- b) Antenna types, feature and characteristics encompassing:

- Dipole antennas and characteristics
-

Note.

Examples include radiation resistance, dipole length, antenna resistance, antenna Q and bandwidth, conical antennas, dipole polarisation, radiation patterns and directivity, antenna gain and folded dipoles

- Marconi ground-plane vertical antenna features and characteristics
-

Note.

Examples include radiation pattern, ground plane radials and counterpoise, radiation resistance, antenna length and directivity,

- UHF and microwave antennas
 - Relationship between directivity and gain
 - Antenna arrays

Note.

Examples include parasitic arrays and driven arrays

- Impedance matching

c) Radio wave propagation characteristics

Note.

Examples include optical characteristic, propagation through space

d) Calculation of received power

e) Antenna selection and location

f) Transmission lines

2.10.10 Electronic communications, microwave

Evidence shall show an understanding of microwave communications to an extent indicated by the following aspects:

a) Propagation of electromagnetic waves through the atmosphere, transmission lines and waveguides including characteristic impedance, impedance matching, standing waves, microwave frequency bands

b) Microwave device parameters involving wavelength, phase, VSWR, impedance matching, circuit parameters, amplifiers, transmission, reception, oscillation, noise figure, noise temperature

c) Microwave devices and components

d) Microwave operational constraints and operating parameters such as power, bandwidth, gain, efficiency, operational life, electrical parameters, stability, cooling, size, testing and device selection

e) Microwave measurements, test equipment and testing techniques

f) EMI/EMC, generation, suppression and reduction

2.10.11 Electronic communications, satellite

Evidence shall show an understanding of satellite communications systems to an extent indicated by the following aspects:

a) Types of satellite systems and sub-systems

b) Earth station locality and antenna parameters

c) Link specifications and link calculations

d) Base band signalling processes

e) Modulation and system access

2.10.12 Electronic communications, optical methods

Evidence shall show an understanding of optic methods of communication to an extent indicated by the following aspects:

- a) Optical principles
- b) Optical fibre cable principles, types construction and applications
- c) Optical transmitters, detectors and receivers
- d) Calculation of transmission losses in fibre optical cables and connectors

2.10.13 Television and video reception

Evidence shall show an understanding of reception signals and decoding to an extent indicated by the following aspects:

- a) Broadcast systems
- b) Basic operation of a TV cameras
- c) Basic operation of a TV receiver including tubes and displays and operating components
- d) Reception aerials and arrays
- e) Operation of a video cassette recorder including tape recording, helical scanning, mechanical principles and adjustments, electronic principles and adjustments, servo control loops

2.10.14 TV antenna systems

Evidence shall show an understanding of TV antenna systems to an extent indicated by the following aspects:

- a) The common difficulties associated with TV receptions
- b) Operating characteristics of common types of TV receiving antennas
- c) Selection of coaxial cable
- d) Multiple outlet TV aerial systems
- e) Operation of satellite receiving systems
- f) Performance testing and fault-finding on multiple outlet antenna systems

2.10.15 Antenna installation and servicing

Evidence shall show an understanding of antenna installation and servicing to an extent indicated by the following aspects:

- a) Propagation of radio waves from a transmitter to a receiver
- b) Characteristics of antenna systems
- c) Selection of antennae systems for various applications
- d) Installation techniques for antennae to receiver and antennae to transmitter transmission and distribution systems

2.10.16 Transmission lines and antennae

Evidence shall show an understanding of transmission lines and antennae to an extent indicated by the following aspects:

- a) Reflectometry minimum and maximum voltage and current values on a transmission line carrying an RF signal
- b) Transmission line loss measured in decibels
- c) EH field directions in relation to antenna elements
- d) Differences between hertz and Marconi antennas
- e) Principles for microwave antennas used for terrestrial and satellite transmissions

2.10.17 Electronic communications, multiplexing and de multiplexing

Evidence shall show an understanding of multiplexing and de multiplexing to an extent indicated by the following aspects:

- a) Coding schemes (line coding, error coding, bit rate reduction)
- b) Multiplexing schemes (MPEG1&2)
- c) Spread spectrum (CDMA, COFDM)

2.10.18 Electronic communications, microwave antennas and wave guide fundamentals

Evidence shall show an understanding of microwave antennas and wave guides to an extent indicated by the following aspects:

- a) Antenna and wave guide principles and components
- b) Installation techniques for microwave communication systems
- c) Setting up techniques for microwave communication systems

2.10.19 Electronic communications, commissioning process

Evidence shall show an understanding of commissioning electronic communication systems to an extent indicated by the following aspects:

- a) Purpose of commissioning
- b) Commissioning planning and documentation
- c) Initial tests and adjustments
- d) Commissioning procedures

2.10.20 Electronic communications, sonar transducers and arrays

Evidence shall show an understanding of sonar transducers and arrays to an extent indicated by the following aspects:

- a) Hazards and risk control measures
- b) Transducer types, their operating principles and parameters
- c) Transducer array encompassing:
 - Types and their construction
 - Applications
- d) Transducer hull outfits
- e) Beam forming principles and requirements
- f) Transducer installation and operational maintenance

2.10.21 Electronic communications, sonar system operating principles

Evidence shall show an understanding of sonar system operating principles to an extent indicated by the following aspects:

- The purpose and application of sonar systems
- Sonar equipment encompassing:
- Types and their applications

- Sub-system components (i.e. functional blocks) and their function encompassing:
 - Transducer
 - Input amplifier
 - Sonar interface unit
 - Beamforming network (transmit / receive)
 - Signal processing
 - Own Doppler nullification
 - Display system
 - Headset
 - Interfaces
 - Transmitter
 - T/R Switch
 - Timer/Timing

e) Sonar operating parameters

f) Sonar transmission characteristics

2.10.22 Electronic communications, sonar measurement and set up

Evidence shall show an understanding of sonar measurement and set up to an extent indicated by the following aspects:

- a) Sonar parameters and measurements
- b) Sonar physical parameters
- c) Constraints and Consequences

2.10.23 Electronic communications, secondary radar and related systems

Evidence shall show an understanding of secondary radar and related systems to an extent indicated by the following aspects:

- a) Secondary radar principles encompassing:
 - Role of secondary radar
 - Transponder operation
 - Operating principles
 - Signal processing
 - Pulse generation, transmission and detection
 - Mode generation, detection and response
 - Display symbol generation

- Synchronisation with primary radar
- Advantages over primary radar with respect to: clutter;
- signal/noise ratio; transmit power required for operation

b) Interfaces to other systems providing information for transmission of mode data encompassing:

- Slaving/synchronisation to primary radar
- Clutter reduction/elimination
- Defruiting
- Degarbling
- Interfaces to other systems
- Range/ducting effects
- Advantages over primary radar
- Power supplies and UPS
- International standards
- National Curriculum
- Hot standby, cold standby

c) Application of secondary radar systems

Note.

Examples are Traffic Collision Avoidance System (TCAS), Selective Identification System (SIF), Air Traffic Control Radar Beacon System (ATCRBS), Instrument Landing System (ILS), Tactical Air Navigation (TACAN), Navigation Systems (VOR, GPS, DME), Radar Altimeter, Jamming, Electronic warfare, Second Time Round Returns (STRR), and Identification –friend or foe radar (IFF).

2.10.24 Electronic communications, radar and sonar displays devices

Evidence shall show an understanding of radar and sonar displays devices to an extent indicated by the following aspects:

a) Types and their applications

Note.

Examples are CRT, Plasma, LCD, Monochrome, Colour, and Touch screen.

b) Sub-system components (i.e. functional blocks) and their operating parameters encompassing:

- EHT transformers
- detectors
- video distribution
- time base generators
- phase locked loops

- microprocessors
- memory devices
- demodulators
- focusing/deflection devices
- delay lines
- bleed resistors
- HV generation

c) Calibration testing and maintenance procedures

d) Typical fault finding, their symptoms and cause

2.10.25 Electronic communications, radar fundamentals

Evidence shall show an understanding of radar fundamentals to an extent indicated by the following aspects:

a) Hazards and risk control measures

b) Purpose and uses of radar

c) Environmental conditions affecting radar

d) Design factors which affect performance

e) Propagation of electromagnetic waves

f) Pulse forming circuits

g) Typical radar transmitter encompassing:

- limitations and applications of each type

h) Typical radar receivers encompassing:

- Sub-system components (i.e. functional blocks) and their operating parameters
- limitations and applications

i) Radar antennae encompassing:

- Types, application and radiation patterns

Note.

Examples are parabolic, phased array, log periodic, and cos q

- antenna gain
- efficiency
- length and height factors

j) Microwave techniques, devices and applications encompassing:

- oscillators
- amplifiers
- modulators and demodulators

- mixers and detectors

k) Types and characteristics of various radar systems

2.10.26 Electronic communications, navigation systems

Evidence shall show an understanding of navigation systems to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Environment factors effecting system performance
- c) Typical faults, their symptoms and cause.
- d) Fault diagnosis procedures and testing
- e) Sub-system adjustments

2.10.27 Electronic communications, surveillance and observation

Evidence shall show an understanding of surveillance and observation to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Environment factors effecting system performance
- c) Typical faults, their symptoms and cause.
- d) Fault diagnosis procedures and testing
- e) Sub-system adjustments

2.10.28 Electronic communications, global positioning systems

Evidence shall show an understanding of global positioning systems to an extent indicated by the following aspects:

- a) Sub-system components (i.e. functional blocks) and their operating parameters
- b) Environment factors effecting system performance
- c) Typical faults, their symptoms and cause.
- d) Fault diagnosis procedures and testing
- e) Sub-system adjustments

2.10.29 Digital television transmission towers and equipment

Evidence shall show an understanding of digital television transmission towers and equipment to an extent indicated by the following aspects:

a) The requirements of DTTB program input and monitoring equipment encompassing:

- basic system arrangement

Note.

Example is a central router connected to a number of control rooms.

- Terminologies

Note.

Examples are Vertical, Multi-level; Tie-line Routing and cross point

- typical signal types processed by a router.
- the purpose of "redundant CPU's and power supply units".
- common control protocols used in routers.
- typical analogue audio and video output voltage levels present at the router.
- typical specifications for digital data signals present at the router.
- function of various test equipment used in DTTB measurements.

b) The operating characteristics of a digital television terrestrial broadcast (DTTB) transmitter encompassing:

- typical DTTB digital transmission system.
- safety precautions required when working with high power RF transmitters.
- operating characteristics of a typical MPEG encoder.
- operation of a coded orthogonal frequency division multiplex (COFDM) modulator.
- arrangement of subsystem components in a DTTB transmitter
- purpose of an up converter in a DTTB transmitter.
- typical characteristics of a DTTB power amplifier.
- advantages and disadvantages of air and liquid cooling systems used in transmitters.
- typical DTTB transmitter measurements techniques.

c) The performance requirements of the DTTB combiner and antenna systems encompassing:

- minimum channel separation required between digital and analogue TV channels
- typical specifications of an antenna combiner system.
- the need for combiner systems in DTTB systems.
- typical system faults in combiners and antenna system.

d) The requirements of remote monitoring and measurement equipment encompassing:

- purpose of control panel indicators and controls.
- Process by which the system manages a critical failure.

Note.

Example of component failure deemed as critical are power supplies and CPUs

- different system alarm signals.
- periodic equipment self tests and diagnostic routines on DTTB systems.
- DTTB systems fault diagnostic and rectification techniques.
- function of the basic components of a DTTB system.
- typical units of a DTTB Telemetry system

2.10.30 Wireless devices

Evidence shall show an understanding of wireless devices to an extent indicated by the following aspects:

- a) Types and applications
- b) Operating principles at sub-system level
- c) Programming functions
- d) Networking set up

2.10.31 Electrotechnology Communications Principles

Evidence shall show an understanding of Electrotechnology communications principles to an extent indicated by the following aspects:

- a) The basic electrical circuit
 - basic circuit components
 - function of basic circuit components
 - connection of components
 - measurement of circuit parameters
 - open-circuit, closed-circuit and short-circuits.
- b) Circuit parameter relationships
 - Ohms Law
 - calculation of voltage, current and resistance
 - power dissipated
 - calculation of power.

c) Measurement instruments (voltage, current & resistance)

- safe working procedures
- handling and storing instruments
- selecting and set up of instruments
- connecting instruments
- read analogue scales and digital readouts.

d) Effects of electrical current

- physiological effect
- heating effect
- magnetic effect
- chemical effect
- typical uses

e) EMF sources

- basic generator
- basic thermocouple
- photovoltaic cells
- piezo electric
- primary and secondary cells.

f) d.c. resistive circuits

- series circuits (set-up, measurement and calculations)
- parallel circuits (set-up, measurement and calculations)
- series-parallel circuits (set-up, measurement and calculations).

g) Capacitance

- construction of capacitors
- operation of capacitors
- units
- charge of a capacitor
- RC series circuit.

h) Magnetism and electromagnetic induction

- permanent magnets
- electromagnetism
- induced emf
- inductors
- principles of inductance
- unit of inductance
- electromagnetic radiation (EMR)
- cross talk.

i) a.c. principles

- generation of sinusoidal voltage
- a.c. circuit parameters – frequency, period, amplitude, instantaneous value, maximum value, peak value, peak to peak value and rms value
- calculation of frequency and rms values
- effects of frequency on inductors $(X_L = 2\pi f L)$
- effects of frequency on capacitors $(X_C = \frac{1}{2\pi f C})$
- transformers construction and operating principles.

2.10.32 Amateur radio communication principles, practices, and technical overview

Evidence shall show an understanding of amateur radio communication principles, practices, and technical overview to an extent indicated by the following aspects:

a) Nature of Amateur Radio encompassing:

- Nature of Amateur radio
- Types of licences
- Allocation of frequency bands

b) Licence Conditions encompassing:

- Conditions of licences
- Purpose of the Amateur Service
- Communications by Amateur stations
- Distress and Urgency signals
- Station identification
- Amateur call signs
- Secret messages
- Entertainment not permitted
- Amateur frequency bands and emissions
- Permitted power output
- Notification of change of address
- Harmful interference
- Authorised use of Amateur stations
- Inspection of Amateur licences
- Restriction of operation to avoid interference
- Use of the Licence Condition Determinations

c) Mathematics used for Amateur radio operation encompassing:

- addition, subtraction, multiplication and division
- fractions, percentage, and decimal notation
- units and sub-units; (mega, kilo, UNIT, micro, and pico)
- calculations using simple formulae

d) Amateur radio technical basics encompassing:

- Mains power overview
- Mains power supplies overview
- Voltage and current overview
- Resistance overview
- Ohm's Law overview and the relationship between voltage, current and resistance
- Power in DC circuits overview including calculations related to power in a DC circuit using current and voltage, current and resistance or voltage and resistance.
- Capacitance overview
- Inductance overview
- AC circuits overview
- Impedance and reactance overview
- Tuned circuits overview
- Transformers overview
- Solid state devices overview

e) Transmitters and Receivers – basic overview encompassing:

- Block diagrams of simple transmitters
- Mixers
- Modulation
- Amplifiers
- Transmission quality
- Receiver parameters and terminology
- Simple block diagrams of a Receiver
- Frequency converters
- IF amplifier
- Automatic Gain Control
- Transceivers

f) Transmission lines and Antennas overview encompassing:

- Transmission line basics
- Baluns
- Standing waves
- Antenna Matching Units (ATU)
- Antennas

- Identification of common antennas
- Radiated Power

g) Propagation overview encompassing:

- Electromagnetic radiation
- Ionosphere

h) Interference and Electromagnetic Compatibility (EMC) overview encompassing:

- Interference - Points of entry into electronic equipment
- Filters
- EMC

i) Operating Practices and Procedures overview encompassing:

- Equipment practices
- Authorised frequencies and emissions
- Requirement not to transmit on frequencies in use
- Operating practices
- Operating through a repeater
- Make an all-stations call and change frequency
- Transmitter measurements
- Correcting simple equipment maladjustments
- Recognised abbreviations
- Phonetic alphabet

j) Safety overview encompassing:

- Dangerous voltages
- Electrical safety - equipment to be approved
- Awareness of State Electricity Authority requirements
- Electrical earthing
- Fuses
- Correct fuses to be used
- Replacing fuses
- Station layout for safety
- Power lead safety
- Know location and desirability of a mains OFF switch
- Actions to be taken in the event of an accident involving electricity
- Electric shocks
- Call for help – use of resuscitation techniques
- Battery safety
- Antennas and safety
- Radio waves can be dangerous
- Safe distance from an antenna

- Antenna erection
- Securing and siting antennas
- Lightning protection
- Safe use of headphones
- Station security

k) Measurements

- Frequency measurements
- RF Power measurements
- SWR measurements
- Multimeter measurements

2.10.90 Air Traffic Control Systems Technology

Evidence shall show an understanding of air traffic control systems technology to an extent indicated by the following aspects:

- Regulatory bodies encompassing:
 - structure and function of each of the regulatory bodies

International Civil Aviation Organisation – ICAO

Australian Transport Safety Bureau – ATSB

Civil Aviation Safety Authority – CASA

- standards and recommended practices issued by the regulatory bodies
- relationship between the regulatory bodies and a provider of Air Traffic Services
- Air traffic services encompassing:
 - services provided by Air Traffic Services
 - objectives of Air Traffic Services

- Air traffic control awareness encompassing:
 - process of maintaining an orderly flow of air traffic
 - different states of an aircraft flight
 - need and purpose of flight data regions
 - enroute airspace and sectors
 - airspace and sectors around air traffic control facilities
 - instructions and information exchanged between controllers and pilots
 - information exchanged between air traffic controllers

- The components of an air traffic control system encompassing:

- Air Traffic Management (ATM), Voice Switching and Control (VSCS), Data and Communications Networks, Aeronautical Telecommunications Network (AFTN), Control Maintenance Monitoring (CMM), Buildings & Services
- purpose and function of each of the components of an air traffic control system
- Inputs to the air traffic management system (ATM) encompassing:
 - messages and information received by the ATM system such as surveillance, time, metrological, flight plans and controller input
- Air traffic management (ATM) system architecture encompassing:
 - the various Hardware Configuration Items (HWCI)
 - operating system and other layers of software installed on the ATM system
 - basic block diagram of the ATM system indicating the network topology, data processing subsystem and data presentation processing
 - requirement for redundancy and the master / slave relationship
 - the different partitions, connections and dependencies within the ATM system
 - functions that can be performed from the Control Maintenance and Monitoring work station
- Outputs from the Air Traffic Management (ATM) system encompassing:
 - the Operation Display Suites (ODS) and positions where they are used
 - block diagram of the display suites indicating peripherals and connections
 - different aircraft tracks generated by the ATM system
 - other information shown on an Air Situation Display (ASD)
 - requirement for and use of the recording and playback facility
 - block diagram of the recording and playback facilities showing media devices and connections to the replay position
 - requirement for and use of the trace collection facility
 - block diagram of the trace collection facility showing media devices
 - data and information provided to other systems by the ATM system
- The fallback system for ATM encompassing:
 - purpose of the Ultimate Fallback (UFB) system
 - block diagram of UFB indicating peripherals and connections
 - operating system and application software installed on the UFB computers
 - information used by UFB
 - how the information is presented to the air traffic controllers
 - actions required by an air traffic controller to access UFB system

- Voice switching and control System (VSCS) encompassing:
 - purpose of the Voice Switching and Control System (VSCS)
 - top level block diagram of the VSCS
 - top level operation and protocols used by the VSCS
 - various VSCS interfaces and functionality they provide
 - basic operation of an air to ground communication facility
 - need for and basic operation of air ground retransmission
 - requirement for and use of the audio recording and replay facility
 - block diagram of the audio recording and replay facilities showing the media access devices and connection to the VSCS
 - functionality provided by the System Management System (SMS)
- Fallback for the voice switching and control system (VSCS) encompassing:
 - purpose and functionality provided by the Air Ground Air (AGA) Bypass facility
 - purpose and functionality provided by the Ground Ground (GG) Bypass facility
 - block diagram of the VSCS and AGA Bypass connections
 - block diagram of the VSCS and GG Bypass connections
 - how an air traffic controller would access the AGA or GG Bypass facility if required
- Data and communication networks encompassing:
 - purpose and primary use of the networks used by the air traffic control system
 - systems and end users of each of the networks
 - block diagram to show the high level architecture of each of the networks
 - function of the networking devices used by the networks
 - technologies and protocols used by the networks
- Aeronautical Fixed Telecommunications Network (AFTN) encompassing:
 - function of the AFTN
 - structure and type of message carried by the traditional AFTN
 - type of messages that can be distributed by more contemporary message systems
 - services provided by contemporary message systems
 - basic block diagram of a contemporary message system
- Buildings and services encompassing:
 - building layout and format of an air traffic control centre
 - building layout and format of an air traffic control tower
 - services required to support an air traffic control centre
 - block diagram of the air traffic control centre electrical power system including main

- power, standby generator, UPS, batteries, switching equipment
- block diagram of the air traffic control centre airconditioning system including the major components and the primary and secondary loops
- basic flow chart to show the interaction between the fire system and other services in the air traffic control centre
- physical security requirements of an air traffic control centre
- components and operation of the security system used in an air traffic control centre

- Tower situational awareness display (TSAD) encompassing:
 - need for and functionality provided by the Tower Situational Awareness Display (TSAD) System
 - block diagram of a TSAD installation
 - the source of and the information used by the TSAD system
 - operating system and application software installed on the TSAD computers

- Aeronautical Reference Data Display and Distribution System (ARDDDS) encompassing:
 - functionality provided by ARDDDS
 - block diagram of an ARDDDS installation
 - information used by the ARDDDS
 - operating system and application software installed on the ARDDDS computers

- Navigational aids encompassing:
 - purpose and functionality provided the navigational aids
 - location of navigational aids
 - basic principle of operation of the navigational aids

2.2.11 Equipment and tools

2.11 Equipment and tools

2.11.1 Hand tools

Evidence shall show an understanding of hand tools and their use to an extent indicated by the following aspects:

a) Hand tools for cutting, shaping, drilling, threading, tapping, and finishing

metallic and non-metallic components encompassing:

- types of tools and their purpose
- techniques for the correct and safe use of these tools
- hazards associated with their use
- care and maintenance of hand tools

b) Tools for measuring and marking out.

- types of tools and their purpose
- techniques for the correct and safe use of these tools
- hazards associated with their use
- care and maintenance of hand tools

c) Tools for dismantling and assembling electrical and electronic components encompassing:

- types of tools and their purpose
- techniques for the correct and safe use of these tools
- hazards associated with their use
- care and maintenance of hand tools

2.11.2.1 Power tools

Evidence shall show an understanding of fixed and portable tools and their use to an extent indicated by the following aspects:

a) Fixed power tools for cutting, shaping, drilling, and finishing metallic and non-metallic components encompassing:

- types of tools and their purpose
- techniques for the correct and safe use of these tools
- hazards associated with their use
- care and maintenance of fixed power tools

b) Portable power tools for cutting, shaping, drilling, and structural components encompassing:

- types of tools and their purpose
- techniques for the correct and safe use of these tools
- hazards associated with their use
- care and maintenance of fixed power tools
- requirements for use on construction sites.

2.11.2.2 Electrical workshop machines

Evidence shall show an understanding of electrical workshop machines to an extent

indicated by the following aspects:

- a) Fixed position power tools
- b) Tooling used on drilling machines
- c) Twist drills features, sharpening and faults
- d) Drilling operations
- e) Off hand grinding safety and machine set up
- f) Principles of metal cutting encompassing:
 - Factors influencing the action of cutting tools
 - Principles of chip formation
 - Effects of cutting tool geometry
 - Effects of coolants and cutting fluids
- g) Selection of cutting tools
 - Factors influencing tool selection
 - Cutting tool materials
 - Turning cutting tool design
 - Milling cutting tool design
 - Principles of chip control
 - Identification and selection of carbides
- h) Metal cutting conditions
 - Conditions under which tools cut best
 - Determining cutting data
- i) Cutting tool defects
 - Identification of types of tool failures
 - Causes of tool failure
 - Overcoming causes of tool failure

2.11.3.1 Fixing and support devices and techniques

Evidence shall show an understanding of accessories and support and fixing device and methods and their use to an extent indicated by the following aspects:

- a)
Electrical/electronic/instrumentation/refrigeration/airconditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories.
- b) Device for securing and mounting electrical/electronic accessories encompassing:

- types and safe application of screws, bolts, rivets and similar devices
- types and safe application of devices for fixing to timber, metal, hollow structures and masonry and concrete
- types and safe application of fixing adhesives and tapes
- hazards and safety measures when working with adhesives and chemical fixing devices
- regulatory requirements for use of powder fixing tools.

2.11.3.2 Mobile plant, tools and equipment

Evidence shall show an understanding of tools and equipment for use with mobile plant to an extent indicated by the following aspects:

- a) Types of plant and their use
- b) Regulatory requirements for use of specific plant and equipment

2.11.4 Dismantling and assembling techniques

Evidence shall show an understanding of techniques for assembling and dismantling electrotechnology apparatus to an extent indicated by the following aspects:

- a) Purpose of sequencing dismantling and assembling.
- b) Importance of marking/labelling and storing parts
- c) Techniques for dismantling and assembling close fitting parts.
- d) Use of gasket and seals.

2.11.5 Basic electrical testing and measuring devices and techniques

Evidence shall show an understanding of the safe use and care of portable voltage testers, voltmeters, ammeters and resistance measuring instruments to an extent indicated by the following aspects:

- a) Types of voltage testers, multimeters, clamp meters, continuity testers and insulation resistance testers and their application.
- b) Features of testing/measuring devices

Note:

Features include safety, user calibration and parameter and range settings.

- c) Connection of test/measuring devices into a circuit encompassing:

- safety procedures
- circuit arrangement of test/measuring devices

d) Taking readings

e) Storage, maintenance and care of test/measuring devices.

f) Australian Standard quality assurance requirements for test equipment calibration certification.

2.11.6.1 Advance electrical testing and measuring devices

Evidence shall show an understanding of the safe use and care of advance measuring instruments to an extent indicated by the following aspects:

a) Test/measuring devices and their application

b) Connection of test/measuring devices into a circuit encompassing:

- safety procedures
- circuit arrangement of test/measuring devices

c) Taking readings

d) Storage, maintenance and care of test/measuring devices

2.11.6.2 Electrical field testing and measurement techniques

Evidence shall show an understanding of electrical field testing and measurement to an extent indicated by the following aspects:

a) Measurement concepts encompassing:

- notion of error, accuracy, resolution
- sources of measurement error and uncertainties
- instrument specifications and calibration certificates
- test and measuring instrument safety certification levels and their application.

b) Types of field measuring instruments and their application encompassing:

- instrument meter movements and readouts

Note

These include moving coil, moving iron and dynamometer meter movements, LCD digital and screen readouts.

- Role of a microprocessor/controller in measuring instrument.

c) Measuring low voltages and direct and alternating currents encompassing:

- low voltage and current measurement techniques embodied in

microprocessor based instruments.

- causes of inaccuracies and overcoming them.
- test instrument set up and safety procedures
- interpreting test readings.

d) Measuring high voltages and direct and alternating currents encompassing:

- high voltage and current measurement techniques embodied in microprocessor based instruments.
- causes of inaccuracies and overcoming them.
- test instrument set up and safety procedures
- interpreting test readings.

Measuring fault levels and (earth) fault loop impedance encompassing:

- fault and fault loop impedance measurement techniques embodied in microprocessor based instruments.
- causes of inaccuracies and overcoming them.
- test instrument set up and safety procedures
- interpreting test readings.

e) Measuring power, energy, reactive power, power factor and maximum demand encompassing:

- power measurement techniques embodied in microprocessor based instruments.
- causes of inaccuracies and overcoming them.
- test instrument set up and safety procedures
- interpreting test readings.

f) Measuring power quality encompassing:

- power measurement techniques embodied in microprocessor based instruments.
- causes of inaccuracies and overcoming them.
- test instrument set up and safety procedures
- interpreting test readings.

Note.

Power quality measurement includes waveform distortion, harmonics, power factor and transients.

2.11.6.3 Power cable fault detection techniques

Evidence shall show an understanding of power cable fault detection to an extent indicated by the following aspects:

a) Typical power cable faults

Note.

Faults include poor connection (high resistance), open-circuit, insulation breakdown and arcing.

b) Cable fault detection techniques.

Note.

Techniques include Varley and Murray loop tests, Pulse test, Echo test, Radio based tests.

c) Application and limitations of the various cable fault detection techniques encompassing:

- cable fault detection techniques embodied in microprocessor based instruments.
- causes of inaccuracies and overcoming them.
- test instrument set up and safety procedures
- interpreting test readings.

2.11.7.1 Electronic testing and measuring devices and techniques

Evidence shall show an understanding of the safe use and care of electronic measuring instruments to an extent indicated by the following aspects:

a) Test/measuring devices and their application

Note

Examples are analogue and digital multimeters, voltage and digital testers, signal generators and oscilloscopes

b) Connection of test/measuring devices into a circuit encompassing:

- safety procedures
- circuit arrangement of test/measuring devices

c) Taking readings

d) Storage, maintenance and care of test/measuring devices

2.11.7.2 Advanced electronic testing and measuring devices and techniques

Evidence shall show an understanding of the safe use and care of advance electronic measuring instruments to an extent indicated by the following aspects:

a) Test/measuring devices and their application

Note

Examples are frequency counters, and synthesisers, spectrum analysers, noise and

distortion meters and RF communications service monitor.

b) Connection of test/measuring devices into a circuit encompassing:

- safety procedures
- loading and matching
- storage and delay
- circuit arrangement of test/measuring devices

c) Taking and interpreting readings

d) Notion of decibels including dBm, dBr, dBu, dBo

2.11.8 Data and voice cabling testing and testing devices

Evidence shall show an understanding of data and voice cabling testing and the correct and safe use and care of testing devices to an extent indicated by the following aspects:

a) Performance parameters associated with copper cables, coaxial cables and optical cables encompassing:

- Open circuit, short circuit and pair continuity
- Split pair and crossed pair
- Attenuation
- Return loss
- Insulation Resistance (leakage)
- Near end cross talk (NEXT)
- Attenuation to cross talk ratio (ACR)
- Loop resistance
- Noise (Impulse noise and average noise)
- Characteristic impedance

Note:

Structured cabling including, twisted pair cabling, shielded twisted pair (STP), unshielded twisted pair (UTP) and higher performance cabling.

b) Test results for compliance with required regulation, standards, and or codes for structured copper cables, coaxial; and optical fibre cables encompassing:

- Tests required to evaluate a given performance parameter
- Test equipment and leads needed to evaluate a given performance parameter.
- Operation of test equipment for correct evaluation of specific cable performance parameters and to obtain accurate and reliable results.
- Transmission performance requirements.

c) Testing and validation of a customer premises cabling installation encompassing:

- Requirements of current Standard of site certification for high performance copper cables, coaxial cable and optical fibre cables
- Reporting requirements for the completion of work related to conformity of a cabling installation.
- Documentation required in certifying a cabling installation conforms to relevant standards and specifications.

d) Optical Time Domain Reflectometer (OTDR) operating principles, applications and calibration procedures.

e) Typical causes of non compliant test results.

2.11.9.1 Basic refrigeration testing and measuring field devices

Evidence shall show an understanding of the safe use and care of refrigeration testing devices to an extent indicated by the following aspects:

a) Test/measuring devices and their application

b) Connection of test/measuring devices component/system under test encompassing:

- safety procedures
- testing arrangement of test/measuring devices

c) Taking readings

d) Leak detection techniques

e) Storage, maintenance and care of test/measuring devices

Note:

Examples of testing and measuring devices are those used for temperature, pressure measurement and leak detection.

2.11.9.2 Fitting and removing refrigeration service gauges

Evidence shall show an understanding of techniques for working with refrigeration service gauges to an extent indicated by the following aspects:

a) Risks of working with refrigerants and rotating equipments

b) Types, applications and care of service gauges and hoses

c) Types, applications and care of refrigeration system access fittings

d) Procedures for use of service gauges with minimal loss of refrigerant, including: fitting, removing air, reading gauges, using pressure temperature scales/charts and

removing.

2.11.9.3 Replacement of basic components on a refrigeration system

Evidence shall show an understanding of techniques for replacing basic components on a refrigeration system to an extent indicated by the following aspects:

- a) Risks of working with refrigerants and rotating equipment
- b) Refrigerant isolation/pump down/recovery
- c) Prevention of system contamination
- d) Protection of damage to surrounding equipment/environment
- e) Pressure testing and refrigerant leak detection

2.11.9.4 Appliance diagnostic tools

Evidence shall show an understanding of appliance diagnostic tools to an extent indicated by the following aspects:

- a) Types, construction, operation and application of electrical, electronic and mechanical diagnostic tools

Note.

Examples are appliance manufacturer specific diagnostic tools, binary code via LED display; Test instruments such as multimeters, clamp meters, insulation resistance meters, power analysers and high voltage testers; data loggers, microwave leak detectors, gas (hydrocarbon) detectors and sound meters

- b) Installation requirements, adjustments and safety encompassing:

- Manufacturers' instructions and data
- Installation safety
- Effects and risks of electrical current and mechanical movement
- Protection against indirect contact

- c) Computer and paper based diagnostic tools encompassing:

- Appliance manufacturers programs
-

Note.

Examples are binary code via LED display, remote fault diagnosis via phone access and remote fault diagnosis via Internet

- Text books and manufacturers data

- d) Service, fault finding and repair encompassing:

- Manufacturers' data

- Safety checks
- Operating sequence
- Typical symptoms
- Fault identification using diagnostic tools
- Confirmation of fault
- Repairs limitations

2.11.10.1 Basic air conditioning measurement devices

Evidence shall show an understanding of the safe use and care of basic air conditioning measurement devices to an extent indicated by the following aspects:

- a) Measuring devices and their application
- b) Connection of measuring devices to component/system under test encompassing:
 - safety procedures
 - arrangement of measuring devices
- c) Taking readings
- d) Storage, maintenance and care of measuring devices

Note:

Examples of air conditioning measuring devices are those applicable to air velocity and air flow rates across a grille/register, air temperature, and relative humidity. These instruments include anemometers, thermometers, sling psychrometers.

2.11.10.2 Air conditioning testing devices

Evidence shall show an understanding of the safe use and care of air conditioning testing devices to an extent indicated by the following aspects:

- a) Test/measuring devices and their application
- b) Connection of test/measuring devices component/system under test encompassing:
 - safety procedures
 - testing arrangement of test/measuring devices
- c) Taking readings
- d) Storage, maintenance and care of test/measuring devices

Note:

Examples of air conditioning testing/measuring devices are those applicable to air volume, air velocity, air pressure, air temperature, air relative humidity and sound

levels.

2.11.11.1 Electronic soldering equipment and techniques

Evidence shall show an understanding of electronic soldering equipment and their use to an extent indicated by the following aspects:

a) Electronic soldering equipment encompassing:

- types of equipment and their purpose
- hazards associated with their use
- care and maintenance of brazing and soldering equipment

b) Electronic soldering techniques encompassing:

- safe use of equipment
- preparation of surfaces
- adjusting heat
- application
- basic principles of lead free soldering techniques

2.11.11.2 Surface mount soldering techniques

Evidence shall show an understanding of surface mount soldering technique to an extent indicated by the following aspects:

a) Identification of surface mount components

b) Requirements of standard with respect to surface mount soldering

c) Post solder inspection

d) Ball grid arrays

2.11.11.3 Printed circuit board repair techniques

Evidence shall show an understanding of printed circuit board repair techniques to an extent indicated by the following aspects:

a) Printed wiring board substrate repair encompassing:

- Substrate warpage and cracking damage
- Substrate blistering and delamination

b) Conductor patterns repair

Note.

Examples are pad repair, pad replacement track repair, track alteration, track replacement and the like.

c) Conformal coatings types and their removal and replacement.

2.11.11.4 Lead-free soldering technology

Evidence shall show an understanding of lead-free soldering technology to an extent indicated by the following aspects:

a) Adoption of lead-free solder encompassing:

- Safety issues
- Environmental issues

b) Solder types and characteristics encompassing:

- Solder wires and pastes
-

Note.

Examples are bimetal and trimetal

- Solder characteristics
-

Note.

Examples include melt and wetting temperatures, soldering temperature and flow behaviour.

- Characteristic differences between lead and lead-free solders.
- Industry standards.

c) Types of fluxes and their activity level

Note.

Types include water soluble, no-clean and cleanable fluxes

d) Component requirements for lead-free soldering

- Printed Circuit board (PCB)
-

Note.

Examples include HAZL, ID marking, conformance certificates and re-working old PCBs

- Component considerations
-

Note.

Examples include lead/end cap material, temperature capability and the like.

e) Lead-free soldering cleaning requirements.

Note.

Examples include chemicals and consumable materials, when to clean, white residues and the like.

f) Equipment requirements.

Note.

Examples include temp stability, recovery capability, tip size, tip shape, tip metal mass, tin erosion and the like.

g) Soldering techniques.

Note.

These include soldering tip selection, temperature setting, preheating, use of soldering irons and the like.

h) Completed soldered connections compliance requirements

2.11.12 Instrumentation testing and measuring field devices

Evidence shall show an understanding of the safe use and care of instrumentation testing devices to an extent indicated by the following aspects:

- a) Test/measuring devices and their application
- b) Connection of test/measuring devices component/system under test encompassing:
 - Safety procedures
 - Testing arrangement of test/measuring devices
 - Taking readings
 - Storage, maintenance and care of test/measuring devices

2.11.13.1 Brazing and soldering equipment and techniques

Evidence shall show an understanding of brazing and soldering equipment and their use to an extent indicated by the following aspects:

- a) Silver brazing and soldering equipment encompassing:
 - types of equipment and their purpose
 - hazards associated with their use
 - care and maintenance of brazing and soldering equipment
- b) Silver brazing and soldering techniques encompassing:
 - safe use of equipment
 - preparation of surfaces

- adjusting gas flame
- application
- use of dry nitrogen to prevent contamination

2.11.13.2 Introduction to welding

Evidence shall show an understanding of welding to an extent indicated by the following aspects:

- a) Hazards associated with welding activities and equipment
- b) Welding processes and industry applications
- c) Thermal cutting techniques
- d) Manual metal arc welding processes

2.11.14 Piping and tubing techniques

Evidence shall show an understanding of techniques for working with piping and tubing to an extent indicated by the following aspects:

- a) Risks of working with piping and tubing and their control measures.
- b) Techniques encompassing:
 - Cutting pipe and tubing
 - Bending, shaping/setting pipe and tubing
 - Joining connecting/terminating pipe and tubing, this includes flaring, swaging, silver, brazing and various types of tube and threading fittings

2.11.15 Portable apparatus testing (PAT) devices

Evidence shall show an understanding of portable apparatus testing devices to an extent indicated by the following aspects:

- a) Purpose and features
- b) Testing procedures
- c) Interpretation of test results

2.11.16 Electronic component place equipment

Evidence shall show an understanding of electronic component place equipment to

an extent indicated by the following aspects:

- a) Process control requirements and procedures
- b) Solder paste composition encompassing:
- c) Storage and shelf life
- d) Preparation
- e) Testing
- f) Manual solder paste deposition equipment setup and application
- g) Automatic solder paste deposition equipment setup and application
- h) Automatic component placement systems set up and operation and adjustments
- i) Reflow ovens and solder reflow
- j) Cleaning agents and techniques
- k) Inspection methods and procedures

2.11.17 Electronic assembly correction and rework techniques

Evidence shall show an understanding of techniques for correcting and reworking electronic assemblies to an extent indicated by the following aspects:

- a) Typical faults and their causes requiring correction or rework

Note.

Examples for faults are incorrect components, misalignments, poor connections, design modifications and the like.

- b) Aspects of correction and rework of electronic assemblies

Note.

Examples are readjustment of automated screen printing, component placement equipment and soldering equipment, correcting component selection, manual repair and component substitution.

2.11.18 Electronic assembly functional and quality testing

Evidence shall show an understanding of electronic assembly functional testing to an extent indicated by the following aspects:

- a) Testing encompassing:
 - Equipment set up

Note.

Testing equipment may be specific to a workplace and the electronic assembly

under test

- Routine testing procedures
- Routine interpreting test results within given parameters

b) Quality inspection encompassing:

- Quality items check lists
- c) Non-compliance reporting methods

2.11.19 Electrotechnology engineering practice

Evidence shall show an understanding of engineering practice to an extent indicated by the following aspects:

- a) Scope of work and responsibilities
- b) Working with others in a project team
- c) Maintaining currency in technical and regulatory developments
- d) Applying and working to ethical standards

2.11.20.1 Low voltage motor testing devices and techniques

Evidence shall show an understanding of LV motor testing devices and techniques to an extent indicated by the following aspects:

- a) Test/measuring devices and their application
- b) Connection of test/measuring devices into a circuit encompassing:
 - safety procedures
 - circuit arrangement of test/measuring devices
- c) Taking and interpreting readings
- d) Storage, maintenance and care of test/measuring devices

2.11.20.2 High voltage motor testing devices and techniques

Evidence shall show an understanding of HV motor testing devices and techniques to an extent indicated by the following aspects:

- a) Test/measuring devices and their application
- b) Connection of test/measuring devices into a circuit encompassing:
 - safety procedures

- circuit arrangement of test/measuring devices
- c) Taking and interpreting readings
- d) Storage, maintenance and care of test/measuring devices

2.11.20.3 Electric motor mechanical measuring and testing devices and techniques

Evidence shall show an understanding of electric motor mechanical testing devices and techniques to an extent indicated by the following aspects:

- a) Devices and techniques for measuring geometric attributes
- b) Operational Test/measuring devices and their application
- c) Setting up test/measuring devices encompassing:
 - safety procedures
 - set up procedures
- d) Taking and interpreting readings
- e) Storage, maintenance and care of test/measuring devices
- f) Measurement standards encompassing:
 - traceability relating to instruments and measurement
 - accuracy versus precision
 - quality assurance
 - errors in measurement
- g) Measuring device calibration and certification systems

2.2.12 Instrumentation

2.12 Instrumentation

2.12.1 Instrumentation principles

Evidence shall show an understanding of instrumentation principles to an extent indicated by the following aspects:

- a) The role of measurement in industrial processes.
- b) Instrument measurement terminology.
- c) The standards applicable to instrumentation and process control.

Note:

Examples include fluids and respective process piping colour coding, instrument symbols

d) Instrumentation basic calibration process

Notes:

Confined to Lever/Link mechanisms

e) Instrumentation tables and graphs.

2.12.2 Pressure

Evidence shall show an understanding of pressure to an extent indicated by the following aspects:

a) Concept of pressure and its units of measurement

Note:

For examples the relationship between pressure height and density of liquid columns and force exerted by pressure on a surface

b) Factors defining pressure and their relationship.

Note:

Examples include absolute pressure, gauge pressure, and differential pressure

c) Methods and devices for measuring pressure encompassing:

- Operation and characteristics of mechanical gauge elements
- Operation and characteristics of electrical pressure measuring devices
- Pressure measurement and calibration devices and methods.

d) Factors affecting pressure measurement

2.12.3 Density and level

Evidence shall show an understanding of density and level to an extent indicated by the following aspects:

a) Density and relative density

b) Calculate density

c) Level and/or density measuring instruments in common use.

d) Electronic and a pneumatic level measuring instrument encompassing:

- control loop
- pneumatic level measuring device

2.12.4 Fluid flow

Evidence shall show an understanding of fluid flow to an extent indicated by the following aspects:

a) Principles of fluid flow (gas and liquid) encompassing:

- basic laws of fluid flow
- fluid flow characteristics.

b) Units of fluid flow and flow rate encompassing:

- SI and other commonly used units.

c) Principles of operation of the common types of flow quantity meters encompassing:

- principles of operation of selected quantity meters including positive displacement flow meters.

d) Principles of operation and characteristics of the differential head types of flow rate meter encompassing:

- principles of operation of the various differential head fluid flow meters.
- characteristics of differential head flow meter
- construction of selected examples of DP flow rate meters.

e) Principles of operation and characteristics of a range of flow rate meters, other than differential head types, in use in industry.

f) Principles of operation of selected flow rate meters

g) Principles of operation of open channel flow meters encompassing:

- the principles of operation of flumes and weirs.
- various shapes of flumes and weirs.

h) Square root extraction, integration and other computations used in relation to fluid flow encompassing:

- Automatic computation in relation to fluid flow.

i) Flow characteristics of a flow rate meter from practical data encompassing:

- characteristics of a flow rate meter.

j) Square root extraction instrument and/or a flow integrator encompassing:

- program, calibrate or adjust a square root extractor or flow integrator.
- report on the performance of the instrument.

2.12.5 Temperature

Evidence shall show an understanding of temperature to an extent indicated by the

following aspects:

a) Temperature and other heat-related phenomena encompassing:

- terms associated with temperature and other heat related phenomena.

b) Temperatures between scales encompassing:

- units commonly used in temperature measurement.
- Imperial and SI units.
- fixed points outlined in the International Practical Temperature Scale.

c) Operation of the primary elements and measuring elements encompassing:

- principles of operation and characteristics of the various temperature sensors and measuring systems.
- operation of the temperature measuring systems.
- operation of the various compensation and protection devices utilised in temperature measuring systems.
- techniques used for the measurement of temperature average and temperature difference using the various types of electrical thermometers.

d) Calibration of temperature system of optimum performance.

2.12.6 Process control systems

Evidence shall show an understanding of process controller principles to an extent indicated by the following aspects:

a) Controller types and basic operation and methods of achieving the control in each of the following

Note.

Examples of controller types are pneumatic; hydraulic; electronic and microprocessor

b) Control modes used on PID controllers as they related to process requirements encompassing:

- control actions
 - control options
 - Set point change
 - Process demand change
-

Note.

Examples are increasing and decreasing controller gain (in systems using P, PI, and PID); with and without Integral (in systems using PI and PID); increasing and decreasing Integral (in systems using PI and PID); with and without derivative (in systems using PID); and increasing and decreasing derivative (in systems using

PID).

- c) Principles of controller alignment.
 - d) Commonly accepted methods of tuning control loops
 - e) Microprocessor based controllers configuration and tuning methods
 - f) Purpose of various control modes and how they are applied
-

Note.

Examples of control modes are feedback, feedforward, cascade, ratio, batch and the like.

- g) Effect of control valve characteristics on the performance of a control loop.

2.12.7 Control valve principles

Evidence shall show an understanding of control valve principles to an extent indicated by the following aspects:

- a) Valve body and trim types and flow characteristics encompassing:

- control valve body types and their typical applications.
- seating and trim arrangements.
- flow characteristics of various valves.

- b) Control valve terms
-

Note.

Examples are leakage, turndown, rangeability, choked, flow, Cv rating, and perform basic calculations and Cv a rating

2.12.8 Control valve selection

Evidence shall show an understanding of control valve selection to an extent indicated by the following aspects:

- a) Valve purpose size and characteristic
- b) Valve manufactures specifications
- c) Valve faults

2.12.9 Actuators and positioners

Evidence shall show an understanding of actuators and positioners to an extent indicated by the following aspects:

a) Spring opposed diaphragm actuator encompassing:

- control valve actuators
- air-to-raise
- air-to-lower.
- fail-safe action of a valve/actuator combination.

b) Actuator characteristics and applications encompassing:

- actuator forces, spring rate values and process pressure on valve performance.
- spring opposed actuator to suit air-to-open and air-to-close valves. Adjust a single seating valve for shut-off.

c) Valve positioners encompassing:

- valve positioner operation.
- Calibrate/adjust valve positioners for various signals.
- cam and spring feedback positioners on control valves.
- pneumatic, electro-pneumatic and electro hydraulic positioners/actuators.
- Reverse positioner control action and adjust for split range.

d) Power cylinder (piston actuator) types encompassing:

- test power cylinders.
- extension and retraction forces.
- single acting positive
- single acting negative
- double acting

e) Position controllers (positioners) encompassing:

- position controllers.

f) Directional control valves and pilot operators

g) Power cylinder pilot valve combinations

Note.

Examples are two, three and five port types, actuation and return modes: solenoid, mechanical, electrical, spring, regulator, filter and lubricator sets and pneumatic control circuits

h) Self-acting pressure and temperature control valves encompassing:

- pressure or temperature regulating valves.
- self-acting valves to load changes.
- pressure reducing and pressure relief valves.
- self acting valve for required control point.

2.12.10 Transmitters and converters

Evidence shall show an understanding of transmitters and converters to an extent indicated by the following aspects:

- a) Pneumatic and electronic transmitters, converters and transducers encompassing:
 - operation of transmitters, transducers and converters.
 - Calibration of various transmitters, converters and transducers
 - typical applications for a range of transmitters, transducers and converters.

2.12.11.1 Industrial processes

Evidence shall show an understanding of industrial processes to an extent indicated by the following aspects:

- a) Principles of operation of the processes studied using diagrams and circuits encompassing:
 - chemistry/physics underpinning the process.
- b) Instrumentation required for each of the selected processes.
- c) System faults encompassing:
 - causes of system failure.
 - fault location diagram.
 - methods to overcome common faults.

2.12.11.2 Process control, commissioning

Evidence shall show an understanding of commissioning process control instruments and systems to an extent indicated by the following aspects:

- a) Purpose of commissioning
- b) Commissioning planning and documentation
- c) Procedures for commissioning instrumentation encompassing:
 - configuring
 - calibrating
 - tuning
 - validating system to drawings
 - procedures followed to commission instrument systems.
- d) Purpose and importance of documentation

2.12.12 Distributive control principles (DCS)

Evidence shall show an understanding of distributive control principles to an extent indicated by the following aspects:

a) Concepts of a DCS encompassing:

- differences between hierarchical and distributive systems.
- Functional and geographical distribution.

b) Individual features of a DCS encompassing:

- Major components in a DCS
- historical and managerial data collection
- type and form of information at the operator and engineering interface levels.

Note.

Distributive control system may include programmable logic controllers, SCADA/touch screen systems, system server and smart devices connected by a control network.

c) Function block technology to design control algorithm encompassing:

- various loop types, using function block technology from an available DCS.

d) Optimum control of a variety of process loops.

e) Connection of field instrumentation for selected control operation and diagnostic checking to ensure correct operation of system.

f) On-line changes to parameters in a DCS with minimum interference to controlled variable.

2.12.13 Instrumentation and control communications

Evidence shall show an understanding of instrumentation and control communications to an extent indicated by the following aspects:

a) Purpose and application of control system networks systems

b) Open and common proprietary control system networks models (layers) and protocols

Note.

Examples of systems are CANopen, ControlNet, Devicenet, Ethernet, Foundation Fieldbus, Interbus, Modbus, and Profibus.

c) Control system networks interface.

d) Remote measurement and control and typical application for telemetry systems.

e) Categories of telemetry systems and the standards which refer to these systems.

- f) Major components of various types of telemetry system.
- g) Signal compatibility used with telemetry systems encompassing:
 - signal conditioning.
 - standard signals levels
- h) Common types of signal conditioning, instruments encompassing:
 - principles of operation signal conditioners and instruments
 - isolators and protection equipment.
- i) Analogue and digital signals encompassing:
 - structure of a typical message block.
 - differences between analogue and digital signals.
 - typical message block used with a digital telemetry systems.
- j) Functions and operation of the main subsections of a digital telemetry system.
- k) Types of cable, connectors, sources and detectors used in a fibre optic telemetry system
- l) Types of transmission links,

2.12.14 Indicators and methods of recording process data

Evidence shall show an understanding of indicators and recorders to an extent indicated by the following aspects:

- a) Types of indicator and their principles of operation.
- b) Indicators in remote measurement loop.
- c) Calibration of indicators.
- d) Methods and applications of recording process data encompassing:
 - Need for process data
 - Types of dedicated recorders and their principles of operation
 - Computerised methods such as supervisory control and data acquisition (SCADA) systems

2.12.15 Gas analysis

Evidence shall show an understanding of gas analysis to an extent indicated by the following aspects:

- a) Principle of operation of various indicators connected in remote measurement loop.

Note.

Examples are reagent analysers (e.g. Orsat), electrolytic, paramagnetic - wind-dumbbell, zirconia oxide, thermal conductivity, thermal reaction, infra-red and the like.

b) Indicator calibration procedure

c) Types of recorder used in process measurement encompassing:

- sampling and conditioning systems.
- prescribed measuring elements.

d) Operation of hygrometers.

2.12.16 Water analysis

Evidence shall show an understanding of water analysis to an extent indicated by the following aspects:

a) Terms associated with industrial water analysis equipment.

b) Industrial applications of specified water analysis equipment.

c) Principle of operation of an analyser sensor.

d) Principle of operation of an analyser measuring elements.

e) Appropriate installation requirements for specified analysers

f) In system checks and instrument calibration

g) Water analyser maintenance procedures.

h) Manufacturers' specifications.

2.12.17 Scientific analysis

Evidence shall show an understanding of scientific analysis to an extent indicated by the following aspects:

a) Wavelength characteristics of the electromagnetic spectrum and radiation sources

b) Basic principles of refraction and dispersion encompassing:

- Wavelength and bandwidth of monochromatic devices.

c) Principle of operation of an absorption spectrometer

d) Principle of operation of an emission spectrometer

e) Principle of operation of an atomic absorption spectrometer encompassing:

f) Principle of operation of a gas chromatography

g) Principle of operation of a liquid chromatography.

h) Principles of operation of basic sample preparative instruments

2.12.18 Weight measurement principles

Evidence shall show an understanding of weighing measurement principles to an extent indicated by the following aspects:

- a) Weighing and the relationship between force and weighing.
- b) Methods of weighing and common factors affecting weighing system performance.
- c) Principles of strain gauge measurement encompassing:
 - compression and tension stress.
 - relationship between stress and strain.
- d) Principles of operation of various load cells in common use encompassing:
 - Pneumatic and hydraulic load cells.
 - Linear Voltage Differential Transformer
- e) Methods of weighing materials in motion encompassing:
 - weigh feeder control
 - method of calibration of a belt weigher.
 - operation of a nuclear radiation conveyor weigher and the safety precautions to be observed.

2.12.19 Instrument calibration methods

Evidence shall show an understanding of instrument calibration methods to an extent indicated by the following aspects:

- a) Purpose of calibration
- b) Calibration and set up techniques encompassing:
 - Following apparatus manufacturer's set up instructions and process requirements
 - Connecting necessary testing devices
 - Making adjustments
- c) Need to document calibration setting and procedures

2.12.20.1 Process equipment installation requirements and techniques

Evidence shall show an understanding of process equipment installation

requirements and techniques to an extent indicated by the following aspects:

- a) Regulatory requirements
- b) Equipment specification
- c) Manufacturer's installation instructions
- d) System specifications
- e) Communication/signal cabling installation requirements
- f) Power wiring requirements
- g) Initial set up procedures

2.12.20.2 Process control arrangements and equipment selection

Evidence shall show an understanding of arrangement of electrical systems in buildings and equipment selection to an extent indicated by the following aspects:

- a) Typical apparatus and circuit loadings
- b) Apparatus arrangement considerations
- c) Control cable selection methods encompassing:
 - Environmental considerations
 - Signal requirements
 - Route length limitations
- d) Control tubing/piping selection criteria
- e) Selection of control cable and tubing/piping support
- f) Documentation of installation arrangements and equipment.

2.12.21 Control system installation, testing and verification methods

Evidence shall show an understanding of testing and verification of control installations to an extent indicated by the following aspects:

- a) Testing and verification requirements.
- b) Device calibration and set up
- c) Testing techniques
- d) Visual inspection methods
- e) Documentation

2.12.22.1 Medical equipment principles

Evidence shall show an understanding of medical equipment principles to an extent indicated by the following aspects:

- a) Equipment function and operation
- b) Hazards and safety procedures
- c) Causes of failure
- d) Safety testing requirements and methods

Note:

Categories and examples of medical equipment are:

1. Cardiovascular systems including: blood warmers, cardiac catheterisation systems, defibrillators, electrocardiogram(ECG) machines, electrocardiogram(ECG) monitors, heart-lung machines, infusion pumps, intra-aortic balloon pumps, pacemakers, syringe pump and cardiac output measurement equipment.

2. Respiratory systems including: anaesthetic delivery and monitoring units, medical gases, oxygen concentrator, pulse oximeter, respiratory humidifier, respiratory support units and ventilators.

3. Neurological systems including: electroencephalograph (EEG recorder), electromyograph (EMG recorder) and intracranial pressure monitoring (ICP).

4. Renal systems including: haemodialysis machine, CVVH machine and peritoneal dialysis.

5. Medical imaging including: x-ray equipment, computerised axial tomography (CT scan), magnetic resonance imaging (MRI), nuclear medicine and diagnostic ultrasound equipment.

6. Physiological equipment including: blood pressure monitors, foetal cardio-tocograph, infant care systems, multiparameter systems, thermometry, telemetry, networking and patient warmers.

7. Miscellaneous equipment including: electrosurgery, electric stimulators, and endoscopy and laparoscopy systems, laser, operating microscopes, therapeutic diathermy and ultra sound.

2.12.22.2 Medical equipment, anatomy and physiology and infection control

Evidence shall show an understanding of medical equipment principles to an extent indicated by the following aspects:

- a) Nature of infection

- b) Control of microbial growth
- c) Infection control strategies
- d) Body systems

2.12.23 Transducers and sensing devices

Evidence shall show an understanding of transducer and sensing devices to an extent indicated by the following aspects:

- a) Measurement principles and concepts encompassing:
 - SI system of units
 - Standards, calibration and traceability
 - Accuracy precision sensitivity and sources of error
- b) Types and operating mechanisms encompassing:
 - Classifications
 - Operating principles measuring and sensing elements

Note.

Examples are detection and measurement of temperature, pressure, flow, and chemical makeup; detection of linear, angular and rotary motion and proximity and level

- basic configurations of measuring circuits.
 - typical device specifications
- c) Installation requirements encompassing:
 - Safety precaution for the various types of devices
 - Connecting devices
 - Locating, aligning and adjusting devices.

2.12.24 Calibration techniques

Evidence shall show an understanding of calibration techniques to an extent indicated by the following aspects:

- a) Principles of common calibration techniques
- b) Purpose of Standards and calibration certification
- c) Minimising error during calibration encompassing:
 - source and type of errors
 - techniques to minimise errors during measurements
 - calculating the degree of error and calibration factors

- d) Determining the parameters to which the device will be calibrated
- e) Need for normal performance check.
- f) Purpose of calibration documentation

2.2.13 Maintenance and repair

2.13 Maintenance and repair

2.13.1 RAPS plant area cleaning

Evidence shall show an understanding of RAPS plant area cleaning to an extent indicated by the following aspects:

- a) Needs for clean and tidy plant area
- b) RAPS system components and associated equipment and their location within the plant area

Note:

Associated equipment may include manual fuel pump

- c) Plant area cleaning techniques

Note:

Cleaning techniques include those for dealing with fuel, oil and acid and spills; removal of dust, insects, spiders, animals and removal of non-RAPS equipment

- d) Technique for reporting and dealing with cleaning issues.

2.13.2 RAPS systems battery bank maintenance techniques

Evidence shall show an understanding of RAPS systems battery bank maintenance to an extent indicated by the following aspects

- a) Scope of regular testing, checking and corrective actions
- b) Measurement of specific gravity and voltages of battery cells; checking and topping up electrolyte levels; checking for acid leakage, cracks in battery casing, corrosion of battery terminals and connections, cleaning of terminal connections and treating with an anticorrosive.

2.13.3 RAPS systems generator sets maintenance techniques

Evidence shall show an understanding of RAPS systems generator sets maintenance to an extent indicated by the following aspects

- a) Checking of radiator and oil level; periodic oil change and air, oil and fuel filter change.
- b) Maintaining log books and maintenance regime

2.13.4 RAPS systems photo voltaic array maintenance techniques

Evidence shall show an understanding of RAPS systems photo voltaic array maintenance to an extent indicated by the following aspects:

- a) Cleaning of photo voltaic modules; checking of module connections, connecting cable and integrity of the array structure
- b) Maintaining log books and maintenance regime

2.13.5 RAPS systems wind generator maintenance techniques

Evidence shall show an understanding of RAPS systems wind generator maintenance to an extent indicated by the following aspects

- a) Checking the integrity of support structure; visual inspection of wind generator operation
- b) Maintaining log books and maintenance regime

2.13.6 RAPS system use auditing techniques

Evidence shall show an understanding of effective RAPS systems use to an extent indicated by the following aspects:

- a) Tidiness of RAPS plant area
- b) Appropriate use of RAPS system components

Note:

Appropriate use includes not overloading system components, using generator supply for heavy loads and the like.

- c) State of RAPS system components

2.13.7 RAPS systems maintenance scheduling

Evidence shall show an understanding of RAPS systems maintenance scheduling to an extent indicated by the following aspects:

- a) Limitation of the role of the RAPS service worker
- b) Periodic maintenance planning procedures

Note:

Planning includes:

1. Development of vehicle booking procedures, check lists for replacement equipment, items to be checked, items to be replaced and procedures for recording and reporting.
 2. Scheduling of maintenance at a number of homeland communities.
 3. Check list for preparation of service vehicle and tools and equipment needed to carry out the maintenance
 4. Processes for sourcing and funding replacement components
-

2.13.8 Scheduled maintenance processors

Evidence shall show an understanding of maintenance processors to an extent indicated by the following aspects:

- a) Maintenance principles encompassing:
 - maintenance function
 - role of maintenance department
 - occupational health and safety requirements
- b) Maintenance systems encompassing:
 - maintenance terminology
 - preventative maintenance
 - predictive maintenance
 - corrective maintenance
- c) Data acquisition encompassing:
 - plant history cards/files
 - inspection techniques
 - predictive maintenance
 - remote visual inspection
 - non-destructive testing
 - thermography
 - vibration analysis
 - oil analysis
- d) Maintenance plan encompassing:

- characteristics of plant operation
- assessment of failure characteristics
- link failure characteristics to maintenance systems
- identify production windows
- resources
- labour
- materials
- establish plan
- implementation procedures

e) Review of maintenance plan encompassing:

- analysis of records
- manual recording methods

f) Computerised recording methods

2.13.9 Business equipment fundamentals

Evidence shall show an understanding of business equipment to an extent indicated by the following aspects:

- a) Type of equipment
- b) Operating principles
- c) Component parts
- d) Routine faults and repairs
- e) Maintenance.

Note:

Documentation requirements for recording the maintenance process and results

2.13.10 Cooling plant maintenance procedures

Evidence shall show an understanding of cooling plant maintenance procedures to an extent indicated by the following aspects:

a) Cooling towers/evaporative condensers encompassing:

- Types, applications.
- Cleaning,
- Decontamination.

b) Humidifiers encompassing:

- Types, applications.
- Cleaning,
- Decontamination.

c) Condensate Trays and drains encompassing:

- Fall,
- Cleaning.

d) Water treatment encompassing:

- Water tests,
- Water testing procedures,
- Ph,
- Microbiological,
- Suspended solids,
- Corrosion,
- Bleed,
- Filtration,
- Chemical Treatment,
- Cathodic Protection.

e) Air Filters encompassing:

- Types, applications.
- Pressure drop,
- Face Velocity,
- Cleaning, Changing,
- Fit.

f) Maintenance programs encompassing:

- Purpose,
- Methods of establishing specific requirements,
- Planning,
- Manual and Computer programs,
- Log books

g) Personal Safety encompassing:

- Risks to service personnel and public,
- Safe practices,
- Person protective equipment.

h) Legal Requirements encompassing:

- Duty of Care.

i) Codes and regulations encompassing:

- Regulation under Workplace Health and Safety Act,

- NH&MRC recommendations,
- Code of practice,
- AS3666.

2.2.14. Rail signalling

2.14. Rail signalling

2.14. 1 Basic rail operations

Evidence shall show an understanding of basic rail operations to an extent indicated by the following aspects:

- a) Rail terminology
- b) Train dynamics
- c) Essentials of safe movement of trains
- d) Purpose of rail signalling

2.14.2.1 Rail signalling principles, electrical

Evidence shall show an understanding of electrical rail signalling principles to an extent indicated by the following aspects

- a) Overview of electrical rail signalling
- b) Purpose of elements of an electrical rail signalling systems.

Note:

Elements include signals, point actuating systems, locking and train detection systems, control input devices, indicators, diagrams and monitors, interlocking, and safe working systems.

2.14.2.2 Rail signalling principles, mechanical

Evidence shall show an understanding of mechanical rail signalling principles to an extent indicated by the following aspects:

- a) Overview of mechanical rail signalling
- b) Purpose of elements of a mechanical rail signalling systems.

Note:

Elements include signals, point actuating systems, locking and train detection systems, control input devices, indicators, diagrams and monitors, interlocking, and safe working systems.

2.14.3 Rail signalling, mechanical equipment

Evidence shall show an understanding of rail signalling, mechanical equipment to an extent indicated by the following aspects:

- a) Equipment and their components
- b) Operating principles
- c) Servicing procedures.

2.14.4 Rail signalling, electrical equipment

Evidence shall show an understanding of rail signalling, electrical equipment to an extent indicated by the following aspects:

- a) Equipment and their components
- b) Operating principles
- c) Servicing procedures.

2.14.5 Rail signalling, point actuating devices

Evidence shall show an understanding of point actuating devices to an extent indicated by the following aspects:

- a) Equipment and their components

Notes:

Equipment include point machines, detectors, claw/clamp locks, swing nose mechanisms, in-bearer mechanisms

- b) Operating principles
- c) Servicing procedures

2.14.6 Rail signalling, electronic equipment

Evidence shall show an understanding of electronic equipment used in rail signalling to an extent indicated by the following aspects:

a) Equipment and their components

Notes:

Examples include telemetry (SCADA), monitoring systems, IASS, train describer, panel processors,

b) Operating principles and parameters

c) Servicing procedures.

2.14.7 Rail signalling, computer-based interlocking

Evidence shall show an understanding of computer-based equipment to an extent indicated by the following aspects:

a) Equipment and their components

Notes:

Examples include solid state interlocking (SSI), Microlock, Westrace

b) Operating principles and parameters

c) Servicing procedures.

2.14.8 Rail signalling, computer applications

Evidence shall show an understanding of application software used in rail signalling to an extent indicated by the following aspects:

a) Types of software and their scope

Note:

Examples include interrogator software for loggers, monitors and computer based interlocking, data base (work instruction, commissioning work structures, and cable schedules.

b) Setting up and use.

2.14.9 Rail signalling, train detection

Evidence shall show an understanding of train detection to an extent indicated by the following aspects:

a) Equipment and their components

Notes:

Example include track circuits axel counters and treadles level crossing predictors

- b) Operating principles and parameters
- c) Servicing procedures

2.14.10 Rail signalling, remote control systems

Evidence shall show an understanding of rail signalling remote control systems to an extent indicated by the following aspects:

- a) Equipment and their components
-

Notes:

Examples include PLC, dedicated PCs, prep. systems

- b) Operating principles and parameters
- c) Servicing procedures.

2.14.11.1 Rail signalling, interlocking systems, electrical

Evidence shall show an understanding of electrical rail signalling interlocking systems to an extent indicated by the following aspects:

- a) Equipment and their components
-

Notes:

Examples include route setting (entrance, exit or OCS), automatic signalling, electromechanical, mechanical

- b) Operating principles and parameters
- c) Servicing procedures.

2.14.11.2 Rail signalling, interlocking systems, mechanical

Evidence shall show an understanding of mechanical rail signalling interlocking systems to an extent indicated by the following aspects:

- a) Equipment and their components
- b) Operating principles and parameters
- c) Servicing procedures.

2.14.12 Rail signalling, power supplies

Evidence shall show an understanding of rail signalling power supplies to an extent indicated by the following aspects:

a) Equipment and their components

Notes:

1. Examples of sources include mains, transformers, motor alternator sets, photo voltaic arrays, and primary and secondary battery banks, UPSs.
 2. Components GGIs, automatic transfer switches circuit, earthing and surge protection, switchboards, rectifiers, converters, chargers and cabling
-

b) Operating principles and parameters

c) Servicing procedures.

2.14.13 Rail signalling, electro-pneumatic equipment

Evidence shall show an understanding of rail signalling electro-pneumatic equipment to an extent indicated by the following aspects:

a) Equipment and their components

Notes:

Examples include compressors, air lines, control valves

b) Operating principles and parameters

c) Servicing procedures.

2.14.14 Rail signalling, drawings and diagrams

Evidence shall show an understanding of drawings, diagrams and schedules for rail signalling to an extent indicated by the following aspects:

a) Drawing types and applications encompassing:

- Drawing layouts and conventions.
- Drawing symbols

b) Cable and equipment schedules

2.14.15 Rail signalling, regulations and codes

Evidence shall show an understanding of regulations and codes for rail signalling to

an extent indicated by the following aspects:

- a) Codes philosophy and format
- b) How to read and apply a code
- c) Codes that apply to rail signalling

Note:

Codes are relevant to a particular rail network.

2.2.15 Refrigeration and air conditioning apparatus

2.15 Refrigeration and air conditioning apparatus

2.15.1 Refrigeration compressors

Evidence shall show an understanding of refrigeration compressors to an extent indicated by the following aspects:

- a) Functions of the compressor in a refrigeration system
- b) Types of compressors and their application

Note:

Types of compressors include reciprocating; rotary; centrifugal; scroll; screw.

- c) The methods of lubrication
- d) Lubricants

Note:

Basic types and safe handling

2.15.2 Condensers, liquid receivers and cooling towers

Evidence shall show an understanding of refrigeration condensers, liquid receivers and cooling towers to an extent indicated by the following aspects:

- a) Functions of condensers, liquid receivers and cooling towers
- b) Types of condensers, liquid receivers and cooling towers, and their applications

2.15.3 Evaporators

Evidence shall show an understanding of evaporators to an extent indicated by the following aspects:

- a) Functions of evaporators
- b) Types of evaporators and their applications
- c) Types and applications of secondary refrigerants
- d) Water treatments in water cooled evaporators encompassing:
 - Need for water treatment
 - Water treatment methods
 - Regulatory requirements

2.15.4.1 Refrigerant flow controls and distributors

Evidence shall show an understanding of refrigerant flow controls and distributors to an extent indicated by the following aspects:

- a) Types and application and operation of the various liquid flow controls and distributors found in a refrigeration system.
- b) Types, and application and operation of the various vapour flow controls and distributors found in a refrigeration system.
- c) Techniques for testing and adjusting liquid flow controls and distributors.
- d) Techniques for testing and adjusting vapour flow controls and distributors.
- e) Procedures for removing and installing refrigerant flow controls and distributors from operating systems with due regard to safety and refrigerant conservation.

2.15.4.2 Refrigerant control selection

Evidence shall show an understanding of refrigerant control selection to an extent indicated by the following aspects:

- a) Types, application, operation, and selection of the refrigerant flow controls and distributors found in a refrigeration system.

Note:

Examples include TX valves and other metering devices, CPR valves, EPR valves, solenoid valves, hand valves

- b) Types, application, operation and selection of the refrigerant pressure sensing controls found in a refrigeration system.

Note:

Examples include low pressure controls, high pressure controls and oil pressure

controls

c) Types, application, operation and selection of the temperature/humidity sensing controls found in a refrigeration system.

Note:

Examples include thermostats, humidistat's and defrosts controls.

2.15.4.3 Refrigerant Metering Devices

Evidence shall show an understanding of refrigerant metering devices to an extent indicated by the following aspects:

- a) Functions of refrigerant metering devices
- b) Overview of the major types of refrigerant metering devices, and their applications

2.15.5 Pumps

Evidence shall show an understanding of pumps to an extent indicated by the following aspects:

- a) Function of pumps in refrigeration and air conditioning systems
- b) Types of controls associated with pumps and their function.

2.15.6 Fans and air distribution

Evidence shall show an understanding of fans and air distribution components to an extent indicated by the following aspects:

- a) Functions, types, operation and application of fans
- b) Air distribution methods and control devices
- c) Air flow measurement and adjustment methods
- d) Functions, types, operation and application of air filters

2.15.7 Small appliance repair

Evidence shall show an understanding of small appliance repair to an extent indicated by the following aspects:

- a) Types, applications, operating principles and characteristics
- b) Motors and drive mechanisms
- c) Control and over current protection methods and devices
- d) Typical small appliance faults encompassing:
 - Motor faults
 - Power supply faults
 - Control faults
 - Mechanical faults

2.15.8 Domestic appliance principles

Evidence shall show an understanding of domestic appliance principles to an extent indicated by the following aspects:

- a) Major appliances encompassing:

Note.

Examples of major appliances are washing machines, clothes dryers, dishwashers, refrigerators, freezers, air conditioners, electrical and gas cookers and heaters

- Installation codes, statutory requirements and regulations
 - Manufacturer and company installation requirements and warranty implications
 - Site preparation and accessibility.
 - Fixing and procedures and methods for connecting services.
- b) Operation principles of major domestic appliances that use electrical, gas and/or water services and/or incorporate refrigeration encompassing:
 - Purpose and operational options.
 - Functions of major components.
 - c) Operational testing and set up procedures encompassing:
 - Pre-start checking.
 - Safety controls checking.
 - Operating cycle testing and control adjustments

2.15.9.1 Appliance refrigeration systems

Evidence shall show an understanding of refrigerated appliances to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics

- b) Typical component wear or defects
- c) Typical faults
- d) Component repair/replacement methods
- e) Manufacturers' parts catalogues and service reports

2.15.9.2 Capillary systems

Evidence shall show an understanding of capillary systems to an extent indicated by the following aspects:

- a) Requirements of Domestic Refrigeration Code of Practice.
- b) Function, types, construction, characteristics and applications encompassing:
 - system unloading
 - calculating system operating pressures
 - critical length
 - critical charge
- c) Faults leading to repair/replacement of a capillary tube
- d) Selection of replacement capillary tubes.
- e) Procedures for commissioning and servicing a capillary tube system.

2.15.9.3 Retrofitting domestic refrigeration systems

Evidence shall show an understanding of retrofitting domestic refrigeration systems to an extent indicated by the following aspects:

- a) Reasons for retrofitting encompassing:
 - Montreal Protocol
 - Kyoto Summit
 - Global warming
 - AS Codes of Practice
 - Acts and Regulations
- b) System Analysis encompassing:
 - Equipment identification
 - Systems options
- c) Refrigerant selection encompassing:
 - Safety considerations
 - ANSI / ASHRAE Standard 34

- AIRAH Refrigerant Selection Guide
- Transitional and drop in-refrigerants
- Medium and long term refrigerants
- Refrigerant selection considerations
- Domestic refrigeration system performance testing
- Refrigerant recovery, recycling or reclaim
- Lubricant selection considerations

d) Retrofit procedure encompassing:

- Flushing procedures
- Retrofit procedure for CFC to blended refrigerants

e) Performing a retrofit encompassing:

- Refrigerant recovery
- Flushing the system
- Oil and drier replacement
- Evacuation
- Refrigerant charging
- System labelling

2.15.9.4 Split air conditioning systems

Evidence shall show an understanding of split air conditioning systems to an extent indicated by the following aspects:

a) Wall hung and floor mounted types and applications

b) Construction and components

Note:

Examples are compressors, condensers, evaporators, metering devices, service ports; functions, types, basic operation

c) Evaporation and condensing temperatures and pressure design and operating characteristics

2.15.10 Clothes washers and dryers

Evidence shall show an understanding of clothes washers and dryers to an extent indicated by the following aspects:

a) Types, applications, construction, components and operating characteristics

b) Typical component wear or defects

- c) Typical faults
- d) Component repair/replacement methods
- e) Manufactures' parts catalogues and service reports

2.15.11 Dish washing machines

Evidence shall show an understanding of dish washing machines to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics
- b) Typical component wear or defects
- c) Typical faults
- d) Component repair/replacement methods
- e) Manufactures' parts catalogues and service reports

2.15.12 Gas cooking appliances

Evidence shall show an understanding of gas cooking appliances to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics
- b) Typical component wear or defects
- c) Typical faults
- d) Component repair/replacement methods
- e) Manufactures' parts catalogues and service reports

2.15.13 Room air conditioners

Evidence shall show an understanding of room air conditioners to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics
- b) Typical component wear or defects
- c) Typical faults
- d) Component repair/replacement methods
- e) Manufactures' parts catalogues and service reports

2.15.14 Appliance, testing and compliance verification methods

Evidence shall show an understanding of appliance testing and compliance verification to an extent indicated by the following aspects:

- a) Mandatory testing and verification requirements.
- b) Appliance efficiency
- c) Testing techniques
- d) Visual inspection methods

2.15.15 HVAC control systems fundamentals

Evidence shall show an understanding of HVAC control systems to an extent indicated by the following aspects:

- a) Control fundamentals
 - control terminology
 - HVAC system characteristics
 - control system characteristics
 - control system components
 - product knowledge
- b) Types of control equipment
 - pneumatic:
 - terminology
 - symbols
 - pneumatic control systems
 - air supply equipment
 - thermostats
 - controllers
 - actuators
 - relays - switches
 - electrical:
 - classification of circuits
 - two position control
 - floating control
 - sensors
 - controllers
 - flow control devices
 - electronic:

- operating principles
- sensors
- controllers
- control systems

c) DDC systems

- terminology
- controllers
- controller software
- basic controller programming
- applications

d) Control systems applications

- air handling system controls
- ventilation
- heating
- building airflow system control
- airflow control - singles and multi -
- zones
- chiller boiler and distribution system control (chilled water, boiler, distribution systems)

e) Supervisory control systems

- systems function
- configurations
- introduction building management
- remote building control interface and modem

2.15.16 Energy management systems for commercial refrigeration

Evidence shall show an understanding of energy management systems for commercial refrigeration to an extent indicated by the following aspects:

a) Functions of a commercial refrigeration E.M.S.

- General control function
- Inputs
- Outputs
- Communications
- Graphing
- Supervising
- Data logging
- Scheduling

- Alarms
- Power consumption

b) E.M.S. control components

- Identify components
- Pressure sensors
- Temperature sensors
- Time clocks
- Humidity sensors
- Liquid level sensors
- Leak detector sensor
- State the function and operating parameters of components
- Pressure sensors
- Temperature sensors
- Time clocks
- Humidity sensors
- Liquid level sensors
- Leak detector sensors

c) Installation requirements and consideration

- Installation of controller(s)
- Installation of refrigerant leak detector
- Systems
- Installation of accessory boards
- Installation of pressure transducers & wiring
- Installation of temperature sensors & wiring
- Control wiring considerations

d) System design and applications

- Select control components to suit given applications
- Determine system operating parameters
- Pressure sensors
- Temperature sensors
- Time clocks
- Humidity sensors
- Liquid level sensors
- Leak detector sensors
- Defrost
- Alarm panel

e) Programming a control system

- Display terminal and keypad functions

- Calibration of sensors
- Changing original settings
- Program a given set of parameters to suit an application

f) Component testing and fault finding

- Trouble shooting
- Testing of components

2.15.17 Refrigeration/HVAC direct digital controls

Evidence shall show an understanding of refrigeration/HVAC direct digital controls to an extent indicated by the following aspects:

a) Computer based control fundamentals

- Definitions
- Principles

b) Controller configuration

- Equipment
- Zone level controllers
- System level controllers

c) Controller software

- Operating software
- Application software

d) Controller programming

- System diagrams
- Control diagrams
- Configuration
- Programming
- Initialisation
- EMS, BMS
- SCADA system
- Lan, Bacnet

e) Sensors and actuators

f) Applications

- Refrigeration systems
- HVAC systems
- Logic analysis
- Energy management
- Asset management

- Life cycle

2.15.18 Refrigeration/HVAC pneumatic controls

Evidence shall show an understanding of refrigeration/HVAC pneumatic controls to an extent indicated by the following aspects:

a) Control fundamentals

- Pneumatic control terminology
- Definitions

b) Control basics

- Air supply
- Pilot bleed system
- Signal amplifier
- Sensing elements
- Relays and switches

c) Air supply system

- Air drying methods
- Pressure regulating valves
- Pressure reducing valves

d) System controllers

- Thermostats
- Sensors
- Actuators
- Dampers

e) System control configuration

- Sequence control
- Limit control
- Changeover control
- Compensated control
- Recycling control
- Pneumatic – electric control

f) Control systems

- Refrigeration systems
- Ventilation systems
- Multi-zone A/C systems
- Variable air volume A/C systems
- Face and by-pass system

- Economiser system
- Chilled water systems
- Hot water systems

2.15.19 HVAC air systems

Evidence shall show an understanding of HVAC air systems to an extent indicated by the following aspects:

a) Air distribution principles

- air diffuser selection
- factors affecting the design of ductwork systems
- types of ductwork systems
- static, velocity and total pressure
- laminar and turbulent flow
- moody diagram
- parameters that control cost

b) Pressure loss

- friction and dynamic
- Colebrook - White formula
- in ducts, friction charts
- in fittings, loss co-efficient
- fitting selection criteria
- diffuser pressure loss

c) System sizing

- velocity method
- equal friction method
- static regain method
- balanced pressure drop method
- circular to rectangular equivalent
- standard duct sizes and gauges
- balancing

d) Heat and leakage losses

- heat gain/loss calculation
- bare vs. insulated
- leakage

e) Overview of noise in duct systems

- noise sources in duct systems

- attenuation
- impact on design
- methods of control

f) Fans

- types and characteristics
- fan laws
- system effect
- fan selection
- fan and system curves

g) Air systems

- dual and single duct constant volume
- variable volume
- induction units
- multi-zone
- diversity factors

2.15.20 HVAC hydronic systems

Evidence shall show an understanding of HVAC hydronic systems to an extent indicated by the following aspects:

a) Systems operation

- closed/open systems
- pump head/lift, static head (high rise building)
- system friction losses
- nett positive suction head
- system curves

b) Pumps

- types
- selection criteria
- performance characteristics
- bladder tanks
- coil characteristics
- heat exchangers: plate, shell and tube, tube in tube
- flow measurements: types
- flow switchers
- builders: types and performance characteristics
- cooling towers: elementary cooling thermodynamics and types

c) Valves - flow control devices

- types and applications
- throttling characteristics
- flow measurements
- selection and applications

d) Piping systems

- balancing and commissioning
- air venting
- water treatment
- vacuum breaking and air breaks

2.15.21 Refrigeration/HVAC electronic controls

Evidence shall show an understanding of refrigeration/HVAC electronic controls to an extent indicated by the following aspects:

a) Control fundamentals

- Electronic control terminology
- Definitions

b) Electronic control basics

- Voltage supplies
- Analogue control
- Controller basics
- Inputs and outputs

c) Controllers

- Variable (e.g. temperature)
- Step
- Enthalpy
- Compensation
- Time proportional

d) Sensors

- Temperature
- Humidity
- Enthalpy
- Pressure
- Velocity

e) Actuators

- Water valves
- Dampers
- Relays

f) Control systems

- Refrigeration systems
- Ventilation systems
- Multi-zone A/C systems
- Variable air volume A/C systems
- Face and by-pass system
- Economiser system
- Chilled water systems
- Hot water systems

2.15.22 HVAC control systems

Evidence shall show an understanding of HVAC control systems to an extent indicated by the following aspects:

a) Control diagrams

- electric/electronic control diagrams
- electrical installation documents
- pneumatic diagrams
- DDC diagrams
- controls/electrical power circuit interface
- nomographs

b) Evaluate existing automatic control systems

- review of HVAC system components
- specifications
- briefs
- descriptions of operation

c) Control requirements

- standard and statutory requirements
- economy of operation (energy management)

2.15.23 Microbial control fundamentals

Evidence shall show an understanding of microbial control fundamentals to an extent indicated by the following aspects:

- a) Legislation and regulatory requirements for microbial control
 - b) Types of air and water systems that require control of harmful microbes.
 - c) Harmful microbes and they effects in left uncontrolled
 - d) Methods of controlling harmful microbes
-

Note.

Methods include regular cleaning/decontamination of effected plant, sample testing and approved treatment.

- e) Safe handling and application of treatment materials.

2.15.24 Cool rooms/freezer rooms

Evidence shall show an understanding of cool rooms/freezer rooms to an extent indicated by the following aspects:

- a) Food spoilage encompassing:
 - Effects of storage conditions
 - Controlled atmosphere
 - Relative humidity
 - Evaporator temperature difference
- b) Types and construction encompassing:
 - Pre-fabricated and permanent type walk-in cool rooms and freezer rooms
 - Construction
 - Insulation
 - Vapour barrier
 - Frost heave
 - Interior fittings
- c) Layouts and installation encompassing:
 - Location of equipment
 - Equipment site arrangements and building services
 - Access and obstructions
 - Power supply and electrical services
 - Arrangement of piping
- d) Components and features encompassing:
 - Refrigerant controls
 - Evaporators
 - Solenoid valves
 - Crankcase pressure regulators

- Defrosting method and mullions
- Drain facilities and heaters
- Pressured relief valves
- Door hardware
- Lighting and germicidal lamps

e) System and defrost controls encompassing:

- Operating conditions
- Thermostat and pressure controls
- Defrost timers and controllers
- Overloads and safety control
- Electrical control circuits

2.15.25 Package air conditioning systems

Evidence shall show an understanding of package air conditioning systems to an extent indicated by the following aspects:

a) Types and applications encompassing:

- Safety, environmental and Legislative Issues
- Construction features
- Component and their characteristics
- Ancillary equipment

b) System design features encompassing:

- Heat Loads

c) Characteristics

2.15.26 Merchandising and display cabinets

Evidence shall show an understanding of merchandising and display cabinets to an extent indicated by the following aspects:

a) Types and construction encompassing:

- Deep freeze meat, dairy, and fruit and vegetables
- Multi deck display type
- Single deck, well type and island cases
- Glass door/reach-in merchandiser

b) Components and features encompassing:

- Condensing units

- Refrigerant controls
- Evaporators and fans
- Defrosting method and mullions
- Drain facilities and drain heaters
- Air distribution and air-flow curtains
- Cabinet air temperature, velocity and direction
- Accessories
- Lighting

c) Layouts and installation encompassing:

- Location of equipment
- Equipment site arrangements and building services
- Access and obstructions
- Power supply and electrical services
- Arrangement of piping

d) System and defrost controls encompassing:

- Operating conditions
- Alarm systems
- Thermostats and pressure controls
- Defrost timers and controllers
- Electrical control circuits

e) Multiple systems encompassing:

- Multiple compressors
- Multiple evaporators
- Heat reclaim systems
- Multi-temperature accessories
- Controls and sequencing

2.15.27 Cooling towers, evaporative condensers, evaporative coolers and associated equipment

Evidence shall show an understanding of cooling towers, evaporative condensers, evaporative coolers and associated equipment to an extent indicated by the following aspects:

- a) Health requirements under the Act and regulations
- b) Types, applications and their construction encompassing:

- System components and their function
- System operation
- Process cooling operation

c) Installation requirements encompassing:

- Water supply and drainage requirements
- Electrical requirements
- Special site requirements
- Location and securing of equipment
- Provision for water treatment
- Foundation requirements
- Local authority requirements and codes
- Relevant legislation, legal obligations
- Development/building approvals

d) Installation and assembly methods encompassing:

- Tower identification
- Manufacturer's drawings, specifications and assembly instructions

e) Water pumps and pumping systems encompassing:

- Pump characteristics from pump curves
- Pumping flow controllers

2.15.28 Residential air conditioning

Evidence shall show an understanding of residential air conditioning to an extent indicated by the following aspects:

a) Relevant regulations and codes for the installation and service of residential split air conditioning systems encompassing:

- building codes, electrical, health, environmental

(b) Types, components, construction, operation and application of residential air conditioners encompassing:

- types: window mounted, high wall, floor and ceiling mounted, cassette and ducted
- typical applications for various types of systems
- components, construction and operation of the major components within a system.
- air distribution, flexible ducting and associated fittings, fans, filters
- noise and vibration
- control systems
- operation of a typical system including reverse cycle

c) Procedures for selecting a system for a specific application encompassing

- determining heat load sources using estimating methods and manufacturers data
- unit and associated equipment selection

d) Installation of unit and pipework encompassing:

- respect for customers premises
- unit location and mounting
- flexible ducting and associated fittings
- fixing, securing and mounting methods
- safe lifting, use of ladders and platforms
- manufacturers installation and start up instructions
- refrigerant piping: layout, installation, insulation, fastening and covering
- condensate drains and pumps

e) Starting up system encompassing:

- manufacturers start up instructions
- pressure testing
- evacuation
- opening outdoor unit valves
- checking refrigerant charge: pressures, temperature, sweat line and evaporator superheat
- adding refrigerant
- leak detection
- controls - operating and safety
- customer familiarisation

f) Commissioning procedures encompassing:

- manufacturers specifications
- air balancing

g) Fault finding and servicing encompassing:

- typical fault conditions
- wiring and circuit diagrams

2.15.29 Servicing refrigeration and air conditioning systems

Evidence shall show an understanding of refrigeration and air conditioning to an extent indicated by the following aspects:

a) Preventative maintenance schedules and procedures.

b) Normal and abnormal system and component operations

- c) Gathering and evaluation symptoms
- d) Determining and testing for faults
- e) Procedures for rectifying faults

2.15.30 Commissioning refrigeration and air conditioning systems

Evidence shall show an understanding of refrigeration and air conditioning to an extent indicated by the following aspects:

- a) Determining system design and operating conditions.
- b) Testing, measurements and adjustments
- c) Design and "as installed" drawings
- d) Commissioning reports

2.2.16 Refrigeration and air conditioning installations

2.16 Refrigeration and air conditioning installations

2.16.1 Refrigeration pipework and accessories

Evidence shall show an understanding of refrigeration pipework and accessories to an extent indicated by the following aspects:

- a) Appropriate piping arrangements

Note:

Adequate piping arrangements include those for discharge lines, liquid lines, suction lines, incorporation valves, dryers, site glasses, accumulators, oil separators, heat exchangers, traps and piping for multiple compressor systems

- b) Pipe work accessories and their location

Note:

Pipe work accessories include clamps, joiners, fittings and connections.

- c) Pipe work installation techniques

2.16.2 Refrigeration pipework layout

Evidence shall show an understanding of refrigeration pipework layout to an extent indicated by the following aspects:

- a) Position of equipment in relation pipework
- b) Requirements for vertical and horizontal pipe runs.
- c) Requirements for oil return and prevention of flood back
- d) Techniques for the prevention of noise and vibration
- e) Pipework insulation requirements

2.16.3 Refrigeration installations, equipment requirements

Evidence shall show an understanding of refrigeration installations, equipment requirements to an extent indicated by the following aspects:

- a) Standards, codes and requirements applicable to installing refrigeration equipment.
- b) Techniques for installing equipment and accessories encompassing:
 - Application of accessories
 - Locating and placing components
 - Terminating piping
 - Maintenance of fire rating integrity.

2.16.4 Refrigeration pipe selection and sizing

Evidence shall show an understanding of refrigeration pipe selection and sizing to an extent indicated by the following aspects:

- a) Use of velocity/pressure drop tables
- b) Pressure drop in lines, components and fittings
- c) Oil migration stabilisation
- d) Refrigerant velocity
- e) Effect of varying system capacity
- f) Oil traps, risers and double risers
- g) Liquid migration
- h) Parallel components and multiplex systems

2.16.5 Refrigeration and air conditioning installations, testing and verification methods

Evidence shall show an understanding of testing and verification to an extent

indicated by the following aspects:

- a) Mandatory testing and verification requirements.
- b) Optional testing and their appropriate use
- c) Testing techniques
- d) Visual inspection methods

2.16.6 Split air conditioning system installation

Evidence shall show an understanding of installing split air conditioning systems to an extent indicated by the following aspects:

a) Relevant codes for the installation of split air conditioning systems encompassing:

- building codes, electrical, health, environmental

(b) Types, construction, operation and application of split air conditioners encompassing:

- system's major components – purpose and types
- types: floor and wall mounted, ducted, cassette
- refrigeration system and reverse cycle
- control systems
- air distribution, fans, filters
- noise and vibration

c) Installation of unit and pipework encompassing:

- respect for customers premises
- unit location and mounting
- fixing, securing and mounting methods
- safe lifting, use of ladder and platforms
- manufacturers installation and start up instructions
- refrigerant piping: layout, installation, insulation, fastening and covering
- condensate drains and pumps

d) Starting up system encompassing:

- manufacturers start up instructions
- pressure testing
- evacuation
- opening outdoor unit valves
- checking refrigerant charge: pressures, temperature, sweat line and evaporator superheat
- adding refrigerant

- leak detection
- controls - operating and safety
- customer familiarisation

2.16.7 High pressure refrigerant installation

Evidence shall show an understanding of installing high pressure refrigerant systems to an extent indicated by the following aspects:

a) The function, types, properties, applications, requirements, handling and disposal of refrigerant oils used in the high pressure systems.

b) The essential service tools required to work with high pressure refrigerants encompassing:

- Gauge manifold and hoses
- Vacuum Gauge (Microns)
- Leak Detectors
- Flaring Tools
- Torque wrench for flare nuts
- Refrigerant Scales
- Digital temperature measuring thermocouples

c) Installation, commissioning and service procedures required for high pressure refrigerant systems encompassing:

- Flaring and brazing
- Pressure testing (as per HB40 and AS/NZS1677)
- Evacuation
- Charging and Recharging
- Leak detection
- Recovery

d) The correct safety procedures required to work with high pressure refrigerants encompassing:

- Personal safety protection equipment
- Refrigerant and oil handling
- Material Safety Data Sheets (MSDS)
- HB40, AS/NZS1677, AS2030, copper tube code
- Storage, filling and transport of refrigerant cylinders
- Equipment rooms, job site safety, ventilation and environmental considerations.

2.16.8 Fault-finding and diagnostic techniques

Evidence shall show an understanding of fault-finding and diagnostic skills to an extent indicated by the following aspects:

- a) Establish an accurate description of the fault situation by appropriate questioning of client or operator
 - Demonstrate questioning techniques to efficiently and effectively obtain from a client/operator a description of a fault situation.
- b) Confirm the fault history and symptoms through observation and application of first-line tests.
 - Demonstrate ability to draw valid conclusions from observations. Identify concepts of broad first-line testing.
- c) In the absence of the client or operator, to establish the symptoms through application of systematic tests and observation.
 - Identify appropriate diagnostic tests for given symptoms using manufacturers' charts, handbooks, specification sheets.
 - Use results of systematic tests to identify symptoms.

2.16.9 Commissioning - HVAC systems

Evidence shall show an understanding of commissioning - HVAC systems to an extent indicated by the following aspects:

- a) Fundamentals
 - building specifications/requirements/responsibilities
 - building codes
 - local government regulations
 - human comfort - comfort chart
 - reporting procedures
 - review fluid mechanic principles
 - pre-commissioning checks
 - calibration of instruments, data collection and recording, documentation
- b) Air systems
 - Air testing and balancing
 - air flow
 - pressure
 - temperature
 - fan testing
 - air balancing procedures

- leakage testing
- system capacity calculations

c) Hydronic systems

- hydronic tab instruments
- fluid flow
- pressure
- temperature
- pumps: pump curves and system curves
- pump testing
- hydronic
- balancing procedures
- general
- compensation method
- balancing valves
- capacity calculations

d) Plant and equipment

- controls
- heat exchangers
- chillers
- boilers
- cooling towers

2.16.10 Commissioning commercial / industrial refrigeration systems

Evidence shall show an understanding of commissioning commercial/industrial refrigeration systems to an extent indicated by the following aspects:

a) Fundamentals

- Building specifications/requirements/responsibilities
- Building Codes
- Local Government regulations
- Design conditions
- Reporting procedures
- Review fluid mechanics principles
- Pre – commissioning checks

b) Air Systems (excluding air balancing)

- Air Tabulation instruments
- air flow

- pressure
- temperature
- fan testing
- leakage testing
- system capacity calculations

c) Hydronic Systems

- Hydronic tabulation instruments
- fluid flow
- pressure
- temperature
- Pumps
- Pump curves and system curves
- Pump testing
- Hydronic
- balancing procedures
- general
- compensation method
- Balancing valves
- Capacity calculations

d) Refrigeration Systems

- AS1677
- HB40
- Pressure testing
- Evacuation
- Charging
- Control setting
- Commissioning reports
- System performance and capacity

e) Plant and equipment

- Controls
- Heat exchangers
- Chillers
- Boilers
- Cooling towers

2.16.11 Air conditioning drawing

Evidence shall show an understanding of air conditioning drawing to an extent

indicated by the following aspects:

- a) Standards, regulations and codes
- b) Architectural and mechanical drafting conventions encompassing:
 - Fire, hydraulic, electrical layout diagrams,
 - Sketching of pipework circuits and mechanical services,
 - Drawing standards and symbols,
 - Working, detail and assembly drawings,
 - Ductwork layouts and conventions,
 - Pipework layouts and conventions,
- c) Computer aided drawing techniques

2.16.12.1 Energy management fundamentals

Evidence shall show an understanding of energy management fundamentals to an extent indicated by the following aspects:

- a) Typical energy sources and characteristics
 - supply authorities
 - standard units of measurement
 - electricity
 - steam
 - hot water
 - high temperature hot water
 - town gas
 - LP Gas
 - solar
 - waste heat
 - petrol
 - diesel
- b) Energy Usage
 - office lighting
 - air conditioning systems
 - refrigeration systems
 - security systems
 - computer systems
 - standby/emergency systems
 - lifts and escalators
- c) Energy auditing process

- energy costs and tariffs
- energy consumption
- predicting future costs
- plotting consumption trends
- historical data
- collecting information using surveys
- comparisons of actual to recorded usage
- energy balance
- instrumentation
- building management systems
- estimating savings potential

d) System operation for energy efficiency

- types of systems
- efficiency in building structures
- operation of a vehicle fleet
- proportion total energy consumption against individual systems
- passive building design
- preventative maintenance procedures
- monitoring building management systems
- operation of major and minor plant
- inappropriate energy management procedures
- building plant control systems
- Australian standards/local authority requirements
- case studies

e) Implementing energy management procedures for a building

- recording base year data
- climatic conditions for locality
- establishing energy costs and tariffs
- building and systems surveys
- payback period
- survey analysis
- energy conservation procedures
- informing stockholders
- recommendations and documentation
- implementation issues
- monitoring, evaluation and follow up

2.16.12.2 Energy management

Evidence shall show an understanding of energy management to an extent indicated by the following aspects:

a) Identification of major energy consuming plant

- review of HVAC system components
- lighting systems
- building energy profiles

b) Methods of energy conservation

- review of energy conserving strategies
- house keeping
- time schedules
- lighting control
- good maintenance practices
- filters, fans, appropriate set points, dead bands etc.
- HVAC system control
- night cycle
- optimum stop/start
- purge cycles
- chiller/boiler/cooling tower sequencing
- economy cycles (based on temperature or enthalpy).
- supply air reset
- condenser water temperature reset
- electrical load control
- power demand control
- load limiting
- load shedding
- set point relaxation
- ventilation cycles

c) Tests and data collection procedures

- use of BMS for data collection (trending)
- use of data recorders (loggers)
- monitoring of building operations generally

d) Analyse results from test data

- compare against standards (BOMA)
- review current practices against ideal
- total consumption vs. peak load
- electricity tariffs and implications

e) Methods of reducing energy usage

- plant retrofits
- controls - application of strategies in 2
- plant - fixed OA to economy, boiler to electric reheat, and constant volume to VAV etc. cost/benefit (payback).

2.16.13 Building management systems

Evidence shall show an understanding of building management systems to an extent indicated by the following aspects:

a) Functions of a BMS

- autonomous Functions
- input
- output
- general I/O
- installation management items
- energy management
- risk management
- information processing
- objectives
- building running costs
- smoke control as per AS 1668 part 1

b) BMS hardware

- system architecture
- communication devices
- substations
- PC's
- interfaces with other systems

c) Input and output functions

- digital inputs/outputs
- digital output with status feedback
- analogue input/output
- sensors
- alarms

d) Energy management

- night cycle
- optimum stop/start
- time and event programs
- night purge

- outside air percentage control
- enthalpy control
- power demand control
- duty cycle
- presence detection
- lighting control

e) Information processing functions

- computer systems
- central system management
- programs
- system configuration and security
- operator - machine interface
- data points

f) Risk and maintenance management

- system files
- fire, intruder control
- access control

2.16.14 Management of indoor air quality

Evidence shall show an understanding of management of indoor air quality to an extent indicated by the following aspects:

a) Indoor air quality factors

- interactive nature of pollutants
- comfort criteria
- source of odours
- pathway from source to occupants
- occupant activities
- impact on productivity

b) Cause of IAQ problems

- moisture
- mould and mildew
- bacterial growths
- asbestos and other particulate
- volatile chemicals produced in the building
- chemical products

c) HVAC systems

- types of HVAC systems
- system components
- duct cleaning
- system commissioning
- operation of system
- damper adjustment

d) Measurements

- common parameters to measure
- measurement devices available
- instrument calibration
- analysing and interpreting results
- laboratory tests
- standards

e) Resolving IAQ problems

- conducting IAQ investigations
- the walk-through
- building history
- HVAC system information
- occupant interviews
- troubleshooting

f) IAQ management

- building IAQ profile
- location of potential IAQ problems
- procedures to control IAQ
- communication
- response to complaints
- equipment preventive maintenance
- chemical inventory

2.16.15 Computer aided drafting

Evidence shall show an understanding of computer aided drafting to an extent indicated by the following aspects:

a) Specific procedures

- Creating symbols for library files
- Program specific commands
- Speed enhancement

- Configuring the digitising tablet

b) Methodology for creating layers

- Name
- Colour
- Linetype

c) Methodology for drawing variables

- Limits
- Grid
- Snap
- Dimensions
- Text
- Units

d) ISO drawing sheets

e) Advanced drawings

f) Multiple three dimensional views

- Setting up environment on screen
- Top view
- Front and side views
- Three dimensional views

g) Movement through space

- Draw on any created views
- Relocate coordinate system as necessary

h) Creation of views

- Creation of three dimensional geometric shapes
- Creation of three dimensional complex view by:
- Manipulation of drawing planes
- Location of geometric shapes

i) Editing

- Use of function to facilitate modification of geometric shapes in completion of a three dimensional view

j) Display of three dimensional view

- Wire Line
- Solid Face
- Isometric
- Perspective
- Orthographic

k) Saving

- Use of assembly drawing file for plotting

2.16.16 Refrigeration system components and piping

Evidence shall show an understanding of refrigeration system components and piping to an extent indicated by the following aspects:

a) Standards and Codes encompassing:

- AS1677, detailed understanding
- AS 3666, overview
- ozone protection regulations
- IIR Ammonia Data Book
- ANSI/IIR standards
- ANSI/ASHRAE Mechanical Refrigeration and IIR
- bulletins and standards

b) Calculation of capacity in heat exchangers encompassing:

- $Q = UA (LMTD)$
- $Q = mc\Delta t$
- $Q = m \Delta h$

c) Evaporators encompassing:

- commercial types and applications
- coil bypass factor
- effects of evaporator TD on space humidity
- effects of air circulation on product conditions
- selection criteria and selection tables

d) Condensers encompassing:

- commercial types and applications
- effects of ambient conditions
- condenser control
- heat rejection factor
- condenser TD
- selection criteria and selection tables

e) Compressors encompassing:

- types and applications
- capacity
- displacement
- volume flow rate

- theoretical capacity
- total volumetric efficiency
- effect of operating conditions, including suction
- pressure drop and superheating
- actual capacity
- power
- theoretical requirement
- effects of operating conditions
- actual requirements
- post defrost loads
- pull down torque requirements, high, medium
- and low back pressure compressors
- selection tables, motor selection

f) Liquid expansion devices

- types, operation and applications
- effects from sub-cooling
- distributor types, operation and applications
- selection tables

g) System load balance point encompassing:

- graphical representation

h) Line sizing an design

- velocity tables
- pressure drop in lines and fittings
- oil migration stabilisation
- refrigerant velocity
- effect of varying system capacity
- oil traps
- risers
- double risers
- liquid migration
- design for parallel components and multiplex systems

i) Automatic controls

- fin spacing, suction temp to evaporator suction
- hot-gas bypass valves
- electronic control of valves PLC control
- refrigerant regulating valves
- solenoid valves
- condenser pressure regulating valves

- evaporator pressure regulating valves
- crankcase pressure regulating valves
- cycling controls
- pressure-stats
- thermostats,
- defrost controls
- monitoring and alarm controls
- refrigeration automation systems
- control strategies
- control modes

2.16.17 Retrofitting refrigeration systems

Evidence shall show an understanding of retrofitting refrigeration systems to an extent indicated by the following aspects:

a) Systems and refrigerants suitable for retrofitting encompassing:

- Code and regulation for retrofitting a refrigeration system.
- Suitable refrigerants for retrofitting into existing systems.

b) Retrofitting a refrigerant into a system encompassing:

- Retrofit procedures.
- Selection of refrigerant, oil and components.

c) Procedures for modify an existing system to meet the requirements of the alternative refrigerant encompassing:

- Evaluating performance of a system prior to being retrofitted.
- Testing refrigerant oil in accordance with industry standard.
- Reclaiming and evacuate system.
- Removing and replacing components.
- Pressure testing, evacuating and charging.

d) Procedures for commissioning a retrofitted system to the prescribed standard encompassing:

- Setting operational and safety controls.
- Testing electrical components.
- Adjusting controls and checking system operation.

e) Evaluating key performance factors of a system before and after a retrofit.

2.16.18. Installation and commissioning procedures for Carbon Dioxide refrigeration systems

1

Evidence shall show an understanding of installation and commissioning procedures for sub-critical carbon dioxide refrigeration systems to an extent indicated by the following aspects:

- a) Materials and Installation procedures
 - Material selection
 - Copper pipe standards
 - Pipe connections
 - Pipe supports hangers and connections
 - Arrangement of isolation valves
 - Location of relief valves
- b) Commissioning
 - Pressure testing
 - Evacuation and dehydration
 - Charging refrigerant and lubricant
 - System testing and adjustment
 - Documentation

2.16.19. Installation techniques for hydrocarbon refrigeration systems

1

Evidence shall show an understanding of installation techniques for hydrocarbon refrigeration systems to an extent indicated by the following aspects:

- a) Special features for hydrocarbon system
 - Compatibility Issues
 - Major components
 - Materials/substances
 - Metering devices
 - Regulating valves
 - Electrical controls
 - Tools
 - Refrigerant leakage
 - Enclosures
- b) Codes, regulations and standards
 - AS 1677.1
 - ANZ Refrigerant Handling Code of Practice 2007- Part 1
- c) Site Arrangements
 - Building services
 - Piping requirements for hydrocarbons
 - Suitable Equipment locations

- d) Site Safety
 - Hazards
 - Checklist
 - Report
- e) System diagrams
 - Mechanical layouts
 - Electrical circuits
- f) Installation
 - Assembly
 - Pressure Testing
 - Evacuation
 - Charging
 - Leak Detecting

2.16.19.2 Commissioning hydrocarbon refrigeration systems

Evidence shall show an understanding of commissioning hydrocarbon refrigeration systems to an extent indicated by the following aspects:

- a) Pressure Temperature relationships for hydrocarbon refrigerants
- b) Evaporator Td's for hydrocarbon systems
- c) Condenser Td's for hydrocarbon systems
- d) Cycling control settings
- e) Safety control settings
- f) Regulator settings
- g) Refrigerant metering device settings

2.16.20.1 Installation techniques for Ammonia refrigeration Systems

Evidence shall show an understanding of installation techniques for ammonia refrigeration systems to an extent indicated by the following aspects:

- a) Interpret Drawings
 - Refrigeration Piping Schematic Diagrams
 - Refrigeration Layout Diagrams
 - Electrical Control Diagrams
 - PLC Control Diagrams
- b) Project Management
 - Work Breakdown Structures
 - Network Diagrams / Gantt Charts
 - Costing

- Dealing with Conflict
- Delegation
- c) Refrigerant Piping
 - Pipe Sizing Principles
 - Material Compatibility
 - Installation Principles
 - Welding
 - Hydraulic Shock
 - Relief Valves
 - Pressure Testing/Evacuation
- d) Insulation and Vapour Barrier
 - Insulation Materials
 - Vapour barriers
 - Coolroom and Freezer Construction
 - Construction Materials
 - Construction Methods
 - Underfloor heating
 - Defrost Methods
 - Commissioning Procedures

2.16.20.2 Commissioning Ammonia Refrigeration Systems

Evidence shall show an understanding of commissioning ammonia refrigeration systems to an extent indicated by the following aspects:

- a) Refrigeration Control System Testing and Adjustment
 - Refrigerant Level Controls
 - Refrigerant Pressure Controls
 - Temperature Controls
 - Flow Controls
 - Defrost methods and controls
 - Central PLC System
- b) Testing and Commissioning
 - Compressors
 - Evaporative condensers
 - Water cooled condensers
 - Air cooled condensers
 - High pressure receivers
 - Evaporators (air / fluid cooling)

- Direct contact freezing
 - Secondary refrigerants
 - Start up and Shut Down Procedures
- c) Report on the install and commissioning of Ammonia refrigeration systems
- Operating conditions are recorded
 - Documentation marked up "As Installed"

2.2.17 Refrigeration and air conditioning principles and applications

2.17 Refrigeration and air conditioning principles and applications

2.17.1.1 Refrigeration fundamentals

Evidence shall show an understanding of refrigeration fundamentals to an extent indicated by the following aspects:

- a) Principles of heat transfer
- b) Temperature scales and measurement
- c) Pressure scales and measurement
- d) Relationship between pressure and temperature
- e) The operation of the vapour compression refrigeration cycle.
- f) Refrigeration system components
- g) High and low side pressure
- h) Saturation, superheat, subcooling and enthalpy
- i) Basic pressure, temperature, state and heat cycles
- j) Applications of refrigeration

2.17.1.2 Basic refrigeration system operating conditions

Evidence shall show an understanding of basic refrigeration system operating conditions to an extent indicated by the following aspects:

- a) Evaporator temperature difference
- b) Condenser temperature difference
- c) Ambient conditions
- d) Low side temperatures and pressures

e) High side temperatures and pressures

2.17.2.1 Refrigerants

Evidence shall show an understanding of refrigerants to an extent indicated by the following aspects:

- a) Properties for refrigerants in current use and their alternatives
- b) Causes and effects of contamination in refrigeration systems
- c) Procedures for working with refrigerants encompassing:
 - Reclaiming/recovering refrigerants
 - Pressure testing refrigeration systems
 - Dealing with contamination in refrigeration systems
 - Evacuating refrigeration systems
 - Detecting refrigerant leaks
 - Charging refrigerant
- d) Properties and applications of refrigeration oils in current use

2.17.2.2 Split air conditioning refrigerants

Evidence shall show an understanding of refrigerants commonly used in split air conditioning systems to an extent indicated by the following aspects:

- a) Properties for refrigerants in current use
- b) Causes of contamination in the system
- c) Procedures for working with refrigerants encompassing:
 - Reclaiming/recovering refrigerants
 - Pressure testing systems
 - Evacuating systems
 - Detecting refrigerant leaks
 - Charging refrigerant
- d) Properties of refrigeration oils in current use

2.17.2.3 Appliance refrigerants

Evidence shall show an understanding of refrigerants commonly used in refrigeration and freezer appliances to an extent indicated by the following aspects:

- a) Properties for refrigerants in current use
- b) Causes of contamination in the systems
- c) Procedures for working with refrigerants encompassing:
 - Reclaiming/recovering refrigerants
 - Pressure testing systems
 - Dealing with contamination in refrigeration systems
 - Evacuating systems
 - Detecting refrigerant leaks
 - Charging refrigerant
- d) Properties of refrigeration oils in current use

2.17.2.4 High pressure refrigerants

Evidence shall show an understanding of installing high pressure refrigerant to an extent indicated by the following aspects:

- a) The phase out CFC/HCFC refrigerants in favour of environmentally friendly refrigerants and the responsibilities of installers and manufacturers
- b) The chemistry of R22 and its replacement high pressure refrigerants (R407C and R410A), their properties and applications
- c) The function, types, properties, applications, requirements, handling and disposal of refrigerant oils used in the high pressure systems
- d) The essential service tools required to work with high pressure refrigerants
- e) The differences in the materials required for high pressure refrigerant systems
- f) Installation, commissioning and service procedures required for high pressure refrigerant systems
- g) Safety procedures required to work with high pressure refrigerants.

2.17.2.5 Natural refrigerants

Evidence shall show an understanding of natural refrigerants to an extent indicated by the following aspects:

- a) The phase out CFC / HCFC refrigerants in favour of environmentally friendly refrigerants and the responsibilities of installers and manufacturers
- b) The chemistry natural refrigerants, their properties and applications
- c) The function, types, properties, applications, requirements, handling and disposal of refrigerant oils used in the natural systems
- d) The essential service tools required to work with natural refrigerants
- e) The differences in the materials required for natural refrigerant systems
- f) Installation, commissioning and service procedures required for natural

refrigerant systems

- g) Safety procedures required to work with natural refrigerants

2.17.3.1 Refrigeration system capacity control

Evidence shall show an understanding of refrigeration system capacity control to an extent indicated by the following aspects:

a) Methods of system capacity control

Note:

Capacity control includes the role of oil pressure; refrigerant bypass; air flow; water flow; multiple units and compressor speed.

2.17.3.2 Refrigeration systems and compressor operation

Evidence shall show an understanding of the operation of refrigeration systems and compressors to an extent indicated by the following aspects:

a) The vapour-compression cycle

Note:

Vapour-compression cycle includes refrigeration effect; flow rate; specific volume; system capacity; discharge temperature; total heat rejection; heat of compression and refrigerant properties and effects

b) Methods of system capacity control

Note:

Capacity control includes the role of oil pressure; refrigerant bypass; air flow; water flow; multiple units and compressor speed.

c) System efficiency encompassing:

- Compressor parameters
-

Note:

Examples are piston displacement; compressor displacement; compression ratio; compressor efficiency and heat exchange design.

- Compressor drive methods
-

Note:

Examples are belt drives; direct drives; speed vs. pulley size and alignment requirements.

2.17.4 Air conditioning fundamentals

Evidence shall show an understanding of air conditioning fundamentals to an extent indicated by the following aspects:

- a) Psychrometric terms, basic processes, measurement and charts encompassing:
 - Parameter
 - Methods
- b) Basic air conditioning heat loads sources and effects encompassing:
 - Elements of heat load
 - Industry check figures
 - Basic quick selection heat load tables/graphs
- c) Basic air conditioning process, terms, requirements, classifications and applications
- d) Basic ventilation terms, requirements, methods and applications
- e) Basic air conditioning systems, types, layout and applications

2.17.5 Central plant air conditioning systems

Evidence shall show an understanding of central plant air conditioning systems to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Secondary systems and refrigerants

2.17.6 Hydronic systems

Evidence shall show an understanding of hydronic systems applied to refrigeration and/or air conditioning applications to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods

2.17.7 Beverage dispensers

Evidence shall show an understanding of beverage dispensers to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components, and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Pure food act and HACCP
- f) Dispensed beverage product knowledge:

Note:

Examples are beer, wine, spirits, soft drinks, and the like

2.17.8 Transport refrigeration systems

Evidence shall show an understanding of transport refrigeration systems to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) External power sources

Note:

Examples are diesel/petrol engines, electrical, dual power supplies

2.17.9 Ultra-low temperature refrigeration systems

Evidence shall show an understanding of ultra-low temperature refrigeration systems to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles

- c) Maintenance schedules
- d) System faults and testing methods
- e) Suitability of refrigerants for each application

2.17.10.1 Post mix refrigeration systems

Evidence shall show an understanding of post mix refrigeration systems to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Pure food act and HACCP
- f) Dispensed beverage product knowledge:

Note:

Examples are beer, wine, spirits, soft drinks, and the like

2.17.10.2 Dairy refrigeration systems

Evidence shall show an understanding of dairy refrigeration systems to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Pure food act and HACCP
- f) Dispensed beverage product knowledge

2.17.11 Ice making systems

Evidence shall show an understanding of ice making systems to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components

and typical layout arrangements.

- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Pure food act and HACCP
- f) Dispensed beverage product knowledge

2.17.12 Industrial refrigeration systems

Evidence shall show an understanding of industrial refrigeration systems to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Secondary refrigerants and systems

2.17.13 Refrigeration system analysis

Evidence shall show an understanding of refrigeration system analysis to an extent indicated by the following aspects:

- a) Pressure Enthalpy Definitions
 - high pressure & low pressure refrigerants e.g. R124 & R23
 - triple point of new refrigerants
 - glide of trinary blends
 - differential evaporation of refrigerant blends
 - variable refrigerant volume
- b) Refrigeration cycle
 - expansion process
 - vaporising process
 - compression process
 - condensing process
 - compression ratio
- c) Enthalpy processes

- co-efficient of performance
- effect of suction temperature on cycle efficiency
- effect of condensing temperature on cycle efficiency

d) Actual refrigerating cycles

- effects of superheating suction vapour
- superheating without useful cooling
- superheating that produces useful cooling
- superheating in suction piping outside the refrigerated space
- superheating the vapour inside the refrigerated space
- effects of subcooling the liquid
- liquid - suction heat exchangers
- effects of pressure losses resulting from friction

2.17.14.1 Refrigeration engineering mathematics fundamentals

Evidence shall show an understanding of engineering mathematics fundamentals to an extent indicated by the following aspects:

a) Arithmetic

- Rational and irrational numbers, surds
- SI units, conversion using unity brackets
- Laws of indices (base 10), scientific and engineering notation
- Estimations, errors and approximations, significant figures

b) Algebra

- Substitution
- +, -, x on simple polynomials. Simple indices
- Expanding brackets
- Factorising quadratics. Common factors, difference of two squares
- Simplifying algebraic fractions
- Transposition of engineering formulae
- Solving one variable equations
- Simple algebraic division.

c) Geometry

- Pythagoras Theorem
- Angles: degrees, radians. Parallel lines cut by a transverse
- Triangles: sum of angles, properties of equilateral and isosceles triangles
- Congruent triangles
- Similar triangles: ratio of corresponding sides

- Sin, cos, tan: ratios of a right angled triangle
- Sine and cosine rules
- Circles: circumference, arcs, chords, tangents, circle theorems
- Area and perimeter mensuration on above figures.

d) Coordinate geometry

- 2D plane; x - y axes, s - t axes
- Graph of linear function, $y = ax + b$. Functional notation, $y = f(x)$
- Straight line given slope and one point or given two points
- Linear equations: solving algebraically and geometrically
- Solving 2 linear functions simultaneously, algebraically and geometrically
- Line segment: length and mid point.

2.17.14.2 Refrigeration engineering advanced mathematics

Evidence shall show an understanding of engineering mathematics to an extent indicated by the following aspects:

a) Matrices

- The operations: addition (subtraction), scalar multiplication, matrix multiplication up to 3x3 matrices.
- Identity matrix, inverse matrix
- Elementary algebraic manipulation of matrices
- Solve up to three equations (linear) in three unknowns using inverse matrices and determinants.

b) Quadratic Functions

- Graphs of quadratic functions represented by parabolas and significance of the leading coefficient
- Zeros represented graphically
- Solve quadratic equations by factoring and quadratic formula
- Solve simultaneously linear and quadratic equations algebraically and geometrically.
- Engineering Mathematics- B

c) Exponential and Logarithmic Functions

- Laws of indices
- Graph of $f(x) = kab^x$, emphasising $a = 10, e$
- Definition of the logarithm to any base
- Graph of $f(x) = k \log_a bx$, emphasising $a = 10, e$
- Solve exponential and simple log equations using indices, logs, calculator, graphically

- Change of log base, emphasising 10 and e
- Growth and decay

d) Trigonometric Functions

- The ratios: sin, cos, tan, cosec, sec, cot
- Degrees, radians
- Graphs of $k f(ax + b)$ where $f(x) = \sin x, \cos x, \tan x$, and significance of k, a, b , for example $V = V_m \sin(\omega t + \phi)$
- Trigonometric identities
- Solve trigonometric equations

2.17.15 Refrigeration science

Evidence shall show an understanding of refrigeration science to an extent indicated by the following aspects:

a) Engineering mechanics

- mass/density
- weight
- forces
- specific gravity
- equilibrium
- momentum
- friction loss
- velocity and speed
- energy in all forms
- mechanical advantage
- efficiency
- pressure/stress

b) Molecular theory

- changes of state
- sublimation
- expansion and contraction
- electron flow
- state of aggregation
- internal potential energy
- phase change diagrams

c) Thermodynamics

- temperature scales

- conservation of energy
- specific heat
- sensible, latent and super heat
- properties of steam
- enthalpy
- heat energy/temperature relationship
- heat balance on a body
- heat transfer
- conductivity
- calorimetry
- Peltier effect
- 1st and 2nd law of thermodynamics

d) Gas laws and liquids

- pressure
- Boyles law
- Charles law
- Volumetric relationship
- psychrometrics
- latent heat of vaporisation
- relative humidity
- air conditioning processes
- dynamic pressure loss
- velocity and static pressure
- bourdon tubes
- density and relative density
- Archimedes principle
- Bernoulli's Equation
- manometers
- absorption refrigeration
- centrifugal compression
- external work of a liquid
- pressure volume diagrams
- isothermal and adiabatic processes
- polytropic processes
- Dalton's law of partial pressure

e) Vapour compression

- pressure/enthalpy relationship
- entropy
- characteristics of the evaporation, condensation,

- compression and pressure drop phases
- co-efficient of performance
- theoretical/practical cycles
- characteristics of refrigerants
- theoretical power input
- pressure losses
- heat exchange
- effects of condensing condition changes
- sub-cooling and super-heating

2.17.16 Heat load estimating of commercial refrigeration

Evidence shall show an understanding of heat load estimating of commercial refrigeration to an extent indicated by the following aspects:

a) Heat transfer

- factors affecting heat transfer
- insulation material characteristics
- vapour barriers (seals)
- ambient conditions
- composite walls (heat flows)
- types of common insulation
- thermal conductivity
- film factors

b) Air change load

- room volumes
- room usage (average, medium, heavy)
- heat removed from cooling air to refrigerated conditions
- air curtains
- temperature differences
- door opening sizes
- Tamm's equation

c) Product load

- sensible heat
- latent heat
- heat of respiration
- storage temperatures
- unit running times
- humidity

- air flows
- stacking of products
- freeze, chill, thaw times

d) Total freezer/cool room loads

- wall load
- air change load
- product load
- miscellaneous
- total load, safety factor and unit running times
- floor loads in cool rooms
- door opening loads (ASHRAE & RADS methods)
- door opening loads (for trucks)

e) Process cooling loads

- cooling chemical reactions
- energy balance methods
- sensible & latent cooling of gases
- sensible & latent cooling of water vapour in gas streams

f) Computer programs

g) Cabinet construction and design

- deep freeze case
- meat case
- dairy case
- fruit and vegetable case
- drink cabinets

2.17.17.1 HVAC load estimating fundamentals

Evidence shall show an understanding of HVAC load estimating fundamentals to an extent indicated by the following aspects:

a) Heat flow in buildings

- conduction
- convection
- radiation
- heat paths

b) Thermal storage

c) Different methods of calculations

- ASHRAE

- Carrier
 - finite difference
- d) U Values.
- e) Film coefficients.
- f) Solar heat
- direct
 - diffuse
 - sol air temperature
 - sun position calculations
- g) Design conditions
- outdoor
 - monthly/daily corrections
 - comfort/critical
 - indoor
 - effective temperature
- h) Thermal comfort.
- i) Space characteristics.
- j) Equipment location.
- k) Zoning.
- l) Internal loads
- lighting
 - equipment
 - people
 - load profiles
 - internal partitions
- m) Fresh air/AS 1668
- n) Calculation of fabric loads
- walls
 - roofs
 - floors
- o) Windows
- glass types and factors
 - shade factors
 - internal and external shading
 - shading from adjacent structures
- p) Air quantity calculation

- psychrometrics
- by-pass factor
- coil load
- VAV air quantities

q) Piping and other losses.

r) Refrigeration plant load.

s) Equipment selection

- coils
- air handling
- chillers/boilers
- t) Fresh air preconditioners.

u) Fresh/exhaust air heat exchangers.

v) Computer software

- responsible use

2.17.17.2 HVAC load estimating

Evidence shall show an understanding of HVAC load estimating to an extent indicated by the following aspects:

a) System design parameters

- human comfort
- system requirements in accordance with AS1668
- heat transfer calculations for complex structures and building components
- heat and radiation transfer calculations through complex glass structures including various internal and external shading devices
- indoor air quality
- olfs and decipols

b) Complex shading

- solar data, azimuth and altitude angles
- shading from adjacent structures

c) Computer software

- heat load estimating
- building performance analysis

2.17.18.1 Thermodynamics fundamentals

Evidence shall show an understanding of thermodynamics to an extent indicated by the following aspects:

a) Energy and humanity

- Need for energy and relationship between energy usage and standard of living
- Energy conversion - typical processes and efficiencies
- Sources of energy
- Solar energy - direct heating, photosynthesis, solar cells, power tower, hydrogen for solar energy, ocean thermal energy collector, solar ponds, wind and wave energy, hydro-electric power
- Geothermal energy
- Tidal energy
- Nuclear energy - fission and fusion, burner and breeder reactors
- Stored fuel reserves
- Fuel conservation - reduction in wastage, recycling, greater usage efficiency and use of waste heat
- Thermodynamics

b) Basic Concepts

- Nature of matter - atoms, molecules, inter-molecular forces, molecular motion, states of matter
- Mass and conservation of mass principle
- Volume, density, specific volume, relative density
- Force, weight, pressure (atmospheric, gauge and absolute)
- Temperature (Celsius and Kelvin)
- Systems and black box analysis
- Reciprocating piston and cylinder mechanism – pressure ratio and compression ratio

c) Energy

- Definition and principles
- Potential energy
- Kinetic energy
- Work (linear and rotational), constant and variable force, relationship to pressure and volume change
- Power (linear and rotational)
- Sensible heat - specific heat capacity (constant pressure and constant volume)
- Latent heat
- Chemical energy - energy content of a fuel
- Internal energy

d) Energy transfer in closed and open systems

- Definition of a closed system
- Calorimetry as an example of a closed system (with or without phase change)
- Thermodynamics 1
- Non-flow energy equation - typical applications such as stirring with simultaneous heating or cooling
- Definition of an open system
- Mass and volume flow rate and continuity equation
- Steady flow energy equation (negligible change in kinetic or potential energy) leading to the concept of enthalpy - typical applications such as turbines, compressors, boilers and heat exchangers.

e) Gases

- Definition of a perfect or ideal gas in terms of the molecular model
- General gas equation
- Characteristic gas equation (equation of state)
- Constant pressure process
- Constant volume process
- Isothermal process
- Polytropic process
- Adiabatic process

f) Heat engines

- Definition of a heat engine
- Essentials of a heat engine - heat source, heat sink, working substance, mechanical power output, working cycle
- Energy balance for a heat engine (as a black box) and efficiency
- Maximum possible efficiency (Carnot efficiency)
- Types of heat engines according to working substance, heat source, mechanical arrangement and working cycle
- Typical practical cycles - Stirling, Otto, Diesel, dual, two stroke (spark and compression ignition. Joule cycle.
- Thermodynamics 1

g) Heat engine performance

- Measurement of torque and power output - rope brake, shoe brake, hydraulic dynamometer, electric dynamometer
- Heat supply rate, efficiency, specific fuel consumption
- Measurement of indicated power - mechanical indicator, electric/electronic indicator, Morse test
- Friction power, mechanical efficiency, indicated thermal efficiency
- Volumetric efficiency

- Energy balance
- Performance curves - variable load constant speed, variable speed constant throttle setting.

2.17.18.2 Thermodynamics

Evidence shall show an understanding of thermodynamics to an extent indicated by the following aspects:

a) Heat transfer

- Modes of heat transfer
- Conduction through a flat plate, series flat plates, thick and thin wall pipe, composite pipes (e.g. lagged pipes and drums)
- Convection at a flat surface or tube
- Radiation from a flat surface or tube for black or grey bodies
- Combined conduction and convection through single or multiple flat plates or thin wall tubes
- Combined convection and radiation
- Combined conduction, convection and radiation such as fluid in a tank (convection to wall), through wall and/or insulation (conduction) to outside air (convection and radiation)
- Heat exchangers - parallel, counter flow and cross flow

b) Combustion and fuels

- The combustion process
- Fuels - desirable and undesirable characteristics, solid, liquid and gaseous types, their relative advantages and disadvantages and common methods of combustion
- Air/fuel ration - stoichiometric excess or insufficient air
- Emissions and pollutants and their control
- Combustion equations - element mass balance
- Combustion products - gravimetric basis

c) Steam

- Importance of steam for heat transfer and power production
- Steam/water properties and the inter-relationship between the various properties for unsaturated or saturated water or steam either superheated, saturated or wet
- Saturation temperature and pressure, specific enthalpy, specific volume, dryness fraction
- Temperature-specific enthalpy diagram for steam/water
- Use of steam table to determine steam/water properties (any condition except supercritical)

- Steam generation - water tube and fire tube boilers, boiler efficiency
- Safety devices and controls used with boilers
- Steam plant - steam traps, economiser, air, pre-heater, superheater, air/water separators, water treatment, feedwater pump, exhaust gas treatment
- Heat transfer rates to or from steam/water (any condition except supercritical)
- Steam throttling and formation of flash steam
- Steam heat exchangers and barrel calorimeters
- Steam plant for process heating
- Steam plant for power production

d) Refrigeration/heat pump

- Basic principles and terminology
- Vapour compression cycle
- Performance criteria
- Types of refrigerant - designation, properties advantages and disadvantages
- Refrigerant properties using the p-h diagram
- Ideal vapour compression cycle on the p-h diagram
- Energy balance and heat transfers in compressor, evaporator and condenser
- Actual vapour compression cycle and variations from the ideal - pressure loss in lines and non-ideal compression
- Superheating and subcooling with or without suction/liquid heat exchanger
- Carnot principle applied to refrigerator and heat pump Principles of evaporative refrigeration, absorption refrigeration, air cycle refrigeration and thermo-electric refrigeration

2.17.18.3 Heater exchanger design

Evidence shall show an understanding of heater exchanger design to an extent indicated by the following aspects:

- a) Concepts
- b) Design parameters and limitations
- c) Construction material and components
- d) Testing requirements

2.17.19 Fluid mechanics fundamentals

Evidence shall show an understanding of fluid mechanics fundamentals to an extent indicated by the following aspects:

a) Basic properties of fluids

- Description of a fluid and the difference between solids and fluids, liquids and gases, hydraulics and pneumatics
- Chemical properties, reaction with metals, corrosiveness, flammability, toxicity, pollution and environmental effects
- Dissolves gases and particles in liquids (slurries)
- Foaming of liquids. Basic properties and units - mass, volume, density, specific volume, relative density, force and weight, pressure (absolute, atmospheric and gauge), temperature (Celsius and Kelvin), viscosity, surface tension
- Vapour pressure of a liquid - saturation vapour pressure
- Temperature and pressure effects on the basic properties
- Ideal/perfect gases and liquids
- Gas laws for ideal gases
- Fluid Mechanics 1

b) Components

- Pipes, channels, tubes and ducts (rigid and flexible)
- Valves - gate, globe, non-return/foot, needle, ball, plug cock, diaphragm, pressure regulating/reducing, safety valves
- Filters and strainers for gases and liquids
- Gauges and instruments - pressure and temperature gauges, liquid level gauges, thermometers, thermocouples, manometers, piezometers
- Pipe fittings - elbows/bends, enlargement/contractions, coupler/unions, tees
- Tanks and vessels - storage tanks, pressure vessels, header and surge tanks, weirs/dams/reservoirs
- Nozzles/spray heads
- Flow measurement instruments - venturi and orifice meters, pitot tube, rotameter, anemometer (fan/hot wire)
- Pumps/compressors, motors/turbines
- Actuators - linear (cylinders) and rotary
- Selection of equipment and instruments considering properties and compatibility

c) Fluid statics

- Pressure at a point, direction of pressure on a surface
- Pressure variation with depth in a liquid
- Pascal's Principle
- Manometer/piezometer calculations (vertical and inclined)
- Forces due to fluid pressure on vertical, horizontal and inclined surfaces

- Centre of pressure
- Archimedes Principle - buoyancy, flotation, apparent weight and centre of buoyancy

d) Fluid flow

- Steady and unsteady flow, streamlines and eddies
- Velocity - average or mean and local
- Mass and volume flow rate
- Conservation of mass leading to the Continuity Equation for fluid flow
- Modification of the Continuity Equation for volume flow of liquids or gases with small changes in density
- Bernoulli Equation for ideal fluids, meaning of pressure, velocity and potential head. Total head
- Causes of head loss and modification of the Bernoulli Equation to include a head loss term for real fluids

e) Fluid power

- Definition and units for work, torque and power
- Relationship between force, velocity and power and torque, angular velocity and power
- Work done by a gas expanding at constant pressure
- Relationship between fluid power, mass flow rate and head
- Relationship between fluid power, volume flow rate and pressure
- Efficiency of a pump or turbine
- Modification of the Bernoulli Equation to include a pump or turbine in the fluid circuit as well as a head loss term

f) Forces developed by flowing fluids

- Impulse-momentum equation for fluid flow
- Force developed by a jet striking a stationary plate - perpendicular, inclined or curved
- Force developed by a jet striking a moving plate or blade
- Force developed by a jet striking a series of moving plates or blades - power developed and efficiency

2.17.20 Materials strength fundamentals

Evidence shall show an understanding of strength of materials to an extent indicated by the following aspects:

a) Stress and strain

- normal stress and strain
- modules of elasticity

- deformation
- Poisson's Ratio
- shear stress and strain
- modulus of rigidity
- yield stress, ultimate stress, proportional limit
- factor of safety
- allowable stress

b) Centrally loaded connections

- bolted connections
- shear, tensile and bearing stresses
- centrally loaded welded connections
- fillet and butt
- method of failure
- size and length
- punching of plates

c) Thin walled pressure vessels

- define thin wall
- longitudinal stress
- hoop stress

d) Properties of plane figures

- first moment of area
- second moment of area

e) Simple beams (point and distribute loads)

- shear force diagrams
- bending moment diagrams
- bending stress
- deflection by formula

f) Torsional stress

- torque diagrams
- angle of twist
- torsional shear stress

g) Thermal stress

- coefficient of linear expansion
- thermal stresses in single members

2.17.21.1 Noise and vibration control fundamentals

Evidence shall show an understanding of noise and vibration control fundamentals to an extent indicated by the following aspects:

a) Fundamentals of sound

- frequency
- decibels
- octave bands
- direct sound
- velocity
- sound pressure level
- sound power level
- sound meters

b) Noise and people

- physical measurement of sound
- weighting networks
- NR curves
- noise damage to hearing
- evaluate daily noise exposures
- peak noise levels
- attenuation for hearing protectors
- excess noise levels permissible
- noise abatement acts

c) Identify and analyse problems

- one-dimensional sound waves
- standing waves
- energy in a sound wave
- sources
- effects of air turbulence
- transmitters
- amplifiers
- absorptivity
- reflectivity
- room characteristics
- acoustic design in buildings
- fan and air noise transmission in ducts

d) Methods of control

- natural attenuation
- sound absorbing materials, placement
- duct lining

- lined plenums
- lined duct splitters
- duct attenuators
- white noise
- vibration isolators

e) Acoustic specifications

- attenuator ratings

2.17.21.2 Advanced noise and vibration control

Evidence shall show an understanding of advance noise and vibration control to an extent indicated by the following aspects:

a) Fundamentals of sound

- Frequency
- Decibels
- Octave bands
- Direct sound
- Velocity
- Sound pressure level
- Sound power level
- Sound meters

b) Noise and people

- Physical measurement of sound
- Weighting networks
- NR curves
- Noise damage to hearing
- Evaluate daily noise exposures
- Peak noise levels
- Attenuation for hearing protectors
- Excess noise levels permissible
- Noise Abatement Act
- Advanced Noise and Vibration Control

c) Sound in confined and unconfined spaces

- Inverse square laws
- Direct and reflective sound
- Define reverberation time
- Sabine's formula

- Absorption coefficients of surfaces
- Types of absorbers and their operation
- Insulation performances of partitions

d) Sound insulation

- Plant room breakout
- Controlling plant room noise

e) Duct borne noise

- Sound power spectra for fans
- Noise attenuation in ducts and fittings
- Reducing fan noise transmission
- Regeneration noise
- Sources of regenerated noise
- Use tables to estimate regenerative noises
- Breakout situations
- Fan noise breakout
- List methods of controlling breakout

f) Controlling the cost

- Economical use of attenuation

g) Vibration

- SHM (Simple Harmonic Motion)
- Period
- Frequency
- Amplitude
- Estimate frequencies for fans, pumps and refrigeration plant
- Estimate transmission of vibration
- Vibration control for building structures
- Use transmissibility graphs to select springs, vibration eliminators and pads
- Types of isolation materials and mounting devices
- Select isolation and mounting devices
- Inertia blocks

h) Noise and vibration analysis computer software packages.

2.17.22 Refrigeration and food storage technology

Evidence shall show an understanding of refrigeration and food storage technology to an extent indicated by the following aspects:

a) Food spoilage and possible causes

- physical damage
- animal activity
- chemical breakdown
- enzyme activity
- micro-organisms
- effects of temperature change
- effects of humidity change
- effects of freezing on fresh produce
- effects of slow freezing time
- effect of refreezing

b) Food preservation

- removing or taking out a reactant
- removing or inactivating the catalyst
- reducing temperature
- changing the reaction system
- irradiation

c) Micro-organisms

- conditions for growth
- potentially hazardous foods
- cross contamination

d) Identification of food spoilage

- recognition and suggest possible cause
- physical damage
- animal activity
- chemical breakdown
- enzyme activity
- micro - organisms

e) Types of heat processing techniques

- heat processing using steam and water
- blanching
- pasteurisation
- sterilisation
- evaporation
- heat processing using hot air
- dehydration
- baking and roasting

f) Types of chilling processing techniques

- chilling and controlled atmosphere storage

- freezing
- freeze drying and freeze concentration
- modified atmosphere combined with low temperature cryovac.

2.17.23.1 Industrial refrigeration systems design fundamentals

Evidence shall show an understanding of industrial refrigeration systems design fundamentals to an extent indicated by the following aspects:

a) Standards and codes

- AS1677, detailed understanding
- AS 3666, overview
- ozone protection regulations
- IIR Ammonia Data Book
- ANSI/IIR standards
- ANSI/ASHRAE Mechanical Refrigeration & IIR bulletins and standards (list will be provided by Rama)

b) Operating characteristics

- pH charts
- refrigerating effect, relate back to air and fluid coolers
- heat of compression, relate back to screw, rotary and reciprocating compressors
- heat rejected high side of the system, relate back to air cooled, evaporative, and water cooled condensers
- variable liquid refrigeration systems & liquid overfeed systems
- required mass flow rate of refrigerant and volume flow rate at various points in system
- theoretical compressor power
- required condenser capacity

c) Major system components

- refrigerants, including R717 and R22
- secondary refrigerants
- component lubricant refrigerant compatibility
- evaporators
- condensers, cooling towers
- compressors
- expansion valves
- interconnecting piping and
- isolating valves
- pilot operated valves

- defrost system components for air, water, recycled water, hot gas, electric methods
- refrigerant accumulators and liquid pumps

2.17.23.2 Industrial refrigeration system design

Evidence shall show an understanding of industrial refrigeration system design to an extent indicated by the following aspects:

a) Standards

- AS1677
- ANSI/IIAR Standards
- ANSI/ASHRAE Standards
- IIAR Bulletins

b) Moderate and low temperature industrial refrigeration systems

- revise direct, flooded and pumped liquid recirculation systems
- evaporators
- multi-staged compression
- direct staging
- cascade staging
- compound compressors
- desuperheaters, liquid injection
- direct expansion intercoolers
- open and closed intercoolers
- basic designs of accumulators/intercooler vessels
- oil cooling methods
- oil stabilisation, return and oil recovery in flooded systems

c) Multiple evaporators and multiple compressors

- parallel evaporators
- multiple temperature systems
- evaporator pressure regulators
- temperature control methods
- parallel compressors
- pipework layout
- methods of establishing pressure drop in dry and wet suction lines

d) Indirect refrigeration systems

- classification according to AS1677
- applications
- evaporators

- heat exchangers, types, construction, selection
- secondary refrigerants
- brines
- antifreeze solutions

e) Flooded systems

- applications
- equipment
- accumulators
- level controls
- liquid recirculation pumps
- liquid pressure relief valve

f) Cryogenic systems

- applications and equipment
- system components
- refrigerants
- design safety
- economics
- cascade systems

g) Basic control sequences

- maintaining evaporator conditions
- staging and suction pressure control
- maintaining condenser conditions
- control of intermediate pressure, methods of industrial refrigeration
compressor capacity control

2.17.24 Commercial air conditioning systems design

Evidence shall show an understanding of commercial air conditioning systems design to an extent indicated by the following aspects:

a) Design parameters for single-storey buildings (e.g. offices, restaurants, hotels, bars)

- Customer and objective
- Customer concept of environment desired
- Economics
- Client brief

b) Relevant design criteria

- Building purpose, location, orientation and shape

- External environment ambient conditions
- Internal load diversity
- Thermal capacity behaviour
- Thermal load (full and partial)

c) Zoning and building usage

- Space and building
- Occupancies, single purpose, multi-purpose

d) System selection criteria

- Economics
- Environment
- Control requirements
- Existing structures
- New structures
- System components
- Space for equipment and system
- Selection of appropriate system, equipment, ductwork and components

e) Systems and applications

Design features, engineering and selection procedures for direct expansion air conditioning systems:

RAC's, split systems, package units

Free blow and ducted fan coil units

Cooling, heat pump and electric heating

2.17.25 Statics

Evidence shall show an understanding of statics to an extent indicated by the following aspects:

a) Force and gravity

- the concept of force
- characteristics of force
- basic principles
- rectangular components of force
- graphical addition of forces
- mathematical addition of forces
- universal gravitation
- variation in gravity
- weight as force

- types of supports

b) Equilibrium of concurrent coplanar forces

- concurrent forces
- conditions of equilibrium
- the equilibrant force
- support reactions
- the three force principle
- two and three force bodies

c) Moment and torque

- moment of force
- addition of moments
- equilibrium of moments
- torque
- equivalent force moment systems

d) Equilibrium of non-concurrent coplanar forces

- conditions of equilibrium
- calculation of beam reactions (simply supported, cantilever, point load, udi, self-weight)
- resultant of non-concurrent forces

e) Friction

- coefficient of frictional resistance
- the laws of dry sliding friction
- the angle of friction
- the angle of repose
- friction on inclined planes
- resultant of normal reaction and friction force
- wedges
- stability - overturning versus sliding

f) Couples

- definition
- applications
- moment of a couple
- replacing a force with a force and a couple

g) Forces in frames

- general principles
- method of joints
- combined force polygon (Maxwell diag)
- method of sections

- method of members

2.17.26 Commercial refrigeration system design

Evidence shall show an understanding of commercial refrigeration system design to an extent indicated by the following aspects:

a) Commercial refrigeration system types

- medium and low temperature applications
- operating conditions
- system operating and service requirements
- refrigerant types
- components
- multiple evaporator systems
- multiple temperature systems
- multiple compressor (rack) systems
- two stage compressors
- multiplex systems
- defrost requirements and methods
- electric defrost systems
- hot gas defrost systems
- cool gas defrost systems

b) Manufacturer's data

- rating tables
- selection tables
- catalogues.

c) Operating characteristics

- Effects of temperature glide with blended
- refrigerants,
- Ph Charts,
- Refrigerating Effect,
- Heat of compression,
- Heat Rejected on High Side of the System,
- Required mass flow rate of refrigerant,
- Volume flow rate at various points in system,
- Theoretical compressor power,
- Required condenser capacity.

d) Review automatic controls

- refrigerant regulating valves
- solenoid valves
- expansion valves
- pressure regulating valves
- cycling controls
- pressure-stats
- thermo-stats
- defrost controls
- monitoring and alarm controls
- energy management systems
- refrigeration automation systems
- control strategies
- control modes

2.17.27 Air conditioning system design

Evidence shall show an understanding of air conditioning system design to an extent indicated by the following aspects:

a) Design parameters for multi-storey building

- customer and objective
- customer concept of environment desired
- economic
- client brief

b) Relevant design criteria

- building purpose, location, orientation and shape
- external environment ambient conditions
- internal load diversity
- thermal capacity behaviour
- thermal load (full and partial)

c) Zoning and building usage

- space and building
- occupancies, single purpose, multi-purpose

d) System selection criteria

- economics
- environment
- control requirements
- existing structures

- new structures
- system components
- space for equipment and system
- selection of appropriate system

e) System and applications

- design features, engineering procedures and controls for:
- direct expansion - self contained room/zone, heat pump, multi-zone fan-coils, central station
- all water - room fan-coil
- all-air - constant volume variable temperature, face and bypass, reheat, constant temp variable volume, constant volume induction, dual-duct, dual-conduit
- air water - induction unit, primary air fan- coil

f) HVAC energy conservation techniques

- heat recovery systems
- night cycle
- optimum stop/start
- purge cycles
- chiller/boiler/cooling tower sequencing
- economy cycles (based on temperature or enthalpy)
- supply air reset
- supply water reset
- condenser water temperature reset
- power demand control
- load limiting
- load shedding
- set point relaxation
- ventilation cycles
- plant - fixed OA to economy, boiler to electric reheat, constant volume to VAV etc.
- cost-benefit (payback)

2.17.28 Psychrometrics - advanced

Evidence shall show an understanding of advanced psychrometrics to an extent indicated by the following aspects:

a) Complex psychrometric processes

- revise sensible cooling and heating and evaporative (adiabatic) cooling
- cooling and dehumidification

- cooling and dehumidification with high latent load
- cooling and dehumidification all out door air
- cooling and dehumidification all out door air with dehumidified air requirements less than supply air
- cooling with evaporative humidification
- cooling with near isothermal humidification
- spray process to include cooling and dehumidification, cooling and humidification with heated spray water, heating and humidification.
- partial load processes
- reheat
- bypass of, RA only and mix of RA & OA
- variable air volume
- variable coil effective surface temperature
- split coil, horizontal, vertical and intertwined.

b) System performance

- saturation efficiency of sprayers
- system capacity calculated from air quantity and enthalpy change

c) Required plant capacity and airflow rates

- effects of coil bypass factor and ADP
- calculation of dehumidified air quantity, using both TSH and ERSB methods.

d) Recap on psychrometrics formulae and charts

- properties of air
- gas constants
- derivation of air constants
- combined gas laws
- Dalton's law of partial pressures
- Carrier's equation
- psychrometric property tables
- psychrometric charts
- air mixing equations
- air quantity equations
- indirect evaporative coolers
- analysis of cooling coil selection and performance
- psychrometric analysis of:
 - air conditioning in tropics
 - all outdoor air
 - LCV/HWF systems
- psychrometric analysis using equations and tables

2.17.29 Exhaust systems design

Evidence shall show an understanding of exhaust systems design to an extent indicated by the following aspects:

a) Relevant codes and regulations

- health and safety
- noise
- smoke
- fire
- hazard identification

b) System types

- applications
- application flow charts
- system requirements
- hazard identification
- effluent types and removal
- relationship with smoke spill systems
- supply air dilution applications
- natural ventilation applications
- fan assisted exhaust applications
- replenishment of exhaust air
- system components

c) Duct design

- static, velocity, total pressure
- pressure drop
- fouling
- transitions
- elbows
- fan position and mounting
- noise and noise attenuation
- requirements for access and maintenance
- system integrity

d) Fan and motor selection

- applications
- suitable fan types
- motor rating and suitability
- balancing the fan duct system

- flame proofing

e) Filters and filter selection

- types and applications
- capture velocity

f) Outlet design and location

- prevailing winds
- position relative to air intakes
- weather and bird proofing

g) Cycling/operation control

- applications
- code/regulation requirements
- monitoring of contaminants
- contaminant detection
- sensors
- variable speed fans
- flame proofing of control equipment

2.17.30 Heating systems design

Evidence shall show an understanding of heating systems design to an extent indicated by the following aspects:

a) Heating techniques:

- electric resistance heaters
- hot water boilers
- steam boilers
- refrigeration heat pump
- heat reclaim
- thermal storage systems
- comparative heating costs
- Australian Standards

b) Heating equipment selection

- double bundle condensers
- heat pumps
- boilers
- coils
- expansion tanks
- pumps, characteristics curves

- control valves, types, flow diagrams,
- air purge points
- water treatment
- pipe anchors and expansion joints

c) Hydronic system configuration

- piping configurations
- single pipe closed circuit
- two pipe closed circuit
- direct return
- three pipe closed circuit with reversed return
- three way diverting valves
- risers and headers
- component location
- evaluation of piping configurations
- capital cost
- owning and operating costs
- noise vibration
- maintenance
- future expansion
- commissioning and balancing
- operating characteristics
- cavitation

d) System pipe sizes

- pipe dynamic and friction losses for different materials
- fitting pressure losses for different materials
- thermal heat losses
- bare, insulated and underground pipes

2.17.31 Hydronic system design

Evidence shall show an understanding of hydronic system design to an extent indicated by the following aspects:

a) Principles of fluid flow

- properties of fluids
- flow of ideal fluids
- fluid flow equipment
- Bernoulli Theorem
- fluid flow in pipes

b) Pressure loss and static head - calculation

- flow throughout system
- pressure throughout system
- friction losses
- pressure loss charts for: copper, steel, UPVC
- dynamic losses
- fitting pressure losses
- fitting interaction
- total losses
- calculating system (static and dynamic) head

c) Pump performance and selection

- pump classification and types
- pump performance terminology, discharge, head, power, efficiency, speed, net positive suction head required
- pump performance curves
- pump laws
- system head and 'K' factor
- balance points
- energy considerations
- pump cavitation
- calculation of net positive suction head available
- Series and parallel operation

d) Pipe sizing

- maximum friction rate
- erosion and equipment life
- industry standards
- recommended system water velocities
- economic balance - first cost and operating cost

2.17.32 Sources of technical development and processes for their adoption

Evidence shall show an understanding of sources of technical development and processes for their adoption to an extent indicated by the following aspects:

a) Sources of information on alternative or new technologies

- Industry organisations
- Industry technical journals
- Government and private research papers/literature
- Manufacturers' bulletins

b) Comparison of technical data from different manufacturers

c) Evaluating performance benefits and limitations of new and developed technologies for given applications, encompassing:

- Capital cost benefits
- Operations efficiency
- Risk hazardous and issues related to environmental and health and safety
- Functionality

d) Processes to facilitate adoption

Note:

Research; analyses; reporting; recommending; and the like, utilising a range of techniques, processes and technologies

2.17.33 Refrigeration systems

Evidence shall show an understanding of introduction to refrigeration to an extent indicated by the following aspects:

a) Major components, type and functions:

- evaporators
- compressors
- expansion devices
- ancillary components
- refrigerants

b) System operation and performance:

- thermodynamic properties of refrigerants
- pressure enthalpy charts
- the refrigerant cycle
- the refrigerant cycle represented on pH charts
- introduction to refrigerating effect, heat of compression, heat rejected on high side, co-efficient of performance, liquid sub-cooling suction superheating
- effects on performance of changing operating pressures, liquid sub-cooling, suction superheating

c) Application of refrigeration:

- introduction to industrial refrigeration, specific system component types and refrigerants applied.
- scope of commercial refrigeration, specific system component types and refrigerants applied

d) Refrigerated enclosures and cabinets:

- merchandising and display cabinets:
- deep freeze meat
- dairy
- fruit and vegetable
- multi-deck display
- single deck
- well type
- island cases
- glass door
- reach door
- reach in merchandisers
- defrosting methods
- cold rooms and freezer rooms
- types and construction
- insulation
- vapour barrier
- frost heave
- interior fittings
- location of equipment
- defrosting methods
- cold tracking
- trace heating
- storage conditions
- temperature
- relative humidity
- air velocity
- air patterns
- load limits

e) Air conditioning chills & DX coil types and construction

2.17.34 Air conditioning systems

Evidence shall show an understanding of air conditioning to an extent indicated by the following aspects:

a) Occupational health requirements:

- WH&S requirements
- BCA requirements

- AS1668 parts 1 & 2
- AS3666
- noise and vibration
- air quality
- sick building syndrome

b) Operating requirements:

- ventilation
- air distribution
- terminal velocity
- temperature
- relative humidity
- air quality
- noise
- basic psychrometrics

c) Operating modes

- ventilation
- evaporative cooling
- ventilation and cooling
- ventilation and heating
- dehumidification
- dehumidification
- dehumidification and reheat
- humidification

d) Operating terminology/characteristics:

- throw, drop
- primary and secondary air
- coanda effect

e) HVAC system components and functions:

- fans
- ducting
- registers
- dampers
- filters
- cooling coils
- heating coils
- induction units
- fan coil units
- terminal units

- humidifiers, pumps and sprayers
- hydronic systems and components

f) Applications and construction of air conditioning systems:

- applications
- residential, commercial, low and high rise, industrial ventilation and air conditioning
- packaged plant
- RACs, split systems (wall and floor console, ceiling fan coil), wall fascia, roof top, reverse cycle option central station plant
- all air systems, constant volume variable temperature, constant temperature variable volume, air/water systems
- all water system, multi-zoning, thermal storage systems
- basic air conditioning system diagrams
- duct layout
- hydronic layout
- unit/conditioner drawings

g) HVAC control systems:

- basic principles
- terminology
- symbols and diagrams
- basic applications

2.17.35 Applied psychrometrics

Evidence shall show an understanding of applied psychrometrics to an extent indicated by the following aspects:

a) Fundamentals and terms

- sensible heat factor (conditioned space and grand total)
- quantity of air
- effective surface temperature
- bypass factor

b) Coil characteristics

- processes
- sensible cooling
- cooling, dehumidification
- sensible heating

c) Spray processes

- saturation efficiency

- processes
- adiabatic/evaporative cooling
- cooling & humidification
- sensible cooling
- cooling and/or humidification
- chemical dehumidification process: dehumidification & heating
- cooling tower characteristics: humidification & cooling
- indirect evaporative cooling process

d) System analysis

- partial load
- reheat control
- bypass control
- volume control
- dump back systems
- low velocity coils

e) Psychrometric formulae and charts

- properties of air
- gas constants
- derivation of air constants
- combined gas laws
- Dalton's law of partial pressures
- Carrier's equation
- psychrometric property tables
- air mixing equations
- air quantity equations

2.17.36 Ventilation systems

Evidence shall show an understanding of ventilation to an extent indicated by the following aspects:

- a) Requirements necessary to supply/install/maintain a ventilation/air conditioning system. (not design)
- b) Fan classifications and applications.
- c) Identification and correct usage of various items of test equipment.
- d) Procedures to be followed when conducting an air balance.
- e) Filtration applications and service requirements of ventilation - air conditioning systems.

- f) Noise and vibration sources in ventilation – air conditioning system.
- g) Site work/architectural drawings.
- h) Auxiliary equipment.
- i) Layout and zoning of duct work system.
- j) Occupational health aspects.

2.17.37 Beverage vending cabinets

Evidence shall show an understanding of beverage vending cabinets to an extent indicated by the following aspects:

- a) Types, construction and operation of refrigerated drink vending cabinets encompassing:
 - Coin operated mechanism on the refrigerated vending cabinet.
 - Electro-mechanical mechanism on the coin operated vending cabinet.
 - Electronic mechanism on the coin operated vending cabinet.
- b) Specialised components and features required for the operation of a coin operated refrigerated vending cabinet encompassing:
 - Electrical / electronic control circuitry.
 - Air distribution and air flow curtains.
 - Lighting arrangements.
- c) Installation requirements for a refrigerated coin operated vending cabinet encompassing:
 - Location requirements
 - Access requirements and avoidance obstruction
 - Power supply and electrical service requirements
- d) System operating conditions for a coin operated refrigerated vending cabinet.
- e) Commissioning, service and maintenance procedures of a refrigerated coin operated vending cabinet encompassing:
 - Electrical / electronic control devices checks and adjustments.
 - Air flow checks and adjustments.
 - Mechanical checks and adjustments
 - Typical faults

2.17.38.1 Servicing and repair techniques for Ammonia refrigeration Systems

Evidence shall show an understanding of servicing and repair techniques for

Ammonia refrigeration systems to an extent indicated by the following aspects:

- a) Servicing Procedures
- b) Leak detection methods
- c) Adding refrigerant
- d) Removing refrigerant

2.17.38.2 Operating conditions of Ammonia Refrigeration Systems

Evidence shall show an understanding of operating conditions of ammonia refrigeration systems to an extent indicated by the following aspects:

- a) Compressors
 - Function of the compressor
 - Types, construction and their applications
 - Capacity control of compressors
 - Factors affecting performance
 - Economiser operation
 - Types of oil separators
 - Methods of oil cooling
 - Operation and maintenance
- b) Lubrication and lubricants
 - Lubrication methods
 - Safe handling of lubricants
 - Selection of lubricants
 - Oil / Ammonia separation
 - Adding and removing oil from Ammonia systems
 - Methods of oil recovery
- c) Evaporators / Cooling Units
 - Types of evaporators (air / fluid cooling)
 - Direct contact freezing
 - Secondary refrigerants
 - Evaporator defrost methods and controls
 - Operation and maintenance
- d) Condensers and high pressure receivers
 - Evaporative condensers
 - Water cooled condensers
 - Air cooled condensers
 - High pressure receivers
 - Operation and maintenance
- e) Low Pressure Receivers

- Suction accumulators
 - Intercoolers
 - Liquid refrigerant pumps
 - Liquid level controls
 - Operation and maintenance
- f) Purging
- Non condensable gases
 - Manual; purging of Ammonia systems
 - Automatic refrigerated purgers
 - Operation and maintenance
- g) Refrigerant Flow Devices
- Expansion valves
 - Automatic liquid feed control devices
 - Pressure regulating devices
 - Operation and maintenance
 - Methods of oil recovery
- h) Ancillary Components
- Strainers, isolating valves
 - Liquid level indicators
 - Pressure relief valves
 - Ammonia leak detectors
 - Safety controls
 - Operation and maintenance

2.17.38.3 Ammonia Refrigeration Systems

Evidence shall show an understanding of ammonia refrigeration systems to an extent indicated by the following aspects:

- a) Vapour Compression Systems
- Revision of Vapour Compression Cycle
 - Properties of Ammonia
 - Safe Handling of Ammonia
- b) Types of Ammonia Systems
- Direct Expansion Systems
 - Flooded Systems
 - Liquid Recirculation Systems
- c) Multi Staged Systems
- Single Staged Systems
 - Multi Staged Systems

- Cascade Systems

2.17.38.4 Technical standards, regulations and codes for ammonia refrigeration systems

Evidence shall show an understanding of Technical standards, regulations and codes for ammonia refrigeration systems to an extent indicated by the following aspects:

- a) Environmental and safety considerations in the use and disposal of ammonia refrigerant
 - Toxicity of ammonia, the effects on human health and the legislative limitations imposed on ammonia refrigerant as a result
 - Flammability of ammonia, concentration, LEL
 - Environmental effects
 - Safe disposal
 - MSDS samples
 - Registration requirements for transport and on-site use
 - Relationship between ammonia system refrigerant charge and Dangerous Goods Storage regulations
 - Engine ventilation requirements and determination of ventilation rates
 - Scrubbers for elimination of the harmful effects of ammonia

2.17.38.5 Ammonia refrigeration system design requirements

Evidence shall show an understanding of Ammonia refrigeration system components and piping to an extent indicated by the following aspects:

- a) Applications of refrigerant ammonia (NH₃) in industrial refrigeration
 - Introduction to industrial ammonia refrigeration applications and systems
 - Applications in Industrial Refrigeration: Cool and cold storage, food processing, beverage manufacturing plants, fertilizer plants, second compression stage of CO₂ systems
 - Application in environment control and air conditioning: Large scale reticulated water/secondary refrigerant systems
 - Advantages and disadvantages of ammonia refrigerant compared with other natural and synthetic refrigerants
- b) Properties, application and limitations of ammonia refrigerant
 - General classification of ammonia refrigerant according to AS 1677 Refrigerating Systems
 - Common contaminants in ammonia refrigeration systems, water, oil, non-condensable and the effects of same on cycle efficiency and system

wear

- Refrigeration machine oils soluble in ammonia, oil type, applications, reactions with water
- Thermal and transport properties of ammonia in comparison with other natural and synthetic refrigerants including the behaviour in a vapour compression cycle

c) Application concepts and principles

- Single stage vapour compression cycles with dry expansion refrigerant feed
- Single and dual stage vapour compression cycles with liquid overfeed
- Single stage vapour compression cycles with screw compressors and liquid overfeed
- Cascade NH₃/CO₂ systems with dry expansion and liquid overfeed
- Single and dual stage vapour compression cycles with gravity flooded refrigerant feed
- Single and dual stage vapour compression cycles with NH₃ used as a volatile secondary refrigerant
- Dual stage vapour compression cycles with multiple (>2) saturation temperature levels
- Automatic defrost principles including off-cycle air defrost, ambient air defrost, hot gas defrost, electric defrost and water defrost
- Selection and sizing of ammonia pumps for liquid overfeed systems
- Selection and sizing of high pressure and low pressure vessels
- Refrigerant pipe sizing using Ammonia refrigerant
- Selection of suitable refrigerant oil

2.17.38.6 Ammonia refrigeration system components and piping

Evidence shall show an understanding of Ammonia refrigeration system components and piping to an extent indicated by the following aspects:

a) Corrosion and Material selection

- Materials compatibility table
- Thermal and other properties of materials in use
- Pipe material and jointing methods/materials
- Compressors
- Pumps, impellers and seals
- Isolation and control valves
- Heat exchangers

b) Pipe and insulation materials, pipe stresses and pipe suspension methods

- Mild steel pipe
- Stainless steel pipe
- Sharpy tested pipe
- Post-installation insulation (in situ foaming, formed insulation, closed cell)

flexible insulation

- Pre-insulated pipe material
- Vapour barrier – importance and maintenance

c) Heat exchangers

- Finned air coolers or evaporators - induced draught, forced draught, stainless steel/aluminium, mild steel galvanized, all aluminium, stainless steel/AlMg3, all stainless steel; description of what materials are used where and for what reason; various refrigerant feed methods including advantages/disadvantages i.e. top feed, bottom feed, vertical up flow/down flow of air; fin spacing, fin thickness; impact of geometry on fluid pressure drops
- Condensers – evaporative, air cooled, air cooled adiabatically assisted, water cooled shell and tube, water cooled plate/plate, water cooled plate and shell, cascade shell and tube, cascade plate/plate, cascade plate and shell; material selection for condensers, importance of discharge temperature for condenser design
- Cooling towers
- Intercoolers and economizers of the closed type, sizing of liquid subcooling coils and tube bundles
- Liquid coolers or evaporators – plate/plate, plate/shell, shell and tube; material selections, refrigerant feed methods, oil management
- Screw compressor oil coolers – plate/plate type, shell and tube type, water cooled, refrigerant cooled, surface enhancement options
- Heat recovery – shell and tube desuperheaters, plate/plate desuperheaters, heat recovery condensers of various types

d) System control and monitoring

- Compressor capacity control – pressure and temperature signals
- Room temperature and humidity control – understanding the principle of cooling and re-heating air streams to control absolute moisture contents
- Control of condensers – optimization of overall plant C.O.P.
- Floating condensing pressures
- Control of fluid temperatures within the system – oil, secondary refrigerants, subcooling
- Control of flows – thermostatic expansion valves, low pressure floats, high pressure floats, motorized valves, electronic expansion valves, hand regulating valves, oil return systems between compressor oil separators and compressors
- Pressure controllers - evaporating pressure controllers, thermostatic controllers, hot gas bypass valves, crankcase pressure regulators, overflow valves, NH3 pump pressure control, flow controllers, defrost pressure controllers
- Defrost control
- PLC control systems

- SCADA systems
- e) Water treatment and desiccant dehumidifiers
 - Condenser water treatment – purpose and legislative requirement
 - Treatment of secondary refrigerant loops including monitoring
 - Desiccant dehumidifiers and their role in infiltration minimization, defrost control and energy savings
- f) Equipment Selection
 - Use computer software and manufacturers data to select major components of an Ammonia refrigeration plant

2.17.39.1 Operating conditions of carbon dioxide Refrigeration Systems

Evidence shall show an understanding of operating conditions of carbon dioxide refrigeration systems to an extent indicated by the following aspects:

- a) CO₂ Refrigeration Compressors and lubricants
 - Types, construction and their applications (reciprocating, screw,)
 - Types of compatible compressor oil (POE), (PAO)
 - Safe handling of lubricants for CO₂ applications (MSDS - POE's, PAO)
- b) System components, construction and operation
 - CO₂ Low temperature evaporators design features
 - Medium Temperature Liquid re-circulation evaporators
 - Hand expansion valves (medium temp.)
 - Electronic expansion valves (low temp)
 - Cryogenic pressure relief devices
 - Plate heat exchangers
 - Liquid –Suction heat exchangers
 - Liquid CO₂ Refrigerant Pumps
 - "Q" Min and "Q" Max valves
 - Interconnecting piping
 - Refrigerant receiver
 - Isolation valves
- c) Applicable Standards and Codes
 - Hazards associated with Carbon Dioxide (MSDS)
 - AS/NZS 1677
 - AS/NZS 1571
 - IIAR Bulletins
 - ANSI/ASHRAE Standards
 - IOR Safety code for Refrigerating Systems utilising Carbon Dioxide

2.17.39.2 Carbon Dioxide Refrigeration Systems

Evidence shall show an understanding of carbon dioxide refrigeration systems to an extent indicated by the following aspects:

- a) Introduction to Carbon Dioxide refrigeration System
- b) Benefits of using Carbon Dioxide as a Refrigerant
- c) Thermophysical Properties
- d) Introduction to Liquid recirculation /Cascade system employing Carbon Dioxide refrigerant at Sub-Critical condition.
 - Systems and Major components
 - Basic operation
 - Typical applications

2.17.39.3 Servicing and repair techniques for carbon dioxide refrigeration systems

Evidence shall show an understanding of Servicing and repair techniques for carbon dioxide refrigeration systems to an extent indicated by the following aspects:

- a) Service Gauges
 - Appropriate Type
 - Care and Maintenance of Gauges and hoses
- b) Service procedures
 - Charging CO₂ into a system in both vapour and liquid form
 - Discharging CO₂ from a system safely
 - Pressure testing
 - System and component isolation
 - Leak detection methods for CO₂
- c) Cylinder Regulators CO₂
 - All currently available regulators provide vapour feed only
 - Pressure readings (bottle and line)
- d) Refrigerant Cylinders CO₂
- e) Refrigerant conditions
 - Hazards and related safe working practices (dangerous system pressures)
 - Pressure to temperature conversion (Saturated P/T is only between 430 kPa and 4399kPa)
- f) System standing pressure as a result of power loss.
- g) Moisture problems with CO₂ systems

2.17.39.4 Technical Standards, Regulations and Codes for carbon dioxide refrigeration systems

Evidence shall show an understanding of technical Standards, Regulations and Codes for carbon dioxide refrigeration systems to an extent indicated by the following aspects:

- a) Standard philosophy and format
- b) Standards, regulations and codes that apply to CO₂ refrigeration systems
- c) Equipment manufactures specifications

2.17.39.5 Carbon Dioxide refrigeration system design requirements

Evidence shall show an understanding of Carbon Dioxide refrigeration system design requirements to an extent indicated by the following aspects:

- a) Possible areas of applications of CO₂ refrigeration systems
 - Mobile air conditioner
 - Heat pump water heater
 - Commercial refrigeration
- b) Thermodynamic properties of CO₂
 - CO₂ phase diagram
 - CO₂ properties tables and chart
- c) Conventional refrigeration cycle versus CO₂ refrigeration cycle
 - T-s and p-h diagram representations
 - Isentropic efficiency
 - Volumetric efficiency
- d) Types of CO₂ refrigeration system configurations
 - Sub-critical operation
 - Trans-critical operation
 - Cascade systems
- e) Performance analysis of CO₂ refrigeration systems
 - Sub-critical cycle
 - Trans-critical cycle
 - Cascade systems

2.17.39.6 Carbon Dioxide refrigeration system components and piping

Evidence shall show an understanding of Carbon Dioxide refrigeration system components and piping to an extent indicated by the following aspects:

- a) Design preliminaries
 - System operating parameters
 - Project specifications
 - Equipment selection criteria

- Selection tables, charts and catalogues
- b) Heat exchanger selection
 - Selection of evaporators
 - Selection of condensers
 - Selection of coolers
- c) Compressor selection
- d) Liquid expansion devices selection
- e) System load balance point
- f) Refrigeration line design and sizing
- g) Automatic controls
- h) Safety devices
- i)

2.17.39.7 Trans-Critical Carbon Dioxide Refrigeration and Heat Pump Systems

Evidence shall show an understanding of servicing and repair techniques for Trans-critical Carbon Dioxide refrigeration and Heat Pump Systems to an extent indicated by the following aspects:

- a) Introduction to Carbon Dioxide refrigeration and heat pump systems encompassing -
 - Benefits of using Carbon Dioxide as a Refrigerant
 - Thermophysical Properties
- b) Access procedures Introduction to self contained systems employing Carbon Dioxide refrigerant at Trans-Critical condition.
 - Systems and major components
 - Basic Operation
 - Typical applications
 1. Domestic refrigerators and freezers
 2. Refrigerated cabinets
 3. Heat pump water heaters
- c) Servicing tools, equipment and procedures

Service Gauges

- Appropriate Type
- Care and Maintenance of Gauges and hoses

Service procedures

- Charging CO₂ into a system in both vapour and liquid form
- Discharging CO₂ from a system safely
- Pressure testing

- System and component isolation
- Leak detection methods for CO₂

Cylinder Regulators CO₂

- All currently available regulators provide vapour feed only
- Pressure readings (bottle and line)

Refrigerant Cylinders CO₂

Refrigerant conditions

- Hazards and related safe working practices (dangerous system pressures)
- Pressure to temperature conversion (Saturated P/T is only between 430 kPa and 4399kPa)

System standing pressure as a result of power loss.

Moisture problems with CO₂ systems

d) CO₂ refrigeration compressors and lubricants

- Types, construction and their applications
- Types of compatible compressor oil (POE), (PAO)
- Safe handling of lubricants for CO₂ applications (MSDS - POE's, PAO)

e) System components, construction and operation

- CO₂ evaporators design features
- CO₂ sub-cooler design features
- Refrigerant flow controls
 1. Capillary tubes and accumulator
 2. Electronic expansion valves
- Pressure relief devices
- Liquid –Suction heat exchangers

f) Applicable Standards and Codes

Hazards associated with Carbon Dioxide (MSDS)

- AS/NZS 1677
- AS/NZS 1571
- IIAR Bulletins
- ANSI/ASHRAE Standards
- IOR Safety code for Refrigerating Systems utilising Carbon Dioxide

2.17.40.1 Self Contained Hydrocarbon refrigeration and Air Conditioning systems

Evidence shall show an understanding of servicing and repair techniques for

Hydrocarbon refrigeration systems to an extent indicated by the following aspects:

- a) Hydrocarbon refrigeration systems
 - Basic operation system types, applications and design operating conditions
 - Domestic refrigerators
 - Self contained refrigeration cabinets
 - Self contained air conditioners
 - Single head split air conditioners
 - Heat pump water heaters
- b) Operating conditions for hydrocarbon refrigeration systems
 - Compressors
 - Functions of the compressor
 - Types, construction and their applications
 - Lubrication and lubricators
 - Lubrication methods
 - Safe handling of lubricants
 - Selection of Lubricants
 - Adding and removing oil from Hydrocarbon systems
 - Evaporators / Cooling Units
 - Types, construction and applications
 - Evaporator defrost methods and controls
 - Operation and maintenance
 - Refrigerant Flow Devices
 - Types, construction and applications
 - Operation and maintenance
 - Ancillary Components
 - Leak detectors
 - Safety controls
 - Operation and maintenance
- c) Applicable Standards and Codes
 - Hazards associated with Hydrocarbons
 - AS/NZS 1677
 - AS/NZS 1571
 - IIAR Bulletins
 - ANSI/ASHRAE Standards
 - International Standards EN378
- d) System access tools
 - Schraeder valves
 - Piercing valves
 - Process tube adaptors

- Gauge manifold sets
- Maintenance
- e) Access procedures
 - Ignition sources
 - Ventilation
 - Gauge manifold hoses
 - System operating values
- f) Refrigerant removal/recovery and flushing
 - Bleed to atmosphere
 - Recovery to a cylinder
 - Burning
 - Flush with inert gas
- g) Tube joining methods
 - Lok-ring
 - Flare joints
 - Silver brazed joints
 - Flux
- h) Compressor lubricants
 - Types
 - Properties
 - Replacing
 - Disposing
- i) Pressure testing
 - Requirements
 - Recommended pressures
- j) Evacuation
 - Vacuum pumps
 - Vacuum measuring devices
 - Maintenance
 - Recommended depth of vacuum
 - Procedure
- k) Charging
 - Precautions
 - Liquid or vapour charging
 - Suitable methods
 - Disposing of contaminated refrigerant and oil
- l) Leak detection
 - Methods
 - Procedure

- Maintenance

2.17.40.2 Hydrocarbon Refrigeration System Design

Evidence shall show an understanding Technical standards, regulations and codes for hydrocarbon refrigeration systems to an extent indicated by the following aspects:

- a) Technical standards, regulations and codes for hydrocarbon refrigeration systems
 - Standard philosophy and format
 - Standards, regulations and codes that apply to Hydrocarbon refrigeration systems
 - Equipment manufactures specifications
- b) Hydrocarbon refrigeration system design requirements
 - Applications of hydrocarbon refrigeration systems
 - Domestic refrigerators
 - Commercial refrigeration
 - Thermodynamic properties of HC
 - HC phase diagram
 - HC properties tables and chart
 - HC Refrigeration cycle
 - P-h diagram representation
 - Expansion, evaporation, compression and condensation processes
 - Performance analysis of HC refrigeration systems
 - Refrigerating effect
 - Heat of rejection
 - Heat of compression
 - Coefficient of performance
 - Effects of suction superheating on cycle efficiency
 - Effects of liquid sub-cooling on cycle efficiency
 - Actual HC refrigeration cycles
 - Superheating inside and outside the refrigerated space
 - Liquid-suction heat exchangers
 - Pressure drop in piping due to friction and dynamic losses
- c) Hydrocarbon refrigeration system components and piping
 - Design preliminaries
 - System operating parameters
 - Project specifications
 - Equipment selection criteria
 - Selection tables, charts and catalogues
 - Materials used with HC refrigerants

- Heat exchanger selection
- Selection of evaporators
- Selection of condensers
- Compressor selection
- Liquid expansion devices selection
- System load balance point
- Refrigeration line design and sizing
- Automatic controls
- Safety
- MSDS of HC refrigerants
-

2.17.41.1 Service and repair secondary refrigeration systems

Evidence shall show an understanding of servicing and repair secondary refrigeration systems to an extent indicated by the following aspects:

- a) Carry out repairs to secondary refrigerant systems.
 - Safety
 - Appropriate personnel contacted before isolation repairs to pumps
 - Additions required to maintain chemical integrity of refrigerant
 - Repairs to cooling coils/ freezing coils
 - Repair system leaks
 - Repair pipework or insulation
 - Repair / replace defective control valves
 - Repair / replace defective control system component
 - Refrigerant disposal EPA requirements
- b) Complete report on repair activities
- c) Tools and equipment for repair work
- d) Applicable Standards and Codes
- e)

2.17.41.2 Components of secondary refrigeration systems

Evidence shall show an understanding the components of secondary refrigeration systems to an extent indicated by the following aspects:

- a) Introduction to secondary refrigeration systems
 - Safety
 - Basic operation
 - Typical applications
 - Safety in handling Secondary Refrigerants
 - Types of secondary Refrigerants
 - Need for anti bacterial and corrosion inhibitor use
 - Use of PPE (Personal Protective Equipment)

b) Major components location, purpose and operation

- Safety
- Major components Operation
- Pipe work and insulation
- Pumps
- Cooling coils
- Low temperature defrost systems
- Heat recovery coils
- Control system, pressure temperature, and safety
- Control, balance and operational valves
-

2.17.41.3 Maintenance procedures for secondary refrigeration systems

Evidence shall show an understanding of maintenance procedures for secondary refrigeration systems to an extent indicated by the following aspects:

a) Maintenance requirements of secondary refrigeration systems.

- Safety
- Operation of primary cooling source
- Tool and equipment
- Operation of pumps
- Chemical integrity of refrigerant
- Cooling coils/ freezing coils operation
- Leak detection additives
- Leak test system
- Pipework and insulation check
- Control valve test
- Control system check

b) Complete report on maintenance activities

c) Tools and equipment for maintenance work

d) Applicable Standards and Codes

e)

2.17.41.4 Technical standards, regulations and codes for secondary refrigeration systems

Evidence shall show an understanding of technical standards, regulations and codes for secondary refrigeration systems to an extent indicated by the following aspects:

a) Environmental and safety considerations in the use and disposal of secondary refrigerants

- Toxicity and food compatibility
- Flammability
- Environmental effects

- Safe disposal
- MSDS samples
- Registration requirements for transport and on-site use
-

2.17.41.5 Secondary refrigeration systems design requirements

Evidence shall show an understanding of secondary refrigeration systems design requirements to an extent indicated by the following aspects:

- a) Applications of secondary refrigeration systems in refrigeration
 - Introduction into Secondary Refrigeration
 - Applications in Industrial Refrigeration: Cold storage, food processing, climatic test chamber
 - Application in Commercial Refrigeration: Supermarkets, Small commercial systems
 - Advantages and disadvantages of secondary refrigerants over the direct use of primary refrigerants
- b) Properties, application and limitations of available secondary refrigerants
 - General classification of secondary refrigerant types – single phase, volatile, phase change
 - General types of single phase secondary refrigerants available: Glycols, Alcohols, Brines, Hydrocarbons, Silicone oils, Water
 - Common types of volatile and phase change secondary refrigerants available: CO₂, Ice slurries
 - Thermal and transport properties of most widely used single phase secondary refrigerants (MEG, PG, Ethyl Alcohol, CaCl₂, Potassium brines)
 - Pump selection for viscous fluids
- c) Application concepts and principles
 - Main and loop circuits, use of variable speed pumps and overflow valves
 - Buffer and storage tanks, benefits and disadvantages
 - Loop temperature control and loop pump selection
 - Control valve options: Regulating and on/off, 2-way and 3-way, mixing and diverting
 - Expansion and contraction of components, compensation for pipe expansion, effect of pipe pre-insulation
 - Expansion and contraction of secondary refrigerant, use of membrane expansion tanks versus open expansion tank
 - Air purging
 -

2.17.41.6 Secondary refrigeration system components and piping

Evidence shall show an understanding of secondary refrigeration system components and piping to an extent indicated by the following aspects:

- a) Corrosion and Material selection
 - Materials compatibility table

- Thermal and other properties of materials in use
 - Pipe material and jointing methods/materials
 - Pumps, impellers and seals
 - Isolation and control valves
 - Heat exchangers
- b) Pipe and insulation materials
- Metal pipe
 - Plastic pipe
 - Post-installation insulation (in situ foaming, formed insulation, closed cell flexible insulation)
 - Pre-insulated pipe material
 - Vapour barrier – importance and maintenance
- c) Heat exchangers
- Plate heat exchangers, brazed, welded, semi-welded, gasketed. Design considerations in conjunction with primary refrigerant, flooded, direct expansion, pump circulated primary refrigerant
 - Shell & tube and Plate & shell heat exchangers
 - Fan coil units
- d) System control
- Primary pump speed and staging control
 - Maintenance of minimum flow and control valve pressure head
 - Overflow valves
 - Secondary loop temperature control
 - Room humidity and temperature control with fan-coil units
 -

2.17.42 Air conditioning System Equipment and Component Selection

1. Residential Air Conditioning Unitary Equipment

Construction, operation, application and selection of:

- room air conditioners
- split systems – wall hang, cassettes and ducted
- small package units
- cooling only and reverse cycle

2. Line sizing and design

- quick selection tables
- velocity tables
- pressure drop in lines and fittings

- oil migration stabilisation
- effect of varying system capacity
- oil traps
- liquid migration

3. Control Systems

Construction, operation, application and selection of:

- cycling and safety controls
- pressure-stats
- thermostats,
- de-ice controls
- air conditioning automation systems
- control strategies

4. Air Distribution

Principles

- factors affecting the design of ductwork systems
- flexible ductwork systems
- static, velocity and total pressure

Pressure loss

- friction and dynamic
- in ducts, friction charts
- in fittings, loss co-efficients
- diffuser pressure loss

System sizing

- standard duct sizes and gauges
- duct selection
- fitting selection
- air diffuser selection
- balancing

2.17.43 Refrigeration System Components & Piping Selection

1. Calculation of capacity in heat exchangers:

$$Q = UA \text{ (LMTD)}$$

$$Q = mc\Delta t$$

$$Q = m \Delta h$$

2. Evaporators

- commercial types and applications
- coil bypass factor
- effects of evaporator TD on space humidity
- effects of air circulation on product conditions
- selection criteria and selection tables

3. Condensers

- commercial types and applications
- effects of ambient conditions
- condenser control
- heat rejection factor
- condenser TD
- selection criteria and selection tables

4. Compressors

- types and applications
- capacity
- displacement
- volume flow rate
- theoretical capacity
- total volumetric efficiency
- effect of operating conditions, including suction pressure drop and superheating
- actual capacity
- power
- theoretical requirement
- effects of operating conditions
- actual requirements
- post defrost loads
- pull down torque requirements, high, medium and low back pressure compressors

- selection tables, motor selection

5. Refrigerant flow controls

- types, operation and applications
- effects from sub-cooling
- distributor types, operation and applications
- selection tables

6. System load balance point

- graphical representation

7. Line sizing and design

- quick selection tables
- velocity tables
- pressure drop in lines and fittings
- oil migration stabilisation
- refrigerant velocity
- effect of varying system capacity
- oil traps
- risers
- liquid migration

8. Automatic controls

- fin spacing, suction temp to evaporator suction
- hot-gas bypass valves
- electronic control of valves PLC control
- refrigerant regulating valves
- solenoid valves
- condenser pressure regulating valves
- evaporator pressure regulating valves
- crankcase pressure regulating valves
- cycling controls
- pressure-stats
- thermostats,

- defrost controls
- monitoring and alarm controls
- refrigeration automation systems
- control strategies
- control modes

2.2.18 Safety

2.18 Safety

2.18.1 Occupational Health and Safety principles

Evidence shall show an understanding of Occupational Health and Safety to an extent indicated by the following aspects

- a) Occupational health and safety fundamentals encompassing:
 - underlying principles of OH&S
 - general aims and objectives of the relevant state or territory legislation relating to OH&S.
 - employer and employee responsibilities, rights and obligations.
 - major functions of safety committees and representatives.
 - powers given to Occupational Health and Safety Inspectors
 - housekeeping and potential hazards in relation to improper housekeeping
 - selecting appropriate personal protective equipment (PPE) given hazardous situations
 - The work environment encompassing:
 - typical hazards associated with a range of work environments
 - procedures used to control the risks associated with these hazards
 - principles of risk assessment / management and state the purpose of each.
 - hierarchy of OH&S hazard control measures.
 - required documentation for risk assessment.
 - commonly used workplace safety signs.
 - workplace emergencies that pose a threat to health and safety and suitable procedure for an emergency workplace evacuation.
 - appropriate fire extinguisher for a given type of fire.
 - requirements for the location, mounting and maintenance of portable fire extinguishers.
 - basic process of fighting a fire.
 - safe premises, buildings and security are important in an industrial setting and the consequences of non- compliance with these.

- *standard work procedure* is and why they are required in some circumstances.
- b) Manual Handling encompassing:
- typical manual handling injuries and the effect they can have on lifestyle
 - situations that may cause manual handling injuries
 - correct procedures for lifting and carrying to prevent manual handling injuries
 - Chemicals in the workplace encompassing:
 - hazardous substances and dangerous goods.
 - Classification of chemicals as hazardous substances and/or dangerous goods
 - requirements for labelling of chemicals in the workplace
 - safe storage procedures for chemicals
 - purpose of and interpretation of material safety data sheet (MSDS)
 - Working at heights encompassing:
 - dangers associated with working on ladders and scaffolds
 - identification of work area as a height risk and use appropriate safety equipment to prevent a fall
 - selecting an appropriate ladder for a given situation and perform a safety check before use
 - precautions that should be taken when ascending and working off a ladder
 - precautions that should be taken when working on and around a scaffold and elevated platforms.
- c) Confined spaces encompassing:
- hazards associated with working in a confined space
 - identifying workplace situations that could be classified as a confined space
 - control measures for working in a designated confined space
- d) Physical and psychological hazards encompassing:
- short and long term effects of excessive noise and techniques to avoid damage to hearing due to excessive noise
 - effects of vibration on the human body and work practices to protect against vibration
 - effects of thermal stress on the human body and work practices to protect against thermal stress
 - effects of ultraviolet (UV) radiation on the human body and work practices to protect against UV radiation.
 - dangers associated with laser operated equipment and tools and suitable protective measures to overcome the danger.
 - occupational overuse syndrome, state examples of how it occurs and describe means to overcome it
 - factors that cause stress in the workplace, symptoms of a person suffering from stress and personal stress management techniques
 - detrimental effects and dangers of drug and alcohol use in the workplace
- e) Working safely with electricity encompassing:

- effects of electric shock on the human body
 - common causes of electrical accidents
 - precautions that can minimise the chance of electric shock (earthing, extra low voltage, fuses, circuit breakers and residual current devices – RCDs)
 - protection offered by a residual current device (RCD)
 - need for ensuring the (safe) isolation of an electrical supply
 - appropriate method of removing an electric shock victim from a live electrical situation
- f) Life support - CPR in the workplace encompassing:
- First Aid.
 - responsibilities of the First Aider.
 - priorities of first aid management for any accident or injury.
 - procedures required at an accident scene.
 - legal and ethical issues, which may impact on the management of care.
 - 'Duty of Care'.
 - examination of a casualty for injuries.
 - effect of cardio pulmonary arrest on the body.
 - Managing simulated conditions of: airway obstruction; respiratory arrest and cardio pulmonary arrest,
 - single and two-person cardio pulmonary resuscitation (CPR).
 - signs and symptoms of an altered level of consciousness
 - management of simulation of a casualty with an altered level of consciousness.
 - signs and symptoms of shock.
 - management of simulation of a casualty in shock

2.18.2 Electrical safe working practices

Evidence shall show an understanding of working safely on or around electrical equipment through the application of risk management principles and control measures for dealing with non-electrical hazards and extra-low voltage, low-voltage and high-voltage hazards and high-current hazards. The following aspects indicate the extent of understanding required:

- a) Risk management and assessment of risk encompassing:
- Principle and purpose of risk management, and
 - Processes for conducting a risk assessment
- b) Hazards associated with low-voltage, extra-low voltage and high-currents encompassing:
- Arrangement of power distribution and circuits in an electrical installations

- Parts of an electrical system and equipment that operate at low-voltage and extra-low voltage,
- Parts of an electrical system and equipment where high-currents are likely.

Risks and control measures associated with high-voltage encompassing:

- Parts of an electrical system and equipment that operate at high-voltage,
- The terms ‘touch voltage’, ‘step voltage’, ‘induced voltage’ and ‘creepage’ as they relate to the hazards of high-voltage, and
- Control measures used for dealing with the hazards of high-voltage.

d) Optical fibre safety encompassing:

- Coherent optical sources and joining procedures
- Laser safety class 3a devices or their replace

e) Risks and control measures associated with low voltage encompassing:

- Risks associated with modifying electrical installations, fault finding, maintenance and repair.
- Control measures before, while and after working on electrical installations, circuits or equipment.
- Isolation and tagging-off procedures.
- Risks and restrictions in working live.
- Control measures for working live.

f) Risks and control measures associated with harmful dusts and airborne contaminants.

Note

Sources include thermal insulation, fibrous cement materials and asbestos and other fibre reinforced switchboard materials.

g) Safety, selection, use, maintenance and care of test equipment encompassing:

- Safety characteristics of electrical testing devices,
- Safe use of electrical testing device, and
- Checks and storage methods for maintaining the safety of testing devices.

2.18.3.1 Refrigeration and air conditioning safe working practices

Evidence shall show an understanding of working safely with refrigeration and air conditioning systems through the application of risk management principles and control measures for dealing with refrigerant gas hazards and health hazards associated with open water systems. The following aspects indicate the extent of understanding required.

a) Risk management and assessment of risk encompassing:

- Principle and purpose of risk management, and

- Processes for conducting a risk assessment

b) Hazards and risk control measures associated with refrigeration/air conditioning components and systems encompassing:

- Harmful effects of refrigerant gases
- Control measures for the use, handling and storage of refrigerants
- Risks associated with modifying refrigeration/air conditioning installations, fault finding, maintenance and repair.
- Control measures before, while and after working on refrigeration/air conditioning components and systems.

c) Safety, selection, use, maintenance and care of test equipment encompassing:

- Safety characteristics of refrigeration/air conditioning testing/measuring devices,
- Safe use of testing/measuring device, and

Checks and storage methods for maintaining the safety of testing/measuring devices.

2.18.3.2 Split air conditioning systems safe working practices

Evidence shall show an understanding of safely installing split air conditioning systems to an extent indicated by the following aspects:

a) Relevant regulations and codes for the installation of residential split air conditioning systems encompassing:

- building codes, electrical, health, environmental
- risks associated with installations of split air conditioning systems
- implementing job safety analysis

(b) Types, components, construction, operation and application of residential air conditioners encompassing

- types: wall hung, floor and ceiling mounted, cassette and ducted fan coil
- typical applications for various types of systems
- components, construction and operation of the major components within a system.
- air distribution, flexible ducting and associated fittings, fans, filters
- noise and vibration
- control systems
- operation of a typical system including reverse cycle

c) Installation of unit and pipework encompassing:

- respect for customers premises
- unit location and mounting

- flexible ducting and associated fittings
- fixing, securing and mounting methods
- safe lifting, use of ladders and platforms
- manufacturers installation and start up instructions
- refrigerant piping: layout, installation, insulation, fastening and covering
- condensate drains and pumps

d) Starting up system encompassing:

- manufacturers start up instructions
- pressure testing
- evacuation
- opening outdoor unit valves
- checking refrigerant charge: pressures, temperature, sweat line and evaporator superheat
- adding refrigerant
- leak detection
- controls - operating and safety
- customer familiarisation

2.18.3.3 Safe working practices with hydrocarbon refrigerants

Evidence shall show an understanding of safe working practices with hydrocarbon refrigerants to an extent indicated by the following aspects:

- a) Environmental issues
 - Ultraviolet light and the Ozone Layer
 - The Greenhouse Effect and Global Warming
 - Refrigerant categories and basic compositions
 - Environmental issues for each category
- b) Hydrocarbon Types and applications
 - Introduction to hydrocarbons as a refrigerant
 - Types
 - Applications
 - Properties
 - Compatibility
- c) Acts, Regulations and Standards
 - OH&S Overview
 - Purpose of Acts, Regulations, Codes of Practice, Standards & guidelines
 - Duty of care
 - Applicable acts, standards and codes
 - Record keeping requirements

- Toxicity and flammability groupings
- d) Emergency Procedures & Incident Management
 - Workcover
 - Hazard Control and Risk Assessment
 - Typical emergency response plans
- e) First Aid
 - Personal protective equipment
 - Hydrocarbon exposure
 - Asphyxiation and revival techniques
- f) MSDS and HAZCHEM codes
 - Types and layout
 - Reading MSD sheets
 - HAZCHEM codes
- g) Cylinders and Storage
 - Ignition sources
 - Storage requirements for hydrocarbons
 - Typical plant room layouts and requirements
 - Maintenance procedures
 - Cylinder and system labelling
 - Disposal of hydrocarbon refrigerants and lubricating oils

2.18.3.4 Safe working practices with carbon dioxide refrigerant

Evidence shall show an understanding of safe working practices with carbon dioxide refrigerant an extent indicated by the following aspects:

- a) Introduction to Carbon Dioxide refrigerant
 - Refrigerants and CFC/HFC phase out
 - Introduction to Carbon Dioxide – CO₂
 - Benefits of using Carbon Dioxide as a Refrigerant (R744)
- b) Introduction to HAZCHEM Codes and Material Safety Data Sheets (MSDS)
 - Classification of Dangerous Goods
 - HAZCHEM CODE
 - Refrigerant 2RE Hazchem Codes
 - UN (United Nations) Number
 - Material Safety Data Sheets (MSDS)
 - Personal Protection Equipment (PPE)

c) Carbon Dioxide Plant Safety

- Carbon Dioxide CO2 R744 Detectors
- Appropriate Type
- Care ,Maintenance and Installation
- Cylinder Regulators CO2
- All currently available regulators provide vapour feed only
- Pressure readings (bottle and line)
- Refrigerant Cylinders CO2
- Refrigerant conditions
- Hazards and related safe working practices (dangerous system pressures)
- Pressure to temperature conversion (Saturated P/T is only between 430 kPa and 4399kPa)
- Carbon Dioxide Relief Valves AS1894-1997

d) Emergency Management

- Planning for emergencies
- The emergency plan
- Risk Assessment

e) First Aid for CO2 Exposure

- Type of exposure
- Acute
- Chronic
- Swallowed
- Eye
- Skin
- Inhaled
- Carbon Dioxide CO2 R744 is a narcotic and an asphyxiant in large concentrations in air. Concentrations above 10% in air may lead to death very quickly.
- First Aid Facilities
- Ensure plenty of drinking water
- Safety shower
- Eye wash station eye wash bottle available
- Oxygen for resuscitation
- Always seek urgent medical attention when an incident occurs with Carbon Dioxide CO2 R744 refrigerant.
- DRABC – steps or procedures that must be carried out if a first aid person or emergency personnel come across a person who is unconscious
- SCBA – Self contained breathing apparatus. Compressed air comes in bottles strapped to the user's body. Note all personnel who may be required to use SCBA type equipment require specialised training

f) Applicable Standards and Codes

- Hazards associated with Carbon Dioxide (MSDS)
- AS1894 – 1997
- New South Wales OH&S Act 2000 No40
- Storage and handling of workplace Dangerous Goods National Code of Practice (NOHSC:2017 – 2001)
- Dangerous Goods Act
- AS1940-2004 The storage and handling of flammable and combustible liquids
- AS/NZS 1677
- AS/NZS 1571
- IIAR Bulletins
- ANSI/ASHRAE Standards
- IOR Safety code for Refrigerating Systems utilising Carbon Dioxide

2.18.3.5 Safe working practices with Ammonia refrigerant

Evidence shall show an understanding of safe working practices with Ammonia refrigerant an extent indicated by the following aspects:

- a) Introduction to Ammonia Refrigerant
 - Properties of Ammonia
 - Occupational Health and Safety Legislation
 - Physical Effects of Ammonia
 - Flammability of Ammonia
- b) Australia Standards
 - AS/NZS 1667.1:1998 Refrigerating Systems Refrigerant Classification
 - AS/NZS 1667.2:1998 Refrigerating Systems Safety Requirements for Fixed Applications
 - AS/NZS 2222: 2003 Anhydrous Ammonia – Storage and Handling
- c) Safety
 - Hazards in a refrigeration plant
 - Hazards of Ammonia
 - Dealing with emergencies
 - Personal Protection Equipment
 - Draining oil procedure
 - Ammonia decanting procedure
 - Ammonia charging procedure

- Ammonia pump down procedure
 - Ammonia purging procedure
 - Confined spaces
 - First aid for Ammonia
 - Chemical Safety
 - Material Safety Data Sheets (MSDS)
- d) Safety Management and Risk Management
- Operating Procedures
 - Preventative Maintenance Programs
 - Risk Assessment
 - Risk Management Plan
 - Training
 - Safety Audits
 - Record keeping
 - Permits
 - Incident investigation and reporting
 - Duty of care

2.18.4 Remote area power supply safe working practices

Evidence shall show an understanding of working safely on or around remote area power supplies (RAPS) through the application of risk management principles and control measures for dealing with hazards typical of RAPS systems. The following aspects indicate the extent of understanding required.

a) Types of hazards in and around remote area power supplies

Note:

In addition to the safety hazards found in most workplace RAPS systems are likely to have the hazards related to electricity supplied from more than one source, rotating machines, fuels and oils, exhaust fumes, and acids and flammable gases from batteries.

b) Measures for dealing with hazards in and around remote area power supplies encompassing:

- Purpose and methods for isolation and de-energisation of power supplies
-

Note:

Isolation and de-energisation includes processes for preventing generator from automatically starting and isolating photo voltaic arrays, wind driven generators, battery and inverter power sources prior to and during maintenance & repair activities

- Purpose and method for ensuring adequate area ventilation

Note:

Adequate ventilation is in reference to exhaust fumes from generator prime movers and safe fuel storage.

- Safe fuel storage practices
- Methods for limiting access to plant areas
- Types and locations of safety signs.

c) Purpose and use of personal protective equipment

2.18.5 Rail safe working practices

Evidence shall show an understanding of working safely in rail networks and rail systems through the application of risk management principles and control measures for dealing with track and equipment hazards. The following aspects indicate the extent of understanding required:

- a) Rail enterprise safety standard and procedures
- b) Rail safe working requirements
- c) Possessions protection and management

2.18.6 Hazardous area safe working practices

Evidence shall show an understanding of working safely in hazardous areas to an extent indicated by the following aspects:

- a) The main features and purpose of a 'clearance to work' system;
- b) Typical safety procedures that should be followed before entering a hazardous area;
- c) The purpose of gas detectors and their use and limitations encompassing:
 - Effects of temperature on gas and vapour detection;
 - Frequency of monitoring for presence of gas or vapours, i.e. effects of temperature rise;
 - Factors affecting the accuracy of gas detectors, for example, contamination, condensation, temperature;
 - Safety in use of gas detectors, for example, 'read and run concept'
- d) Safety measures to be taken when working in a hazardous area.
- e) The roles of the parties involved in the safety of hazardous areas encompassing:
 - common Acts and Regulations related to the safety of hazardous areas and the Authorities responsible for their implementation;
 - where assistance and further information can be obtained to assist persons

with hazardous area responsibilities.

Note:

1. Examples include Standard bodies, experienced consultants;
2. Persons with hazardous area responsibilities include the hazardous area responsibilities of the owner of premises in which a hazardous area exists; the occupier of premises in which a hazardous area exists; enterprises and personnel engaged in installation and/or maintenance of explosion-protection systems; enterprises and personnel engaged in the classification of hazardous areas and/or design of explosion-protection systems; enterprises and personnel engaged in the overhaul, modification and/or assessment of explosion-protected equipment; enterprises and personnel engaged in the inspection of explosion-protection installations; manufacturers of explosion-protected equipment; designated authorities; insurers.

2.18.7 Instrumentation safe working practices

Evidence shall show an understanding of working safely on or around process equipment through the application of risk management principles and control measures for dealing with hazardous materials and processes. The following aspects indicate the extent of understanding required.

- a) Risk management and assessment of risk encompassing:
 - Principle and purpose of risk management, and
 - Processes for conducting a risk assessment
- b) Hazards associated with processing and processed products, encompassing:
 - Types of materials encountered in instrumentation work
 - Hazardous materials
 - Hazardous areas
 - Safety and environmental consequences of uncontrolled hazardous materials
- c) Risk control measures associated with hazardous materials and hazardous areas
- d) Risk control measures associated with electrical equipment and systems.

2.18.8.1 Occupational Health and Safety, supervisory responsibilities

Evidence shall show an understanding of OHS enterprise responsibilities to an extent indicated by the following aspects:

- a) Provisions of relevant occupational health and safety legislation
- b) Principles and practice of effective occupational health and safety management
- c) Workplace hazards, range and selection of control measures

- d) Organisational health and safety management systems and policies and procedures needed for legislative compliance
- e) Impact of characteristics and composition of the workforce on occupational health and safety management
- f) Relevance of occupational health and safety management to other organisational management policies, procedures and systems.
- g) Analysis of entire work environment and judge occupational health and safety interventions
- h) Analysis of relevant workplace data
- i) Ability to assess resources needed for risk control.

2.18.8.2 Occupational Health and Safety, enterprise responsibilities

Evidence shall show an understanding of OHS enterprise responsibilities to an extent indicated by the following aspects:

- a) Provisions of relevant health and safety legislation
- b) Principles and practice of effective occupational health and safety management
- c) Management arrangements relating to regulatory compliance
- d) Enterprise hazards and risks, control measures and relevant expertise required
- e) Characteristics and composition of workforce and their impact on occupational health and safety management
- f) Relevance of enterprise management systems to occupational health and safety management
- g) Analysis of working environment and design of appropriate occupational health and safety management systems
- h) Analysis of relevant data and evaluation of occupational health and safety system effectiveness
- i) Assess resources to establish and maintain occupational health and safety management systems.

2.18.9 Electronic safe working practices

Evidence shall show an understanding of working safely on or around electronic equipment through the application of risk management principles and control measures for dealing with non-electrical hazards and extra-low voltage, low-voltage and high-voltage hazards and high-current hazards. The following aspects indicate the extent of understanding required.

a) Risk management and assessment of risk encompassing:

- Principle and purpose of risk management, and
- Processes for conducting a risk assessment

b) Hazards associated with low-voltage, extra-low voltage and high-currents encompassing:

- Parts of an electronic systems and equipment that operate at low-voltage and extra-low voltage,
- Parts of an electronic systems and equipment where high-currents are likely.

c) Risks and control measures associated with high-voltage encompassing:

- Parts of an electronic systems and equipment that operate at high-voltage,
- The terms used - 'touch voltage', 'step voltage', 'induced voltage' and 'creepage' as they relate to the hazards of high-voltage, and
- Control measures used for dealing with the hazards of high-voltage.

d) Risks and control measures associated with low voltage encompassing:

- Risks associated with installation, fault finding, maintenance and repair.
- Control measures before, while and after working on electronic systems or equipment
- Isolation and tagging-off procedures.
- Risks and restrictions in working live.
- Control measures for working live.

e) Risks and control measures associated with the high levels of radiation encompassing:

- RF hazards
- Maximum exposure levels to RF
- Maximum exposure to microwave radiation

f) Optical fibre safety encompassing:

- Coherent optical sources and joining procedures
- Laser safety class 3a devices or their replace

g) Safety, selection, use, maintenance and care of test equipment encompassing:

- Safety characteristics of electrical testing devices,
- Chemical cleaning solvents, glues and joining wastes used in electronics,
- Safe use of electrical testing device, and
- Checks and storage methods for maintaining the safety of testing devices.

2.18.10 Medical equipment safe working practices

Evidence shall show an understanding of working safely with medical equipment and treatment areas the application of risk management principles and control

measures for dealing with infection hazards. The following aspects indicate the extent of understanding required:

- a) Risk management and assessment of risk encompassing:
 - Principle and purpose of risk management, and
 - Processes for conducting a risk assessment
- b) Hazards associated with medical equipment, encompassing:
 - Infections
 - Toxic materials
 - Electrical components
 - Radiation
- c) Risks and control measures associated with working with medical equipment

2.18.11 Fire protection equipment safe working practices

Evidence shall show an understanding of working safely on or around fire protection equipment through the application of risk management principles and control measures for dealing with electrical, chemical and other hazards. The following aspects indicate the extent of understanding required.

- a) Risk management and assessment of risk encompassing:
 - Principle and purpose of risk management, and
 - Processes for conducting a risk assessment
- b) Hazards associated with low-voltage, extra-low voltage and high-currents encompassing:
 - Arrangement of power distribution and circuits in an electrical installations
 - Parts of an electrical system and equipment that operate at low-voltage and extra-low voltage,
 - Parts of an electrical system and equipment where high-currents are likely.
- c) Risks and control measures associated with fire protection equipment encompassing:
 - Procedures for isolating/reinstating and disconnection and reconnection of supplies in excess of extra-low voltage

Note.

1. Isolation and disconnection and reconnection are required to be performed by an appropriately qualified and authorised persons.

- Arrangements for isolating/reinstating fire protection systems to inhibit back-to-base signals to monitoring station.
- Arrangements for isolating/reinstating fire protection systems to inhibit alarms operating fire protection suppression equipment

- Arrangements for isolating/reinstating sections or parts of a fire protection system to inhibit alarms during building maintenance or system testing.
- Interface arrangements to isolate control functions between different fire protection building service systems
- Documentation and licensing requirements for working on fire protection systems
- Identification of personal and environmental hazards in working on fire protection systems.
- Control measures used for dealing with the hazards related to fire protection systems

2.18.12 Business equipment servicing safe working practices

Evidence shall show an understanding of business equipment servicing safe working practices to an extent indicated by the following aspects:

a) Risk management and assessment of risk encompassing:

- Principle and purpose of risk management, and
- Processes for conducting a risk assessment

b) Hazards associated with low-voltage, extra-low voltage and high-currents encompassing:

- Parts of an electronic systems and equipment that operate at low-voltage and extra-low voltage,
- Parts of an electronic systems and equipment where high-currents are likely.

c) Risks and control measures associated with high-voltage encompassing:

- Parts of an electronic systems and equipment that operate at high-voltage,
- The terms ‘touch voltage’, ‘step voltage’, ‘induced voltage’ and ‘creepage’ as they relate to the hazards of high-voltage, and
- Control measures used for dealing with the hazards of high-voltage.

d) Risks and control measures associated with low voltage encompassing:

- Risks associated with installation, fault finding, maintenance and repair.
- Control measures before, while and after working on electronic systems or equipment
- Isolation and tagging-off procedures.
- Risks and restrictions in working live.
- Control measures for working live.

2.18.13 Appliance servicing working practices

Evidence shall show an understanding of appliance servicing working practices to

an extent indicated by the following aspects:

a) Risk management and assessment of risk encompassing:

- Principle and purpose of risk management, and
- Processes for conducting a risk assessment

b) Hazards associated with low-voltage, extra-low voltage and high-currents encompassing:

- Parts of an electronic systems and equipment that operate at low-voltage and extra-low voltage,
- Parts of an electronic systems and equipment where high-currents are likely.

c) Risks and control measures associated with high-voltage encompassing:

- Parts of an electronic systems and equipment that operate at high-voltage,
- The terms ‘touch voltage’, ‘step voltage’, ‘induced voltage’ and ‘creepage’ as they relate to the hazards of high-voltage, and
- Control measures used for dealing with the hazards of high-voltage.

d) Risks and control measures associated with low voltage encompassing:

- Risks associated with installation, fault finding, maintenance and repair.
- Control measures before, while and after working on electronic systems or equipment
- Isolation and tagging-off procedures.
- Risks and restrictions in working live.
- Control measures for working live.

2.18.14 Aerial safety practice

Evidence shall show an understanding of working safely on or around aerial cabling through the application of risk management principles and control measures for dealing with electrical hazards. The following aspects indicate the extent of understanding required.

a) Risk management and assessment of risk encompassing:

- Principle and purpose of risk management, and
- Processes for conducting a risk assessment

b) Hazards associated with low-voltage, extra-low voltage and high-currents encompassing:

- Parts of an electronic systems and equipment that operate at low-voltage and extra-low voltage,
- Parts of an electronic systems and equipment where high-currents are likely.

c) Risks and control measures associated with high-voltage encompassing:

- Parts of an electronic systems and equipment that operate at high-voltage,
- The terms ‘touch voltage’, ‘step voltage’, ‘induced voltage’ and ‘creepage’ as they relate to the hazards of high-voltage, and
- Control measures used for dealing with the hazards of high-voltage.

d) Risks and control measures associated with low voltage encompassing:

- Risks associated with installation, fault finding, maintenance and repair.
- Control measures before, while and after working on electronic systems or equipment
- Isolation and tagging-off procedures.
- Risks and restrictions in working live.
- Control measures for working live.

2.18.15 Trenching safety practices

Evidence shall show an understanding of working safely on or around cable trenches through the application of risk management principles and control measures for dealing with trenching hazards. The following aspects indicate the extent of understanding required.

- a) Identification of trenching conditions
- b) Notification of relevant authorities/utilities
- c) Digging and trenching equipment safety
- d) Methods of shoring
- e) Public safety
- f) Personal safety equipment
- g) Permits

2.18.16 Documenting hazards and identifying risks

Evidence shall show an understanding of occupational hazard identification, risk assessment and control measures to eliminate or mitigate the risk to an extent indicated by the following aspects:

- a) Hazard identification by work-site inspections involving visual checks, looking at ways work can be carried out, consulting with others, review of prior incident reports, using manufactures equipment details
- b) Recording hazards and assessing the risk in relation to voltage levels, nature of the job, number of people involved, plant, machinery and equipment involved, working environment and conditions, capability and experience and age of the people doing the work and foreseeable abnormal conditions.

- c) Determine the degree of the risk in relation to high (potential to kill or permanent disability), medium (potential to cause an injury or illness of a permanent nature) or low (potential to cause a cause minor injury requiring first aid but no permanent disability)
- d) Identify control measures so as to eliminate the risk (discontinue activity, use different approaches to the work, use different equipment or fix faulty machinery), redesign the equipment or work process and/or adopt administrative procedures and use of personal protective equipment.
- e) Monitor and review processes to ensure control measures remain valid, are updated should an accident occur, unforeseen hazards are identified and/or work practices, equipment or material change.
- f) Principles and legal responsibilities of respective parties in managing and administering hazards and assessing risk in the workplace; with particular attention to elimination and mitigation measures, and documentation requirements for identifying risks and documenting hazards.
- g) Practices and processes associated with implementing hazards identification and risk management

2.18.17 Powerline safety practices

Evidence shall show an understanding of working safely on or around powerlines through the application of risk management principles and control measures for dealing with hazards typical around powerlines. The following aspects indicate the extent of understanding required.

- a) Items of protective apparatus and apparel used by lineworkers and states their applications.
- b) Methods of carrying, erecting, collapsing and lower an extension ladder
- c) Maintenance requirements for wood and fiberglass ladders.
- d) Methods of climbing and working on an overhead structure encompassing:
 - determining whether a pole is safe to climb.
 - inspecting lineworkers body belt.
 - knots and hitches appropriate to the requirements of a lineworker.
- e) Procedures for establishing an effective road traffic management scheme encompassing:
 - purpose of traffic management in accordance with relevant statutory requirements.
 - lineworkers responsibilities in accordance with relevant statutory and electricity supply industry requirements.
 - procedure used to provide an effective traffic management scheme.
 - use of a two-way radio.

f) Application of various fire fighting mediums and operation equipment used to extinguish small fires encompassing;

- extinguishing mediums for various types of fires.
- precautions for personal protection when fighting small fires.
- selection and operation of the appropriate portable fire extinguisher for a specific type of fire.

g) Rescue procedures for victims who become incapacitated encompassing:

- procedure for rescuing a person from heights.
- procedure to rescue a person from confined spaces

2.18.18 Principles of risk management, applications, practices and techniques

Evidence shall show an understanding of principles of risk management, applications, practices and techniques to an extent indicated by the following aspects:

a) Risk Management principles encompassing:

- models including reasonable and practicable
- hazard and risk
- safety and health
- safety risk including Injury Causation Model and Error Agencies
- health Risk including Occupational Hygiene Model
- hierarchy of Controls (Engineering and Administrative)

b) Principles of risk management planning

c) Principles of risk Assessment - planning and prioritisation

d) Principles of risk mitigation – handling and monitoring

e) Principles of risk management procedures encompassing:

- OHS practices – general, training, manual handling, and specific technical/occupational, organisational procedures
- OHS networks
- Hazard control and reporting
- Incident notification
- Emergency procedures and first aid

2.2.19 Special requirements

2.19 Special requirements

Note: EKAS for Hazardous Areas

EKAS for Hazardous Areas previously included in this section have been moved to a new section of this volume. Please see Section 2.22 Hazardous Areas, below.

EKAS for special requirements - restricted electrical work are subject to further review and have been retained with the original numbering. Accordingly EKAS numbered 2.19.1 to 2.19.27 do not appear in this volume.

2.19.28 Fault find — General principles

Evidence shall show an understanding in identifying faults in electrical equipment intended to operate to a connected fixed wired supply, to an extent indicated by the following aspects.

a) Safe work practices and principles used in identifying faults in electrical equipment, not including fixed wired electrical supply, encompassing:

- Conducting live and dead testing.
- Procedures for isolation of equipment from supply.
- Limitations of scope of fault finding for disconnection and/or reconnection of equipment.

b) Principles and typical procedures followed in identifying faults in electrical equipment, encompassing:

- Types of faults that occur in general electrical equipment.
- Selection and setting of appropriate testing and measuring devices.

Notes:

1. Testing devices include approved test lamps and voltage indicators.
 2. Measuring devices include multimeters, insulation testers, continuity testers, ammeters and voltmeters.
 3. It is recommended that voltage testers, multimeters and voltmeters be certified to IEC standard Category III
-

- Components and associated equipment circuits.
- Limitations of fault finding and requirements for referral to appropriate competent persons.
- Reporting and recording faults.

c) Principles and typical procedures used for verifying electrical equipment is safe

for operation and return to service, encompassing:

- Comparison of manufacturer specifications between disconnected and replacement equipment.
- Safe operation of equipment.

Note:

Safety of equipment includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating and arrangements for protection against dangers of mechanical movement are undamaged and in place

2.19.29 Disconnect/reconnect

Evidence shall show an understanding of the principles to disconnect and reconnect fixed wired equipment connected to supply up to 1000 V a.c or 1500 V d.c. The following aspects indicate to the extent of understanding required:

a) Procedures for safely determining the availability of supply, encompassing:

- Selection and setting of appropriate testing device.
- Safe use of testing device.
- Concept of ‘testing the testing device’

b) Isolation mechanisms, encompassing:

- Electrical distribution arrangements within an installation.
- Circuit isolation and protective devices
- Appropriate isolation devices for a given load.

c) Disconnection of an appliance from a single phase and/or multiphase supply of voltages up to 1000 V, encompassing:

- Type and arrangement of circuits supplying various equipment.
- Note: Equipment can include motors, hot water systems, cooking appliances control devices and neon signs.
- Procedures to be followed to ensure the safe isolation of the supply.
- Procedures for disconnection of isolated equipment from fixed wiring.

d) Suitability of an appliance for reconnection to the supply encompassing:

- Comparison of manufacturer specification between disconnected and replacement equipment.
- Safety of equipment for connection to the supply.

Note:

Safety of equipment includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating and arrangements for protection against dangers of mechanical movement are

undamaged and in place.

e) Procedures for ensuring the integrity of the circuit to which the equipment is to be connected, encompassing:

- Insulation resistance of the circuit's active conductors.
- Continuity of the protective earthing conductor to the metallic enclosure of the originating distribution board or main earth electrode.
- Continuity between the neutral conductor and protective earthing conductor.

f) Procedures for the reconnection of equipment to the supply, encompassing:

- The safe isolation of the supply before reconnection
- Wiring preparations for reconnection to equipment.
- Reconnecting equipment to fixed wiring.

g) Procedures for verifying equipment is operational, encompassing:

- Energising supply.
- Safe operation of equipment.

2.19.30 Flexible cords and plugs to 250 V

Evidence shall show an understanding of attaching flexible cords and plugs to electrical equipment connected to a single phase 250 V supply, to an extent indicated by the following aspects:

a) Flexible cords and plugs to suit given applications, encompassing:

- Flexible cord for 250 V single phase load and service duty.
- Types of three pin plugs for specific load and IP rating requirements.

b) Safety of an appliance for connection to the supply, encompassing:

- Appropriate test equipment to check that an appliance is safe.
- Procedures to be followed to ensure the correct use of test equipment.
- Test results that show appliance is unsafe.

c) Connection of flexible cords and plugs to appliances, encompassing:

- Preparation of flexible cords for connection to appliances.
- Connection of flexible cords to appliances.
- Connection of a plug top to a flexible cord.

d) Safety of flexible cord and plug assembly, encompassing:

- Plug and cord testing procedures.
- Safe operation of appliance supplied by cord and plug assembly.

2.19.31 Flexible cords/cables and plugs to 1000 V

Evidence shall show an understanding of attaching flexible cords/cables and plugs connected to a supply up to 1000 V a.c. or 1500 V d.c., to an extent indicated by the following aspects:

- a) Flexible cords/cables and plugs to suit given applications, encompassing:
 - Flexible cable for 1000 V multiphase load and service duty.
 - Types of multiphase plugs to 1000 V for a specific load and IP rating requirements.
- b) Safety of an appliance for connection to the supply, encompassing:
 - Appropriate test equipment to check that an appliance is safe.
 - Procedures to be followed to ensure the correct use of test equipment.
 - Test result that show appliance is unsafe.
- c) Connection of flexible cables and plugs to multiphase appliances, encompassing:
 - Preparation of flexible cables for connection to appliances.
 - Connection of flexible cables to appliances.
 - Connection of a plug top to a flexible cable.
- d) Safety of flexible cable and plug assembly, encompassing:
 - Plug and cord testing procedures.
 - Safe operation of appliance supplied by cable and plug assembly
 -

2.19.32 Disconnect and reconnect HV electric propulsion components

Evidence shall show an understanding of the principles for disconnection and reconnection of 3.3 kV electric propulsion components on off-road earth moving trucks. The following aspects indicate the extent of understanding required.

- a) Procedures for safely determining the isolation of supply, encompassing:
 - Selection and setting of HV testing device.
 - Safe use of HV testing device.
 - Concept of 'testing the testing device'
 - Isolation mechanisms, encompassing:
 - Electrical distribution arrangements within a truck.
 - Drive isolation and protective devices
- b) Disconnection of 3.3 kV electric propulsion components, encompassing:
 - Arrangement of circuits supplying electric propulsion components.
 - Procedures to ensure the safe isolation of the supply.
 - Procedures for disconnection of isolated equipment.
 - Safety of replacement or repaired for reconnection to the truck.

Note: Safety of electric propulsion components includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, and arrangements for protection against dangers of mechanical movement are undamaged and in place.

c) Procedures for the reconnection of electric propulsion components to the supply, encompassing:

- The safe isolation of the supply before reconnection
- HV wiring preparations for reconnection to equipment.
- Reconnecting electric propulsion components.

d) Procedures for verifying electric propulsion components is operational, encompassing:

- Energising supply.
- Methods for testing safe operation of equipment.

2.19.33 High voltage flexible cables and plugs exceeding 1000 V

Evidence shall show an understanding of attaching flexible cables and plugs to electrical equipment connected to a high voltage supply (i.e. exceeding 1000 V a.c. and 1,500 V d.c.) to an extent indicated by the following aspects.

a) Flexible cords/cables and plugs to suit given H.V applications, encompassing:

- Flexible cables and plugs to suit given H.V applications
- Types of multiphase plug H.V for a specific load and IP rating requirements.

b) Safety of a H.V electrical apparatus (including basic principles of its operation non-mathematical and control) of an appliance for connection to the supply, encompassing:

- Appropriate test equipment to check that apparatus is safe.
- Procedures to be followed to ensure the correct use of test equipment.
- Basic principles of operation and control of apparatus supplied by the flexible cables and plug.
- Test results that show apparatus is unsafe.

c) Connection of flexible cables and plugs to multiphase appliances, encompassing:

- Preparation of flexible cables for connection to H.V apparatus.
- Connection of flexible cables to H.V. apparatus.
- Connection of a HV plug to a flexible cable.

d) Safety of flexible cable and plug assembly, encompassing:

- Plug and cord testing procedures.
- Safe operation of apparatus supplied by HV cable and plug assembly.

2.19.34 Fault find to 250 V — Motors

Evidence shall show an understanding of locating and rectifying faults in electrical motors intended to be connected to a fixed wired supply up to 250 V, to an extent indicated by the following aspects:

a) Safe work practices in fault finding and repair work, encompassing:

- Conducting live and dead testing.
- Procedures for isolation of motor from supply.

b) Procedures for identifying basic faults, encompassing:

- Types of faults that occur in 250 V motors.
- Note: Motors include single-phase 'split-phase, capacitor motors and universal type motors.
- Selection and setting of appropriate testing and measuring devices.

Notes:

1. Testing devices include approved test lamps and voltage indicators.
 2. Measuring devices include multimeters, insulation testers, continuity testers, ammeters and voltmeters.
 3. It is recommended that voltage testers, multimeters and voltmeters be certified to IEC standard Category III
-

- Safe operation of single phase motors.
- Comparison of manufacturer specification between disconnected and replacement motors.

c) Procedures for verifying motor is operational, encompassing:

- Energising the supply.
- Safe operation of motor.

Note: Safety of equipment includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating and arrangements for protection against dangers of mechanical movement are undamaged and in place.

2.19.35 Fault find to 250 V — Water heaters

Evidence shall show an understanding of locating and rectifying faults in electrical water heaters intended to operate to a connected fixed wired supply up to 250 V a.c., to an extent indicated by the following aspects:

a) Safe work practices in fault finding and repair work, encompassing:

- Conducting live and dead testing.
- Procedures for isolation of water heater from supply.

b) Procedures for identifying basic faults in single phase water heaters, encompassing:

- Types of faults that occur in water heaters.

Note:

Faults are confined to those related heating elements and control circuits within the water heater.

-
- Selection and setting of appropriate testing and measuring devices.

Notes:

1. Testing devices include approved test lamps and voltage indicators.
2. Measuring devices include multimeters, insulation testers, continuity testers, ammeters and voltmeters.
3. It is recommended that voltage testers, multimeters and voltmeters be certified to IEC standard Category III

c) Procedures for verifying single phase water heaters are operational, encompassing:

- Comparison of manufacturer specifications between disconnected and replacement water heater.
- Energising the supply
- Safe operation of water heater.

Note:

Safety of equipment includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating.

2.19.36 Fault find to 250 V — General appliances

Evidence shall show an understanding of locating and rectifying faults in electrical equipment intended to operate to a connected fixed wired supply up to 250 V, to an extent indicated by the following aspects.

a) Safe work practices in fault finding and repair work of general appliances, encompassing:

- Conducting live and dead testing.
- Procedures for isolation of equipment from supply.

b) Procedures for identifying basic faults in general appliances, encompassing:

- Types of faults that occur in general appliances.
- Selection and setting of appropriate testing and measuring devices.

Notes:

1. Testing devices include approved test lamps and voltage indicators.

2. Measuring devices include multimeters, insulation testers, continuity testers, ammeters and voltmeters.

3. It is recommended that voltage testers, multimeters and voltmeters be certified to IEC standard Category III

- In single phase appliances components and circuits.

c) Procedures for verifying general appliances are safe for operation, encompassing:

- Comparison of manufacturer specifications between disconnected and replacement appliance.
 - Safe operation of appliance.
-

Note:

Safety of equipment includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating and arrangements for protection against dangers of mechanical movement are undamaged and in place

2.19.37 Fault find to 1000 V - Motors

Evidence shall show an understanding of locating and rectifying faults in electrical motors and controlgear intended for connection to a fixed wired supply up to 1000 V, to an extent indicated by the following aspects

a) Safe work practices in fault finding and repair work, encompassing:

- Conducting live and dead testing.
- Procedures for isolation of motor from supply.

b) Procedures for identifying basic faults, encompassing:

- Types of faults that occur in three phase motors and starters.
 - Selection and setting of appropriate testing and measuring devices.
-

Notes:

1. Testing devices include approved test lamps and voltage indicators.

2. Measuring devices include multimeters, insulation testers, continuity testers, ammeters and voltmeters.

3. It is recommended that voltage testers, multimeters and voltmeters be certified to IEC standard Category III

- Safe operation of three phase motors.
- Comparison of manufacturer specification between disconnected and replacement motors.

c) Procedures for verifying motor is operational, encompassing:

- Energising the supply.
- Safe operation of motor.

Note

Safety of equipment includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating and arrangements for protection against dangers of mechanical movement are undamaged and in place

2.19.38 Fault find to 1000 V — Water heaters

Evidence shall show an understanding of locating and rectifying faults in electrical water heaters intended to operate to a connected fixed wired supply up to 1000 V a.c., to an extent indicated by the following aspects.

a) Safe work practices in fault finding and repair work on three phase water heaters, encompassing:

- Conducting live and dead testing.
- Procedures for isolation of water heater from supply.

b) Procedures for identifying basic faults in three phase water heaters, encompassing:

- Types of faults that occur in three phase water heaters.

Note:

Faults are confined to those related heating elements and control circuits within the water heater

- Selection and setting of appropriate testing and measuring devices.
-

Notes:

1. Testing devices include approved test lamps and voltage indicators.
 2. Measuring devices include multimeters, insulation testers, continuity testers, ammeters and voltmeters.
 3. It is recommended that voltage testers, multimeters and voltmeters be certified to IEC standard Category III
-

c) Procedures for verifying three phase water heaters are safe for operation, encompassing:

- Comparison of manufacturer specifications between disconnected and replacement water heater.
 - Safety of water heater for connection to the supply.
-

Note:

Safety of equipment includes sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating.

2.19.39 Status reports using established procedures

Evidence shall show an understanding of status and service reporting to an extent indicated by the following aspects:

a) The purpose of reports

Note:

Examples are parts of a safety or maintenance record, informing the extent of work undertaken or to be done in relation to charging, invoicing or quoting.

b) Content of reports

Note:

Depending on purpose typically inclusions are safety status of equipment and circuits, actions taken with regard to unsafe equipment and circuits, recommendations, item lists, labour and charges.

c) Types of reports

Note:

Example are handwritten, data logged and form completion types.

2.2.20 Sustainable energy and environment

2.20 Sustainable energy and environment

2.20.1 Sustainable energy principles

Evidence shall show an understanding of sustainable energy principles to an extent indicated by the following aspects:

- a) Notions of sustainable energy
- b) Sustainable energy work practices

2.20.2 Environmental and building regulation

Evidence shall show an understanding of environmental and building regulation effecting electrotechnology work to an extent indicated by the following aspects:

- a) Types of heritage listings
- b) Purpose and principles of regulations related maintaining heritage sites

- c) Responsibilities of those working in and around heritage sites
- d) Scope of environmental protection and related regulations
- e) Purpose and principles of regulations related to environmental protection
- f) Responsibilities of those working in and around environmentally protected sites
- g) The protocols for working in and around protected environments and heritage sites.

2.20.3 Introduction to renewable energy technologies

Evidence shall show an understanding of renewable energy principles and technologies to the extent indicated by the following aspects:

a) Major non-technical issues

- impact of economic, social, environmental and political issues on the use of renewable energy technologies.
- how each of the non-technical issues impact on the application of a selected renewable energy technology.

b) Energy services and demand.

- definition of the terms: energy, power, energy efficiency, end use energy, primary energy, embodied energy.
- calculation relating to energy, power and time with the appropriate number and time with the appropriate number of significant figures.
- units and symbols for energy, power, time and temperature using standard SI units and prefixes.
- conversion of energy and power quantities from one unit to another using conversion tables
- the two laws that apply to any energy conversion process.
- efficiency of a simple energy conversion process.
- energy services required by a domestic dwelling.
- power and energy consumption of individual appliances and systems using appropriate meters or other methods.
- calculation of the end use and primary energy required for these energy services.
- selection of the most appropriate energy source for each of these services.
- justification in terms of environmental, economic, social and political constraints.
- selection of appropriate energy efficient appliances and technologies.

c) The solar resource

- definition of the terms: irradiation, latitude, solar constant, direct and diffuse radiation, azimuth and altitude angles, irradiance, solar window, tilt angle,

solstice, equinox.

- units and symbol for irradiation and irradiance and the conversion of one unit to another using conversion tables.
- measurement of solar irradiance with a solarimeter.
- solar radiation data tables and contour maps.
- position of the sun for a given date, time and latitude using a sun path diagram.
- times when an obstacle will shade a given collector.
- how radiation varies throughout the year on the surface of a collector which is either fixed, single-axis tracking or double-axis tracking.
- appropriate tilt angles for fixed and seasonally-adjustable collectors at a given latitude and given application
- calculation of the effect of single-axis tracking and double-axis tracking on collected radiation using radiation data tables.

d) Solar thermal systems

- definition of the terms: conduction, convection, radiation, collector heat loss co-efficient, conductivity, specific heat, solar fraction.
- components for a solar thermal system including collector, storage, reticulation and control.
- solar collector types suitable for low, medium and high temperature applications.
- different types of domestic solar hot water (SWH) systems.
- how the components of thermosiphon and pumped storage systems operate.
- heat loss mechanisms in collectors.
- stratification in storage tanks.
- backup energy systems.
- control and protection strategies.
- solar fraction of a domestic SHW system with the use of table or nomograms.

e) Energy efficient building design

- definition of the terms: thermal comfort, passive system, active system, aspect of the site, orientation of the building, thermal mass.
- the climate factors which affect building design.
- relationship between thermal comfort and climate.
- relationship between the seasonal variation of the sun's path and the heat gain of the building elements (roof, walls, windows, floor).
- effect of the thermal conductivity of building materials on heat flows to and from the building
- use of thermal mass in reducing temperature variations within the building.
- use of ventilation.
- thermal performance of a dwelling using both indoor and outdoor hourly

temperature measurements over the period of at least one day.

- effect of insulation, glazing, orientation, shading devices, thermal mass and ventilation on the thermal performance of a building.
- an active solar system which could be used in a dwelling to complement passive design features in extreme climates.
- aspects of an existing dwelling that contribute to or detract from thermal performance.

f) Photovoltaic arrays

- definition of the terms: photovoltaic (PV) cell, module, series, parallel, array, maximum power point (MPP), nominal operating cell temperature (NOCT), short circuit current (I_{SC}), open Circuit voltage (V_{OC}), I-V curve, current at maximum power point (I_{MP}), voltage at maximum power point (V_{MP}).
- calculations relating to voltage, current and power with the appropriate number of significant figures and using standard SI units and prefixes.
- types of commercially available PV modules, their efficiency and typical applications.
- I-V curve for a typical PV module and label the approximate position of MPP and values of I_{SC} , V_{OC} , I_{MP} and V_{MP} .
- effect of irradiance and temperature on I_{SC} , V_{OC} , I_{MP} and V_{MP} .
- function of blocking and bypass diodes.
- current and voltage of a single module to produce the I-V characteristic curve.
- major specification criteria for a PV module.
- size and configuration of a PV array for a given load and system voltage using tables or nomograms.

g) Wind energy resources

- definition of the terms: kinetic energy, specific wind power, vertical wind speed profile, surface roughness, temperature inversion layer, cut in (v_c), rated (v_r) and furling (v_f) wind speeds, rated power (P_r), power co-efficient (c_p), output co-efficient (c_o), tip speed ratio.
- units and symbols for wind speed, specific wind power and air density.
- large scale wind patterns over the Australian continent, their causes and the effect of local terrain on wind speed, direction and turbulence.
- specific wind power for given wind speeds.
- wind speed at different heights above ground level.
- the mean wind speed based on wind speed frequency distribution data in the form of a histogram.
- suitable minimum tower height for a Wind.
- energy conversion System (WECS) sited downwind from an obstacle.
- isovent maps.

- types of wind-measuring instruments and the minimum requirements for assessing wind energy at a given site.
- measurement of wind speed and direction
- characteristics of horizontal axis and vertical axis, upwind and downwind, lift and drag propelled wind turbines.
- power vs. wind speed curve for a typical WECS showing V_C , V_R , V_F , and P_R .
- major specification criteria for a WECS.
- sizing a WECS for a given load, efficiency and annual mean wind speed using tables or a nomogram.

h) Micro-hydro system basis

- definition of the terms: flow rate, gross or static head, potential energy, net or dynamic head, hydraulic efficiency, MHS efficiency, equivalent pipe length, reaction turbine, impulse turbine
- units and symbols for: flow rate, head, gravitational constant
- methods each assessing flow rate and head.
- measurement of stream flow rate and head.
- assessment from contour maps.
- different MHS in terms of their physical and operating characteristics.
- major specification criteria for an MHS for electricity generation.
- suitable type and size of MHS for a given load, efficiency, available flow rate and net head using tables or a nomogram.

i) Energy storage

- methods of energy storage.
- energy density of the energy storage methods above by mass and volume.
- define the following terms in relation to batteries: nominal voltage, cell, primary and secondary cells, battery, charge and discharge rate, amp hour capacity, watt hour capacity, state of charge (SOC), depth of discharge (DOD), specific gravity (SG), watt hour and amp hour efficiency, cycle life.
- major features of common types of batteries suitable for stand-alone power systems.
- state of charge of a lead-acid battery through measurement of specific gravity or battery voltage using safe working practices.

j) Stand alone power system basis

- d.c. sub-system efficiency.
- block diagram of a typical SPS
- function of each SPS system component
- typical efficiencies of each component.
- major characteristics of different types of commercially available regulators, inverters and battery chargers.

k) Biomass

- definition of the terms: biogas, producer gas, biofuels, feedstock, gross and net calorific values.
- biofuels and their specific energy contents
- method of production of one of these five biofuels including: source of raw material/feedstock, conversion process, yield
- applications for each of the biofuels.
- assessment of the biomass resource required to meet a particular energy service e.g. cooking, hot water, space heat, transport, process heat, electricity.
- social, political and economic impact of large scale use of selected biomass resources.

2.20.4 Greenhouse reduction strategies

Evidence shall show an understanding of greenhouse reduction strategies to the extent indicated by the following aspects:

a) Greenhouse gas emissions profile

- *goals* and *principles* of the National Greenhouse Strategy
- what a greenhouse gas inventory is, why it is required, and the sectors to which it applies
- uses to which the National Greenhouse Gas Inventory can be applied.

b) Understanding and communicating climate change and its impacts

- the possible impact of climate change in Australia.
- techniques for improving the understanding of climate change
- techniques for communicating to and educating the general public on greenhouse gas induced climate change.

c) Partnerships for greenhouse action

- actions achievable by each level of government to implement the NGS.
- methods by which the community activity can be engaged in the reduction of greenhouse gas emissions.
- initiatives that can be undertaken by the private sector to reduce greenhouse gas emissions.
- advantages of international partnerships.
- emissions trading system.

d) Efficient and sustainable energy use and supply

- techniques for reducing the greenhouse intensity of energy supply.
- types of renewable energy sources suitable for use in Australia.
- methods and technique for improving end-use efficiency.

e) Efficient transport and sustainable urban planning

- how integrating land use and transport planning can assist the greenhouse problem.
- how each of the following can be used to mitigate greenhouse gas; travel demand and traffic management strategies; encouraging greater use of public transport, walking and cycling; freight and logistics systems; improving vehicle fuel efficiency and fuel technologies;

f) Greenhouse sinks and sustainable land management

- how enhancing greenhouse sinks and encouraging sustainable forestry and vegetation management can complement the AGS.
- how greenhouse gas emissions are obtained from agricultural production and describe techniques to mitigate the emissions.

g) Models of greenhouse best practice in industrial processes and waste management

- types and methods of reducing greenhouse gas emissions from industry.
- methods of reducing methane emissions from waste treatment and disposal.

h) Adaptation to climate change

- salient points in each of the key sectors that require analysis and the strategies required in the need for adaptation to climate change

i) Kyoto Protocol and greenhouse gas sinks

- Kyoto Protocol
- Greenhouse gas sinks and greenhouse mitigation

2.20.5 Remote area essential services facilities

Evidence shall show an understanding of remote area essential service facilities to an extent indicated by the following aspects:

a) Window repair and maintenance encompassing:

- Emergency repairs
- Louvre type
- Fixed pane type
- Shutters
- Safety awareness

b) Repair and maintenance to fences and gates encompassing:

- Emergency repairs
- Locks and catches
- Security fencing
- Fence maintenance
- Gates

- Safety awareness

c) Maintenance painting encompassing:

- Preparation of surfaces
- Block work
- Concrete
- Timber
- Steel
- Paint selection
- Brush and roller selection
- Paint application
- Clean up process
- Paint and accessories storage
- Safety awareness

d) Essential services facilities lighting encompassing:

- Incandescent light globes
- Fluorescent tubes
- Fluorescent light starters
- Diffusion devices
- Safety awareness

e) Essential services facilities safety and security and emergency checks encompassing:

- Broken windows
- Faulty lighting
- Damaged gates
- Logging the inspections
- Notification of the situation
- Safety awareness

f) Telephone encompassing:

- Answer calls promptly and clearly.
- Using designated business protocol procedures.
- Making and receiving telephone calls in a workplace related context.
- Obtain accurate telephone numbers from an appropriate source.
- Establish contact using designated business protocol procedures.
- Convey purpose all call clearly and concisely.

g) Mathematics encompassing:

- Using basic mathematical skills to perform calculations with

- whole numbers.
- Fractions
- Decimals
- Percentages
- Ratios
- Proportions

h) Electrical encompassing:

- Identification and basic function of electrical components used
- for generating and distributing.
- Electricity safety procedures when working with electricity.
- Identification of faulty electrical components.
- Reporting of faulty electrical components.

i) Fire fighting equipment encompassing:

- Fire extinguishers and signage
- Types of fire extinguishers
- Contents and colour
- Correct identification
- Use of fire extinguishers
- Use of water hose and reel
- Safety awareness

2.20.6 Remote area essential services power plant

Evidence shall show an understanding of remote area essential services power plant to an extend indicated by the following aspects:

a) Minor servicing of a power station's generating plant encompassing:

- Engine oil and filters
- Fuel filters
- Coolant filters
- Water trap devices
- Air cleaners

b) Minor maintenance of a power station's generating plant encompassing:

- Fan and accessory drive belts
- Repair of minor leaks: coolant, oil and fuel

c) Servicing of a power station's generating plants battery systems encompassing:

- Starting battery set
- Switchboard (nicad) batteries

d) Information displayed by the instruments/meters in a power station encompassing:

- Generating equipment (diesel engine)
- Engine lubrication
- System oil pressure
- Engine cooling system coolant
- Temperature (in and out)
- Fuel pressure
- Amperes
- Voltage
- Kilowatt
- Kilowatt hours
- Frequency hertz (Hz)
- Engine running hours
- Station services: Fuel tank dip; Lubricating oil tank level;
- Fuel flow meter

e) Use of the information gathered from instruments/meters encompassing:

- Ordering of: Fuel; Lubricating oil; Coolant
- Schedule regular servicing and maintenance for: Engine oil and filter changes; Fuel filters; Drive belt (condition/adjustment); Valve adjustments (if applicable); Major and minor mechanical servicing by outside agents; Air cleaner (both dry paper and oil bath types)

f) Power station log sheets and readings encompassing:

- Completed log sheets
- Forwarding information to appropriate person/location at regular intervals (weekly)

g) General cleanliness of the power stations plant and buildings encompassing:

- Generation plant
- Oil leaks
- Water leaks
- Fuel leaks
- Safety awareness
- Plant buildings
- Internal floor area
- Used consumables
- Spare parts storage
- Spider webs & other pests
- Rubbish containers
- Ventilation

- Power station compound
- Fence and gate (if applicable)
- Weeds
- Grass (if applicable)
- Rubbish containers
- Fuel and oil supply, (drums)
- Water reticulation (if applicable)
- Tools and equipment
- Location/storage
- Cleanliness
- Maintenance
- Drain/drip tins
- Safety signage
- Location
- Condition
- Suitability

•

2.20.7 Remote area essential services waste water facilities

Evidence shall show an understanding of remote area essential services waste water facilities to an extent indicated by the following aspects:

- a) Location of faults encompassing:
- b) Identification and isolation of faults encompassing:
 - Identifying fault/s
 - Types of fault/s
 - Make safe procedures
 - Isolating the fault/s
 - Gas and fume detection
 - Notification
 - Personal hygiene
 - Safety awareness
- c) Fumes and gases encompassing:
 - Breathing apparatus
- d) Public awareness encompassing:
- e) Emergency repairs and blockages encompassing:
 - Identifying the emergency
 - Locating the emergency
 - Prioritising the repairs

- Notifying the appropriate person/s
- Public safety precautions
- Breathing apparatus
- Safety signage
- Repairing the system
- Reactivating the system
- Personal hygiene
- Safety awareness

f) Treatment and storage of pumping equipment maintenance encompassing:

- Identifying the systems pumping equipment
- Identifying the systems control mechanism/s
- Isolating the system
- Make safe procedures
- Operating the pumps
- Maintenance of the system
- Recording work details
- Notification
- Personal hygiene
- Safety awareness

g) Manhole and grounds maintenance encompassing:

- Safety barricades and fences
- Safety signage
- Manhole cover condition
- Clearing debris
- Grounds maintenance
- Personal hygiene
- Safety awareness

h) Treatment pond maintenance encompassing:

- Weed and grass control
- Pest control
- Scraping of the pond/s
- Closing pen stocks
- Cleaning trash baskets
- Reactivating the system
- Removing the waste
- Burying the waste
- Housekeeping
- Personal hygiene

- Safety awareness

i) Instrumentation, reading and recording of information encompassing:

- Locating the instrumentation
- Identify the instruments
- Read the displayed information
- Log the information
- Notification
- Personal hygiene
- Safety awareness

2.20.8 Remote area essential services water facilities

Evidence shall show an understanding of remote area essential services water facilities to an extent indicated by the following aspects:

a) Valve operation encompassing:

- Types of valves
- Location
- Identification
- Isolation operations
- Make safe procedures
- Maintenance
- Safety awareness

b) Fault conditions encompassing:

- Location
- Identification
- Notification
- Make safe protection
- Rectification
- Safety awareness

c) Corrosion control encompassing:

- Identification
- Descaling
- Repair as necessary
- Prevention procedures
- Reporting procedures
- Safety awareness

d) Leaking pipes encompassing:

- Location
- Identification
- Repairing of the leak/s
- Area protection
- Isolation
- Excavation (if necessary)
- Emergency repairs
- Safety awareness

e) Water meters encompassing:

- Identification and location
- Reading and recording
- Fault identification
- Isolation of the system
- Changing a faulty meter
- Notification
- Safety awareness

f) Valve systems isolation encompassing:

- Location
- Identification
- Isolation of valve systems
- Operation of valve systems
- Make safe procedures
- Maintenance (filtration)
- Recording of work performed
- Safety awareness

g) Treatment plant instrumentation encompassing:

- Location
- Identification
- Reading and recording
- Recognition of fault/s
- Fault condition/s
- Notification of fault condition/s
- Safety awareness

h) Facilities maintenance encompassing:

- Corrosion control
- Painting
- Descaling
- Bolt replacement

- Water leaks
- Site clearing (debris and weeds)
- Notification of work (completed or required)
- Emergency repairs
- Safety awareness

i) Chemicals encompassing:

- Identification
- Storage procedures
- Ventilation
- Signage
- Haz-chem awareness
- Fire control
- Emergency procedures
- Application
- Personal protective equipment
- Safety awareness

j) Gas cylinders encompassing:

- Location
- Identification
- Hoses and fittings
- Storage and handling
- Signage
- Personal protective equipment
- Safety awareness

k) Stock control encompassing:

- Recording
- Receiving
- Gas cylinders
- Filters and seals
- Chemicals

l) Water sampling for analysis encompassing:

- Cleaning and scouring
- Water samples
- Chemical addition
- Recording and reporting of information
- Report findings
- Safety awareness

m) Operation of water pumps encompassing:

- Pump selection
- Pump types
- Water pump operation
- Diesel engine service
- Bore operations
- Safety awareness

n) Reading and recording of the systems instruments encompassing:

- Reading and recording information
- Mechanical instruments
- Electrical instruments
- Bore instruments
- Flow meters
- Notification of faults
- Safety awareness

o) Operation and isolation of components encompassing:

- Isolation valves
- Identification and isolation
- Systems isolation
- Filtration equipment
- Inspection of the system
- Recognition of faults
- Notification of repairs and maintenance
- Safety awareness

p) Maintenance encompassing:

- Painting preparation
- Corrosion control
- Paint selection
- Application methods
- Cleaning and storage
- Solar panels
- Structural
- Storage tank
- Reporting problems
- Housekeeping
- Safety awareness

q) Water sampling (analysis) encompassing:

- Cleaning and scouring
- Weeds and debris

- Water samples
- Recording and reporting information
- Reporting of findings
- Safety awareness

2.20.9.1 Stand-alone renewable energy system components

Evidence shall show an understanding of standalone renewable energy system components to an extent indicated by the following aspects:

a) ELV wiring and circuit protection for renewable power systems.

- extra low voltage (ELV) and low voltage (LV) circuits in a stand-alone or grid connected renewable power system and the regulatory restrictions regarding work at each level.
- earthing requirements for renewable power systems over a range of applications and environments
- required sizes for ELV cabling in a renewable power system, considering allowable voltage drops and cable current carrying capacity, in accordance with AS/NZS 3000 and AS 4509.
- Selection of suitable d.c. circuit protection and isolation for all relevant points in a stand-alone renewable power system, in accordance with AS/NZS 3000 and AS 4509

b) Electrical diagrams for a renewable power system

- functional block diagrams for typical stand-alone renewable power system configurations.
- circuit schematic of typical renewable power systems supplying d.c. and/or a.c. loads, including all major components, protection devices, earthing, isolation, switching and metering
- unit wiring diagram for a typical renewable stand-alone power system d.c. control board
- architectural and site diagrams to show the locations of equipment, fittings and cabling

c) Batteries

- major features of each of the major types of commercially available batteries for stand-alone power system applications including basic chemistry, physical structure, advantages and disadvantages
- factors affecting the life of a battery
- processes of sulphation and stratification in lead acid batteries, their causes, effects and methods of prevention or reduction.
- effect of depth of discharge and of temperature on the capacity and life of lead-acid batteries.
- major specifications for a lead-acid battery in a stand-alone power system application.
- main features of charging regimes suitable for the major types of stand-alone power system batteries, using real examples.
- life of a standalone power system battery in years, based on manufacturer's cycle life data and given capacity, configuration and operating conditions
- precautions required when handling, installing or maintaining lead-acid batteries.
- procedures required for safe disposal of the major commercially available types of batteries in accordance with AS 4509.

d) Balance of system components and common loads.

- features of commercially available inverters suitable for use in stand-alone power systems.
- major operating parameters of an inverter, including d.c. voltage operating window; efficiency, output voltage waveform and output voltage regulation over a range of loads up to 5 minute ratings.
- problems that may be caused by non-sine supply voltage waveforms on typical loads, and the solutions used to overcome these
- significance of low power factor loads for inverter systems and the principle of power factor correction.
- operation of the major types of regulators for use in stand-alone renewable power systems, using commercially available equipment as examples.
- current vs. voltage characteristics, efficiency and charging voltage waveform for a transformer/rectifier type and a switchmode type battery charger suitable for use in stand-alone renewable power systems.
- operation of and applications for MPPTs for photovoltaic arrays.
- basic operation, advantages and disadvantages of mechanical tracking devices for PV arrays.
- control parameters or data using digital displays on inverters, regulators or controllers

e) Basic lighting design.

- properties and features of the major lamp types including their suitability for use in stand-alone PV power systems.
- effect on room lighting levels, of luminaire design and positioning, décor, room construction and windows.
- Selection and sizing of suitable lamps and fittings and their placement in a household taking into account usage, lighting levels required by relevant standards and energy efficiency considerations.

f) Generating sets

- major components in the construction of a generating set
- main components of gas, petrol or diesel internal combustion engines
- basic principle of operation of internal combustion engines, including different fuel types and ignition methods.
- operating characteristics, advantages and disadvantages of gensets using different fuel types, aspiration methods, operating speed and number of cylinders.
- major methods of mechanical coupling and power transmission between an engine and alternator
- function and ratings of mechanical and electronic speed governing systems.
- basic structure and operation of an alternator.
- advantages and disadvantages of different types of excitation system and voltage regulation used for genset alternators.
- components and basic operation of a brushless excitation system in an

alternator, and the principle of self-excitation

g) Generator set sizing calculations

- major electrical and mechanical ratings which control the performance of a genset
- calculations relating to real and apparent power, power factor, mechanical power, voltage regulation and speed droop for single phase gensets
- derating factor for a genset given manufacturer's derating data and a given set of operating conditions.
- Selection of a suitable genset given maximum demand and surge loadings and derating factor.
- Calculation of the fuel consumption of a genset given manufacturer's data and operating conditions.

2.20.9.2 Stand-alone renewable energy system design consideration

Evidence shall show an understanding of standalone renewable energy system components to an extent indicated by the following aspects:

- a) Load analysis and projected use
- b) Availability of sustainable /renewable energy sources
- c) Component selection factors encompassing:
 - Intended environment
 - Distance between system and users
 - Maintenance and serviceability requirements
 - Rating and diversity
- d) Installation requirement

2.20.10 Hybrid energy systems

- a) Energy demand
 - end-use services and energy demand for each service.
 - most appropriate energy sources for each energy service for a given application and location, taking into consideration economic, environmental and client requirements.
 - greenhouse gas savings from a hybrid energy system compared to an existing non-hybrid system, resulting from energy source switching and reduction in fuel usage.
 - daily load profiles illustrating average demand and maximum demand, based on time of use data for all electrical loads
 - daily load profiles based on given load data, with consideration of likely variations in usage patterns.
 - load management strategies and or energy source switching options to reduce the maximum and surge demand, based on load profile analysis
 - load profile using a.c. power logging equipment
 - daily load profiles illustrating average demand and maximum demand, based on time of use data for all electrical loads
- b) Hybrid energy system operation
 - Definition of the terms complementarity (in relation to renewable energy resources) availability

- advantages and disadvantages of hybrid energy systems.
- major features of typical system configurations including pure renewables; renewables and genset; series; switched; parallel (including those with nominal daily genset running)
- operation of a hybrid system over the short term (e.g. daily) and long term (e.g. seasonal, annual).
- response of a genset to a step change in load, and to an overload condition.
- calculations relating to real and apparent power, power factor, mechanical power, voltage regulation and speed droop for single and three phase gensets.
- Calculation of the average efficiency of a genset supplying a given daily load profile, given genset efficiency vs. load data.

c) System design

- system design criteria in consultation with a client.
- renewable energy resources available at a site through the use of on-site measurements and pre-existing weather data as appropriate.
- Selection of a suitable hybrid power system configuration
- Selection and sizing of suitable renewable energy generators for a hybrid energy system taking into consideration available renewable energy resources and daily and seasonal load profiles consistent with AS 4509.2.
- Analysis of load data to determine preferred time of day for genset running, and required energy storage in a parallel hybrid system.
- Selection and sizing of a suitable genset for any system configuration, including a parallel system, according to AS 4509.2
- Selection and sizing of suitable balance-of-system components for a hybrid energy system including energy storage, controls and inverters consistent with AS 4509.2.
- Selection and sizing of a battery bank to meet both energy and maximum power demands in a parallel hybrid system, using an appropriate battery discharge rate and considering load data and genset running times
- Selection of an inverter for a parallel hybrid system, considering load data, genset running times and battery charging requirement.
- Selection and sizing of suitable internal combustion generators (genset) for a hybrid energy system taking into consideration genset characteristics and de-rating requirements
- performance of the system given load data, resource data, equipment specifications, configuration and control strategy.
- Calculation of the load fraction contributed from each renewable energy generator and from the genset.
- Calculation of the genset run time and fuel usage
- Optimisation of the system design based on a mix of design criteria such as cost, availability and reliability, maintenance, environmental factors, convenience etc.

- system manual according to AS 4509.3 and AS 4509.2, given system components and design data

d) Life cycle costing

- present worth of a future payment
- major costs in the life cycle of a hybrid energy system to be **considered** in life cycle costing.
- Selection of an appropriate discount rate, inflation rates, and life cycle for a hybrid system life cycle cost analysis.
- life cycle cost analysis including the cost of finance and tax savings for a hybrid system using computer software
- most cost effective of a number of hybrid energy system options on the basis of life cycle costing analysis according to AS 4536, AS 3595 or similar standards.
- Comparison of the capital cost, simple payback time and life cycle cost of a hybrid energy system with another energy supply option, according to AS 4536, AS 3595 or similar standards.
- sensitivity analysis of life cycle costing to variations in discount rate or other major parameters

e) Installation, commissioning and maintenance

- Specification of the installation and maintenance requirements for a complete hybrid energy system taking into consideration safety and relevant Australian Standards
- installation requirements for fuel storage for a given genset in accordance with AS 1940, AS 4509 and local regulations
- considerations involved in providing adequate genset vibration isolation
- considerations involved in providing a genset exhaust system suitable for a given genset and installation site.
- major considerations and methods used in providing suitable noise attenuation for a genset installation.
- Specification of the physical accommodation requirements for a given genset to provide adequate air flow and noise attenuation, with due regard for safety, maintenance access, and in accordance with AS 3010 and AS 4509.
- methods used to allow extended service intervals for gensets
- main features of engine protection systems commonly used on small gensets and the genset sizes to which these are applicable.
- installation and commissioning work on a small genset and controller observing relevant OHS guidelines.
- symptoms of common genset faults
- basic fault location and rectification on a genset with the aid of troubleshooting guides or flowcharts.
- symptoms, causes and possible solutions for the phenomenon of "hunting".

- maintenance schedule for a hybrid power system.

f) Data communications

- typical applications of data communications in renewable energy systems.
- different types of cables and connectors used in data communications between electronic devices and computers.
- commonly used protocols used for serial data communications
- different communications ports on palmtop, laptop or desktop computers
- Correction of an electronic device (e.g. inverter or charge controller) to a computer directly, and via modems and telephony network, using appropriate cabling, connectors and computer ports
- dial-up connection from a computer to a remote electronic device, such as an interactive inverter.
- standard terminal program or proprietary communications software to send to and receive data from an electronic device.
- Programming and retrieving data from an interactive inverter via a computer and data communications link.
- logged data downloaded from an interactive inverter.

g) Data-logging

- general features and operation of on-site and remote data logging systems for monitoring and control of a hybrid energy system.
- logger programming, data downloading, display and interpretation of the results

h) Interactive inverters

- main features of different devices commonly used as controllers in hybrid energy systems
- function and operation of an interactive inverter.
- system control philosophies used in different interactive inverters
- program parameters for an interactive inverter, as required for the correct operation of a parallel hybrid system given system component details, load data and preferred genset running times.
- appropriate charging regime for the system battery, based on manufacturer's data and system operating conditions.
- Programming an interactive inverter through its front panel interface.
- function, operation and major features of a genset controller and how it interfaces with a system controller such as an interactive inverter.

2.20.11 Sustainability and greenhouse reduction strategies

Evidence shall show an understanding of sustainability to the extent indicated by the following aspects:

a) Principles of sustainability

- ways in which ecosystems moderate climate.
- ways in which ecosystems purify and store water.
- ways in which ecosystems recycle waste.

b) Problems in a sustainable world

- changes to Australian forest cover since white settlement, and the resulting loss of ecosystem and human benefits.
- changes to Australia's soils since white settlement, and the resulting loss of ecosystem and human benefits.
- changes to Australia's waterways since white settlement, and the resulting loss of ecosystem and human benefits.
- place of environmental accounting in quantifying Australia's environmental losses.
- limits to Australia's population carrying capacity.

c) Sustainability principles

- principles within sustainability including: environmental accounting and economies; full cost pricing; triple bottom line ethic; ecologically sustainable development; greenhouse gas abatement; energy efficiency; resource and water use efficiency; life cycle costing; renewable energy substitution, cleaner production; waste minimisation, reuse and recycling; ecological footprint.

d) Addressing the problem of global warming

- greenhouse gases and their sources and quantities that contribute to global warming.
- global warming impacts for Australia for 2030 and 2070 predicted by CSIRO modelling.
- requirements to achieve stable atmospheric concentrations of greenhouse gases.
- ecologically and economically sustainable methods for achieving these stable concentrations.

e) Greenhouse gas emissions profile

- *goals and principles* of the National Greenhouse Strategy
- what a greenhouse gas inventory is, why it is required, and the sectors to which it applies
- uses to which the National Greenhouse Gas Inventory can be applied.

f) Understanding and communicating climate change and its impacts

- the possible impact of climate change in Australia.
- techniques for improving the understanding of climate change
- techniques for communicating to and educating the general public on greenhouse gas induced climate change.

g) Partnerships for greenhouse action

- actions achievable by each level of government to implement the NGS.
- methods by which the community activity can be engaged in the reduction of greenhouse gas emissions.
- initiatives that can be undertaken by the private sector to reduce greenhouse gas emissions.
- advantages of international partnerships.
- emissions trading system.

h) Efficient and sustainable energy use and supply

- techniques for reducing the greenhouse intensity of energy supply.
- types of renewable energy sources suitable for use in Australia.
- methods and technique for improving end-use efficiency.

i) Efficient transport and sustainable urban planning

- how integrating land use and transport planning can assist the greenhouse problem.
- how each of the following can be used to mitigate greenhouse gas; travel demand and traffic management strategies; encouraging greater use of public transport, walking and cycling; freight and logistics systems; improving vehicle fuel efficiency and fuel technologies;

j) Greenhouse sinks and sustainable land management

- how enhancing greenhouse sinks and encouraging sustainable forestry and vegetation management can complement the AGS.
- how greenhouse gas emissions are obtained from agricultural production and describe techniques to mitigate the emissions.

k) Models of greenhouse best practice in industrial processes and waste management

- types and methods of reducing greenhouse gas emissions from industry.
- methods of reducing methane emissions from waste treatment and disposal.

l) Adaptation to climate change

- salient points in each of the key sectors that require analysis and the strategies required in the need for adaptation to climate change

2.20.12 Energy efficient building design

Evidence shall show an understanding of energy efficient building design to the extent indicated by the following aspects:

a) Climate and thermal comfort.

- characteristics of the different Australian climatic types.

- use of climatic data in published and electronic forms to extract the quantities relevant to energy efficient design.
- relationship between climate and comfort using bioclimatic or psychrometric charts.
- calculation of heating or cooling degree days or degree hours for various locations.
- calculation of thermal neutrality for a given location.

b) Solar geometry and radiation

- definition of the terms: declination, hour angle, zenith angle, azimuth and altitude angles, the equation of time.
- conversion of solar time to local time and vice versa.
- position of the sun and the length of shadows with the aid of algorithms, tables, sun charts or computer software.
- daily irradiation incident on a wall, window or roof of a given tilt and orientation.
- relative summer and winter irradiation of windows facing the cardinal orientations.

c) Heat transfer

- thermal processes of conduction, convection and radiation apply to the transfer of heat in buildings.
- calculation of the summer and winter U-values of building elements using tables and software.
- calculation of the infiltration heat transfer in a building.

d) Glazing Systems

- different types of glazing systems and their characteristics.
- different types of shading devices and the window orientations for which they are most appropriate.
- solar heat gain for different glazing types and angles of incidence
- calculation of the average daily irradiation of a window partly shaded by eaves, using computer software.
- calculation of the average daily heat gain through a window partly shaded by eaves.

e) Insulation

- different types of insulation and where they are used.
- how different types of insulation are installed in roofs, walls and floors.
- determination of the minimum R-values of roof insulation for different locations using Australian Standard AS2627 or similar standards.

f) Thermal mass

- advantages and disadvantages of using substantial thermal mass in different climate types and for different heating and cooling regimes.

- where thermal mass can be located in a building.
- explain what is meant by the following terms: time lag, decrement factor, admittance, response factor.

g) Comfort control strategies

- interpretation of the usefulness of a design strategy with the aid of a psychrometric chart showing control potential zones for a particular location.
- selection of the most useful comfort control strategies for Australian climatic regions.

h) Energy efficiency in buildings

- determination of the direction of the following: both true and magnetic, north winter and summer sunrise, winter and summer sunset.
- solar access in summer and winter to various possible house locations on a site and room locations within the house.
- how vegetation can be used to both funnel and deflect wind.
- using cross ventilation as a cooling strategy.

i) Thermal performance of a building

- heating requirements of a building using the heating degree day or hour method.
- dynamic performance predicted by a computer simulation program such as NatHERS or BERS.

j) Integration of active solar systems

- active solar system types available which can provide hot water, space heating and cooling.
- the best location on the roof, and the optimum tilt and orientation of the collector panels.
- function of the main components of an air or water-based solar space heating system.
- schematic of the fluid circuit of an air or water-based space heating system.
- main solar cooling system types.

k) Energy rating schemes

- differences in approach used by house energy rating schemes in Australia.
- energy performance of a number of houses using a computer simulation program such as NatHERS or BERS.
- other methods to reduce energy consumption within and outside a building including appliance efficiency, human behaviour changes, building management strategies and transportation minimisation.
- additional cost of energy efficiency measures and cost savings using life cycle cost or simple pay back methods according to Aust. Standard AS3595 and AS4536.

l) Sustainable and safe building materials

- common building materials and their embodied energy content.
- environmental impact of the production of various building materials.
- problems associated with the use or disposal of building materials.

2.20.13 Photovoltaic installations

Evidence shall show an understanding of photovoltaic installations to the extent indicated by the following aspects:

a) PV array installation requirements encompassing:

- OH&S requirements and methods for working on roofs.
- common methods of roof construction (rafters and tile battens) and methods to ensure integrity of waterproofing.
- common types of roof mounted and free-standing PV array frame construction and methods of tilt angle adjustment.
- fixing methods for different roof types.
- array mounting methods for north orientation roof sections and non-north facing roof sections.
- aesthetic considerations in choosing an appropriate array location and type of mounting.
- the mounting and fixing methods for at least one type of commercially available building integrated PV product.

b) Electrical PV array installation requirements encompassing:

- methods used in wiring and connecting PV arrays as per the Australian Standards AS 4509 and AS5033
- considerations involved in wiring of series connected PV modules in order to minimise power losses due to shading.
- PV array wiring diagram including the placement of blocking and bypass diodes.
- considerations involved in choosing the location of associated system equipment including regulators, d.c. control board, inverters and inverters for grid connected systems.
- cable route from PV array/s to inverters so as to minimise the route length to battery so as to minimise the route length.

c) System installation and maintenance encompassing:

- installation work on a PV power system in accordance with relevant standards and OH&S guidelines.
- correct isolation and shutdown procedures prior to carrying out maintenance tasks.
- routine maintenance tasks on PV arrays.

- required vegetation control to remove or reduce shading or soiling on a PV array

2.20.14

Photovoltaic power systems

Evidence shall show an understanding of photovoltaic power systems to the extent indicated by the following aspects:

a) Daily irradiation encompassing:

definition of the terms: declination angle, reflectance, sunshine hours, extraterrestrial irradiation, Latitude, direct and diffuse radiation, azimuth and altitude angles, radiance, solar window, tilt angle, solstice, equinox

- units and symbols for irradiation and irradiance
- interpretation of solar radiation data tables and contour maps.
- measuring solar irradiance with a solarimeter.
- how radiation varies throughout the year on the surface of a fixed collector.
- determining, using field measurements and a sun path diagram, the times and dates when a PV array will be shaded by obstacles at a particular site.
- calculation of the daily average irradiation on a horizontal plane given extraterrestrial irradiation, location constants and sunshine hour data.
- calculation of the monthly mean daily irradiation falling on a PV array for each month of the year, adjusted for the effects of shading, using irradiance and irradiation data tables and a sun path diagram and/or appropriate software.
- selection of an appropriate tilt angle for fixed and seasonally-adjustable PV arrays at an given latitude

b) Photovoltaic modules encompassing:

- definition of the terms: cell, module, array, mono-crystalline, poly-crystalline, amorphous, band gap energy, semi-conductor
- diagram of a basic crystalline silicon PV cell, showing its physical structure, with at least five major features labelled
- major steps in the production of PV modules based on bulk silicon cells, in comparison with the production of thin film PV modules.
- basic physical principles of PV cell operation for the main types of commercially available PV modules.
- efficiency, spectral response, cost and typical applications of the main types of commercially available PV modules.
- new photovoltaic technologies currently being developed towards commercialisation, and their major features.
- mechanical and electrical features necessary for the long life of a PV module under a wide range of operating conditions.

c) Module characteristics encompassing:

- definition of the terms: I-V curve, fill factor, operating point, maximum power point (MPP), cell temperature co-efficient, nominal operating cell temperature (NOCT), current, voltage and power output co-efficient.
- equivalent circuit for a PV cell, labelling each of the elements and the polarity of the terminals.
- family of I-V curves for a PV module, labelling major points and showing the effects of variation in irradiance and variation in cell temperature.
- major ratings of a PV module from manufacturer's information or nameplate data.
- determination of the operating point of a PV module with a resistive load, a constant voltage source or any other load with known I-V characteristics, using the load line method.
- configuration of a typical PV array, including the function, placement and ratings of blocking and bypass diodes.
- the effect of partial shading of a PV module or array, the impact of bypass diodes and the significance of their configuration on output current in typical operating conditions.
- calculation of the power at MPP, and the power under typical battery charging conditions, of a PV module, given irradiance and ambient air temperature.
- calculation of the daily energy output of a PV array in accordance with AS 4509.2, and by using "rule of thumb" de-rating factors.
- the scope and content of Australian or international standards relevant to the performance of PV modules.
- the electrical characteristics of a PV module according to relevant Australian or International standards, using an outdoor test method.

Evidence shall show an understanding of photovoltaic power systems to the extent indicated by the following aspects:

a) Daily irradiation encompassing:

definition of the terms: declination angle, reflectance, sunshine hours, extraterrestrial irradiation, Latitude, direct and diffuse radiation, azimuth and altitude angles, radiance, solar window, tilt angle, solstice, equinox

- units and symbols for irradiation and irradiance
- interpretation of solar radiation data tables and contour maps.
- measuring solar irradiance with a solarimeter.
- how radiation varies throughout the year on the surface of a fixed collector.
- determining, using field measurements and a sun path diagram, the times and dates when a PV array will be shaded by obstacles at a particular site.
- calculation of the daily average irradiation on a horizontal plane given extraterrestrial irradiation, location constants and sunshine hour data.
- calculation of the monthly mean daily irradiation falling on a PV array for each month of the year, adjusted for the effects of shading, using irradiance and irradiation data tables and a sun path diagram and/or appropriate software.
- selection of an appropriate tilt angle for fixed and seasonally-adjustable PV arrays at a given latitude

b) Photovoltaic modules encompassing:

- definition of the terms: cell, module, array, mono-crystalline, poly-crystalline, amorphous, band gap energy, semi-conductor
- diagram of a basic crystalline silicon PV cell, showing its physical structure, with at least five major features labelled
- major steps in the production of PV modules based on bulk silicon cells, in comparison with the production of thin film PV modules.
- basic physical principles of PV cell operation for the main types of commercially available PV modules.
- efficiency, spectral response, cost and typical applications of the main types of commercially available PV modules.
- new photovoltaic technologies currently being developed towards commercialisation, and their major features.
- mechanical and electrical features necessary for the long life of a PV module under a wide range of operating conditions.

c) Module characteristics encompassing:

- definition of the terms: I-V curve, fill factor, operating point, maximum power point (MPP), cell temperature co-efficient, nominal operating cell

temperature (NOCT), current, voltage and power output co-efficient.

- equivalent circuit for a PV cell, labelling each of the elements and the polarity of the terminals.
- family of I-V curves for a PV module, labelling major points and showing the effects of variation in irradiance and variation in cell temperature.
- major ratings of a PV module from manufacturer's information or nameplate data.
- determination of the operating point of a PV module with a resistive load, a constant voltage source or any other load with known I-V characteristics, using the load line method.
- configuration of a typical PV array, including the function, placement and ratings of blocking and bypass diodes.
- the effect of partial shading of a PV module or array, the impact of bypass diodes and the significance of their configuration on output current in typical operating conditions.
- calculation of the power at MPP, and the power under typical battery charging conditions, of a PV module, given irradiance and ambient air temperature.
- calculation of the daily energy output of a PV array in accordance with AS 4509.2, and by using "rule of thumb" de-rating factors.
- the scope and content of Australian or international standards relevant to the performance of PV modules.
- the electrical characteristics of a PV module according to relevant Australian or International standards, using an outdoor test method.

2.20.14.1 Photovoltaic power systems (design)

Evidence shall show an understanding of photovoltaic power systems (design) to the extent indicated by the following aspects:

a) Site Survey encompassing:

- declination angle, reflectance, sunshine hours, extraterrestrial irradiation
- energy efficiency techniques relevant for domestic dwelling and commercial premises to reduce the electrical energy demand.
- energy efficient initiatives that could be implemented by the site owner.
- assessing the occupational health and safety (OHS) risks when working on that particular site.
- determining the solar access for the site.
- determining whether any shading will occur and estimate its effect on the system.
- estimation of the solar resource for the site.
- determining the available area for the solar array.

- determining whether the roof is suitable for mounting the array.
 - determining how the modules will be mounted on the roof.
 - determining where the switchboard or distribution board is located for connecting the output of inverter.
 - determining where the array junction box (if required) and inverter will be located.
 - determining the cabling route and therefore estimate the lengths of the cable runs.
 - determining whether monitoring panels or screens are required and determine a suitable location with the site owner
- b) PV arrays selection encompassing:
- selection and sizing of PV array for a grid-connected inverter system, based on any of: annual energy demand, budget constraints, architectural constraints or limitations on available inverter sizes.
 - determining the minimum and maximum number of PV modules in a string for the specified voltage
 - Grid connect inverter selection encompassing:
 - determining the operating window of the inverter for the expected minimum and maximum effective cell temperatures
 - selection of an inverter rating with respect to the output power of the array/s.
 - System components selection encompassing:
 - selection and sizing the balance of the system components including cabling, circuit protection and isolation equipment for a grid-connected PV system.
 - determining the energy yield, specific energy yield and performance ratio for system
 - schematic diagrams of common grid-connected inverter circuit configurations including metering arrangements, isolation and connection with respect to RCDs.
 - the major installation details for a proposed grid-connected inverter system, based on the requirements set out in AS 4777 and AS5033
- c) Other design considerations encompassing:
- major non-technical considerations impacting on the design, installation and operation of grid-connected PV systems including economic, financial, contractual, institutional, legislative and regulatory.
 - calculation of the annual reduction in greenhouse gas emissions achieved by a given PV power system at a given location.

2.20.15 Renewable energy system electronics

Evidence shall show an understanding of renewable energy system electronics to the extent indicated by the following aspects:

a) Semiconductor components

- symbols for common semiconductor components including rectifier diodes, LEDs, zener diodes, bipolar transistors, Darlington pairs, MOSFETs, IGBTs, SCRs, and triacs.
- basic function of these devices above.
- major rating parameters of device above.
- applications for each device.
- I-V characteristics of diodes and the current gain characteristic of bipolar transistors.

b) Linear regulated d.c. power supplies

- label circuit diagrams for half wave and full wave, single phase and three phase rectifiers.
- voltage and current waveforms for these rectifier circuits with and without capacitor filtering
- peak output voltages from single phase and three phase rectifier circuits.
- block diagram showing the structure of a regulated DC power supply.
- main features of linear integrated circuit voltage regulator ICs.
- each of the major components and their physical location in a regulated power supply.

c) Switching power control circuits

- power dissipation of a transistor when operated as a switch.
- how Pulse Width Modulation (PWM) can provide a variable output voltage from a switch mode regulator.
- advantages and disadvantages of switch mode power circuits compared with linear power circuits.
- block diagram of a basic PV switching voltage regulator for battery charging.
- applications of switch mode circuits found in renewable energy systems.
- how power control in AC circuits is achieved using SCRs and triacs.
- methods used to reduce radio frequency interference (RFI) in DC and AC circuits utilising high speed switching.

d) Digital electronic circuits

- characteristic features that distinguish analogue and digital devices and circuits.
- how numbers or text information can be represented using binary numbers and how these are represented in digital circuits.
- operation of voltage comparators, Analogue to Digital (A-D) converters, and Digital to Analogue (D-A) converters, and give one example of each one's use in a renewable energy application.
- basic function of microcontrollers, volatile and non-volatile memory devices.

- operation of a solar hot water system pump differential controller, as an example of the use of logic in digital circuits.

e) Inverters

- basic function of inverters and d.c.- d.c. converters and their use in renewable power systems.
- the operation of an inverter bridge and half-bridge.
- output voltage waveforms for square wave, modified square wave and synthesised sine wave inverters showing typical voltages and timing.
- the function of PWM techniques in modified square wave and synthesised sine wave inverters.
- block diagrams showing the structure of common forms of d.c.-d.c. converters and inverters used in renewable energy applications.

f) Maintenance

- safety procedures for work on electronic systems, circuits and apparatus.
- hazards that may be encountered when performing tests on inverters, battery chargers or other equipment containing LV circuits.
- functionality of electronic equipment through appropriate client questioning and application of systematic tests and observation.
- various types of common faults and their causes in renewable energy electronic equipment.
- typical test equipment used to repair electronic and electrical equipment
- safe and correct use of tools and test equipment to locate electronic equipment faults under the direction of an electronics technician.
- replacement of circuit boards, observing appropriate handling precautions for static sensitive devices.
- replacement of socketed ICs such as EPROMs or microprocessors, using appropriate tools and methods.

2.20.16.1 Types, construction and operating features of small WECS

Evidence shall show an understanding of small (WECs) types, construction and operating features to the extent indicated by the following aspects:

- a) Basic operation of lift and drag type WECS
- b) Characteristics of WECS in terms of power and torque, efficiency (power and output co-efficient), solidity and tip speed ratio.
- c) Major categories and sub-categories of WECS.
- d) Advantages and disadvantages of each type of WECS.
- e) Suitable materials for the construction of WECS taking into consideration fatigue stresses and environmental conditions such as salt air, humidity and ice.
- f) Typical system configurations and components for: stand-alone power systems

and water pumping.

g) Strategies and/or mechanisms to control: mechanical stresses on the WECS in gale force winds and power output for battery charging.

h) Appropriate types of WECS for a particular application.

2.20.16.2 Installation and maintenance of small WECS

Evidence shall show an understanding of small wind energy conversion systems (WECS) installation and maintenance fundamentals to the extent indicated by the following aspects:

a) Installation and maintenance of a WECS

- selection of an appropriate tower for the installation of a WECS taking into consideration: soil type and footings, local council approvals, appropriate codes such as AS1170.2, transport of tower.
- appropriate methods, using appropriate safety procedures, for: raising tower and WECS, lightning protection, tower maintenance, safety in the erection and maintenance of the tower and WECS, site management to minimise environmental impacts.
- appropriate electrical transmission voltage and cable size from the WECS to the load or energy storage.
- appropriate installation, commissioning, fault diagnosis and rectification, and maintenance methods using appropriate safety procedures. This will include: WECS power output, voltage regulation, and transmission cable voltage drop, manual and automatic furling, shut-down.
- schematic and wiring diagrams for the WECS showing the general circuit layout and protection between the WECS, energy storage, inverter and loads according to AS/NZS 3000, AS4509 and lightning protection requirements.
- suitable layout for the location of energy storage to meet AS/NZS 3000, AS 3011.1 and AS4509.
- safety procedures for the installation, commissioning, fault diagnosis and maintenance of system components.
- maintenance schedule for the system.

2.20.16.3 WECS siting and performance assessment

Evidence shall show an understanding of siting and performance assessment of WECS to the extent indicated by the following aspects:

a) Wind characteristics

- definition of the terms: weather charts, isobars, fronts and troughs, cyclone and anti-cyclone, atmospheric boundary layer, geotropic wind, gradient

wind, wind shear, wind rose

- major global wind circulations and the formation of major wind flows over your continent.
- major features of the atmospheric boundary layer including: variation of wind speed with height according to logarithmic and power Laws, effects of surface roughness
- atmospheric stability and temperature inversions turbulence.
- major local winds including: trade winds, sea and land breezes, katabatic and anabatic winds.
- likely effects on the major local winds from local topography, surface roughness, isolated barriers and temperature inversions.
- typical diurnal, monthly and seasonal patterns of winds over the local area.
- the formation and likely effects of extreme winds and wind shear.

b) Wind speed data measurement and analysis

- definition of the terms: porosity, internal boundary layer, speed-up factor, temperature inversion factor, wind speed frequency distribution, lull period, calms.
- interpretation of local and regional wind speed and direction data such as local records (E.g. Meteorological Bureau data), ecological indicators and wind speed/energy maps.
- wind speed and direction using data logging anemometers.
- manufacturer's calibration curves for anemometers to correct recorded data.
- calculation at a site, monthly and yearly average wind speed, and wind power density from existing, nearby data or on-site measurements, using appropriate software
- estimation of the wind speed at a WECS tower of suitable height and location given: wind speed data recorded at two or more elevations at the site, and wind speed data recorded at one elevation and appropriate surface roughness, temperature inversion and speed-up factors at the site.

c) Site selection

- the likely effects of local topography, surface roughness, isolated barriers and temperature inversions on a WECS at a given site.
- assessment of available local or regional wind speed, wind energy and direction data.
- selection of the most appropriate site-monitoring location taking into consideration factors such as: topography, accessibility, surface roughness, shielding from isolated barriers (obstacles), turbulence, temperature inversions, power transmission distance, environmental and heritage impacts e.g. noise, visual, bird life, national parks or aboriginal sites.
- measurement of wind speed and direction data at an appropriate site and height(s) using a data logging anemometer over a sufficient period of time.
- analysis of the recorded wind speed and direction data to determine if the site is suitable for wind energy utilisation.

d) Selection of WECS

- selection of suitable WECS specifications to suit site load and wind speed data according to AS4509 including: cut-in, rated and furling wind speeds, blade diameter, rated power at an appropriate rated wind speed, materials of construction.
- select a suitable commercially available WECS that most closely fits the specifications above.
- suitable tower requirements at the site including site access, soil type and foundations, structural certification and planning approvals.
- calculation of the monthly and annual energy output of the selected WECS at the site from wind speed data and load data using appropriate computer software and in accordance with AS4509.
- height of the tower and the size of the WECS for optimum use.
- suitable system configurations.
- balance of system components including: battery storage, inverter, regulator, transmission cable, back-up battery charger and generator.
- equipment reliability and manufacturer/suppliers back-up service including availability of spare parts and service personnel
- installed capital and life cycle costs of various system configurations according to AS3595 and AS4536.
- environmental, cultural and social factors that impact on the implementation of a WECS such as: external costs, WECS manufacturing processes and embodied energy and energy payback time, noise levels, visual amenity, RFI.

2.20.17.1 Micro-hydro systems installation and maintenance processes

Evidence shall show an understanding of micro-hydro systems (MHS) installation and maintenance to the extent indicated by the following aspects:

- a) Selection of an appropriate MHS taking into account the topology of the site, local council approvals, environmental considerations, site access and transport of equipment, water and power transmission distances and daily and seasonal load profiles.
- b) Appropriate methods, using appropriate safety procedures, for: dam or weir construction; watercourse construction and/or penstock installation; turbine installation;
- c) Appropriate installation, commissioning, fault diagnosis and rectification procedures and maintenance methods using appropriate safety procedures.
- d) Maintenance schedule for the system.
- e) Schematic and wiring diagrams for the MHS showing the general circuit layout and protection between the MHS, batteries, inverter and loads according to

Australian Standards AS3000, AS4509, and AS4086.2 requirements.

f) Safety procedures for the installation, commissioning, fault diagnosis and maintenance of system components.

2.20.17.2 Micro-hydro systems

Evidence shall show an understanding of micro-hydro systems (MHS) to the extent indicated by the following aspects:

a) Site evaluation

- definition of the terms: potential and kinetic energy, micro-hydro system, gross head, net head, flow rate.
- available head at a site using a dumpy level or theodolite, altimeter, pressure gauge and contour maps.
- the accuracy, advantages and disadvantages of each method for flow and head assessment.
- the flow rate of a given site using each of the following methods - catchment area calculations, water diversion to fill a container, stream velocity/area measurement and/or weir construction method.
- advantages and disadvantages of each method of head and flow measurement with particular reference to their accuracy.
- long term usable flow rate from long term stream flow if available able taking into account environmental considerations.
- effects of seasonal variation using long term weather data.
- typical daily and seasonal energy consumption profile at a given site.
- effect of the energy demand profiles both daily and seasonally at the site on the system sizing.
- government regulatory requirements such as those covered under environmental or water resource legislation.
- environmental constraints at a site including minimum stream flow rates, ecological impacts, visual and noise impacts.

b) System components and configuration

- structural differences between the Pelton, Turbo Impulse, Francis, and propeller type, Michell or Banki cross flow turbines and PATs (Pumps As Turbines).
- system configuration for each turbine type identifying all major components.
- for impulse and cross flow turbine types, the comparison of bucket and blade shapes, nozzle shapes and types, types of hydraulic and electrical controllers/governors, speed increasers and over speed clutches and their basic operation and appropriate application.
- operational parameters and efficiency of different turbines.
- circumstances under which battery storage would be used.

- respective merits and suitability of various turbine types for various micro hydro-electric applications.
- operation of hydraulic rams or similar water pumps.
- typical efficiencies of hydraulic ram systems and appropriate applications.
- advantages and disadvantages of water energy storage systems with other energy storage systems such as battery banks.

c) System design

- suitable MHS characteristics to suit site load, hydraulic head and stream flow rate characteristics and a suitable type of commercially available MHS to suit.
- frictional losses in delivery pipes using manufacturer's data.
- calculation of the energy output of the selected MHS at the site from water flow rate, head and manufacturer's data, allowing for seasonal variations in performance and environmental constraints.
- design of any required weirs or dams, open races or penstocks, strainer and intake systems.
- optimum the position of the MHS and size of the MHS.
- suitable balance of system components including delivery pipe and fittings, transmission cable and voltage, voltage and frequency regulation, battery storage type and capacity, battery charger, inverter, back-up generator, and load dump.
- likely environmental impacts of the MHS and appropriate measures to minimise these impacts.

d) System costing

- major costs to be considered in the life cycle costing method.
- calculation of the capital and life cycle cost that includes the cost of various system configurations for a micro hydro application.
- external costs that might impact on the cost effectiveness of a MHS.
- most cost effective of a number of options on the basis of life cycle costing analysis.

2.20.18 Solar water heating systems

Evidence shall show an understanding of solar water heating systems to the extent indicated by the following aspects:

a) Daily irradiation

- definition of the terms: declination angle, reflectance, sunshine hours, extraterrestrial irradiation.
- solar radiation data tables and contour maps.
- determination, using field measurements and a sun path diagram, the times

and dates when a PV array will be shaded by obstacles at a particular site.

- calculation of the daily average irradiation on a horizontal plane given extraterrestrial irradiation, location constants and sunshine hour data.
- calculation of the monthly mean daily irradiation falling on a PV array for each month of the year, adjusted for the effects of shading, using irradiance and irradiation data tables and a sun path diagram and/or appropriate software.

b) Energy balance

- definitions of the terms: transmittance, absorptance, emittance, specific heat, absorber, heat removal factor, stagnation temperature.
- explain the heat transfer mechanisms of conduction, convection and radiation and their operation in a simple fin and tube collector.
- how the transmittance, absorptance and emittance properties of materials used in the collector affect the performance of the collector.
- ways to reduce heat losses from a collector.
- energy balance and instantaneous efficiency equations for a collector.
- calculation of the collector constants from the instantaneous collector efficiency equation for a linear relationship.

c) The solar collector

- five major factors that affect the selection of materials for solar collectors.
- features of collectors for low, medium and high temperature applications in terms of heat transfer, optical properties and materials of construction.
- the scope and content of AS 2712 or similar standards.
- requirements of AS 2712 or similar standards in one aspect of collector construction.
- tests required by AS 2712 or similar standards with regard to collector construction.

d) Solar collector performance

- scope and content of Australian Standards AS 2535 and AS 2984 or similar standards.
- method for testing the thermal performance of a solar collector or a solar water heater according to AS 2535 and AS 2984 or similar standards.
- instantaneous efficiency of a solar collector for different inlet temperatures and flow rates.
- effect of varying inlet temperature and flow rate on the performance of a solar collector.
- efficiency curves for various types of solar collectors.
- performance of various types of solar water heaters in terms of their design, location and predicted solar fraction.

e) Hydraulic circuits

- definition of the terms: equivalent length, static head, dynamic head, heat

exchanger.

- configuration of a hydraulic circuit for a pumped storage solar water heating system.
- function of the components in the circuit.
- effects of water quality on the life and performance of components in the hydraulic circuit.
- suitable type and size components to minimise hydraulic and energy losses including pipes, pumps, heat exchangers, expansion tanks, valves and filters for a hydraulic circuit with a given flow rate and head.
- safety requirements of the hydraulic circuit in terms of temperature, pressure and hydrogen gas release.
- requirements to balance flow through parallel/series combinations of collector arrays.
- suitable water and energy conservation measures including user education, water conservation technologies and insulation.
- suitable types and level of insulation for system components to minimise heat losses.

f) Domestic solar water heaters

- definition of the terms: thermosiphon system, pumped storage system, sacrificial anode.
- function of the components in a domestic solar water heater including the collector, storage tank, valves, piping, differential controllers, pumps, insulation and support frames.
- schematic diagram of different types of system configurations showing collectors, storage tank, piping, pumps, filters, valves, heat exchangers and expansion tanks.
- factors which affect system performance including: storage tank and collector design, system location and collector orientation, water quality, hot water demand, usage pattern.
- safety requirements that prevent injury from high temperature water and hydrogen gas explosions during installation, maintenance and use of solar water heaters.
- demand for hot water and irradiation for a given location and collector tilt angle, orientation and shading.
- selection a suitably sized system for a given demand and location to meet a specific solar fraction and/or minimise life cycle cost.
- consequences of under/oversizing of solar water heating systems in terms of: the effect on system performance, safety, life expectancy of components.
- installation, commissioning and maintenance requirements for a given situation including location and mounting of collectors, storage tanks, valves, pumps, pipes and ancillary fittings.
- energy conservation and efficiency measures that will enhance the performance of a solar water heater such as: appropriate usage patterns,

insulation, water conservation technologies, auxiliary energy tariffs.

- the capital cost, simple pay back and life cycle cost of solar and electric or gas hot water heaters according to AS 3595 and AS4536.

g) Commercial solar hot water heaters

- schematic diagrams for two different types of system configurations showing collectors, storage tank, piping, pumps, filters, valves, heat exchangers and expansion tanks.
- steps involved in the design of a commercial solar water heating system.
- assessment of the demand for hot water and irradiation for a given location and collector tilt angle, orientation and shading.
- selection of a suitably sized system for a given demand and location to meet a specific solar fraction and/or minimise life cycle cost.
- consequences of under/oversizing of a solar water heating system in terms of: system performance, safety, life expectancy of components.
- installation, commissioning and maintenance requirements for a given situation including location and mounting of collectors, storage tanks, valves, pumps, pipes and ancillary fittings.
- evaluation of energy conservation and efficiency measures that will enhance the performance of a solar water heater such as: appropriate usage patterns, insulation, water conservation technologies, auxiliary energy tariffs.
- the capital cost, simple payback time and life cycle cost of solar and electric or gas hot water heaters according to AS 3595 and AS4536.

h) Pool solar hot water heaters

- function of the components of solar pool heating systems.
- typical system configuration.
- two factors which affect system performance.

2.20.19 Grid connected inverters

Evidence shall show an understanding of grid connected inverters to an extent indicated by the following aspects:

a) Inverters encompassing:

- types of inverters used in grid connected systems.
- Australian standard symbol for a low voltage inverter
- the basic function of an inverter.
- simple block diagram of a typical inverter used in grid connected system

b) Inverter Operation encompassing:

- the basic principle of operation of a single phase inverter (using switch analogue)
- the operation of an inverter bridge and half-bridge configuration.

- operation of a FET inverter
 - connection of a grid inverter and measurement of the inverter parameters for various loads
- c) Inverter Characteristics encompassing:
- the characteristics which distinguish inverters suitable for grid connected photovoltaic array application from standard inverters.
- using waveform diagrams, the function of PWM techniques in square wave, modified square wave and synthesised sine wave inverters
- output voltage waveforms for square wave, modified square wave and synthesised sine wave inverters showing typical voltages and periodic times
- the six (6) essential inverter specifications
- d) PV Grid Connected System Operation encompassing:
- block diagram of a PV grid connected system.
- operation of grid interactive PV systems including synchronisation, safety feature, power flow control, passive and active anti-islanding, and metered energy for systems.
- schematic diagrams of common grid connected inverter circuit configurations including metering arrangements, isolation and connection with respect to RCDs in accordance with AS 4777.1.
- e) Installation of Grid Connected Inverters encompassing:
- major installation requirements for all system components which will ensure correct operation, long life, safety and ease of maintenance consistent with AS 4509, AS 4086.2, AS/NZS 3000 and relevant OH&S guidelines
 - selection of a suitable location for the PV array, inverter and other components, at a given installation site in accordance with AS2676.2 and AS3011.2, and the considerations given in AS4509 and AS4086.2.
 - typical installation configurations for grid connection of energy systems via inverters
 - the function and operation of a "grid protection device" as specified in AS4777
 - array wiring plan for series connected modules to minimise power loss due to shading at a particular site.
 - installation requirements for a grid connected system.
 - labelling and signage requirements for switchboards supplied with power from grid connected inverters, as set out in AS 4777.1.
 - the additional requirements for UPS systems as specified in AS4777.1.
 - installation of a PV grid connected system
- f) System commissioning and maintenance encompassing:
- the isolation procedures required for grid connected inverters.
 - relevant commissioning procedures including start-up and shut-down procedures for grid connected inverter systems in accordance with AS 4509.
 - testing a grid connected inverter system for correct operation.
 - location and rectification of an electrical fault within a PV array/inverter and

wiring.

- maintenance schedule for a grid connected PV power system.

performing commissioning work on a PV power system in accordance with AS 4509, AS 4086.2, AS/NZS 3000 and AS 3010.1

20.2.20 Renewable energy heating

Evidence shall show an understanding of renewable energy heating to an extent indicated by the following aspects:

a) Heating system technologies encompassing:

- Types and their application
- Operating parameters of common systems

b) System component parameters and specifications

c) System performance and requirements

d) Installation specifications and requirements

2.20.21 Distributed generation

Evidence shall show an understanding of distributed generation to an extent indicated by the following aspects:

a) Structure of the existing generation, transmission and distribution system

b) Benefits, issues and impacts

c) Distributed generation technologies

d) Electrical power distribution systems operation encompassing:

- Electrical characteristics of feeders
- Causes of voltage problems in a power distribution system
- Voltage regulation limits
- Calculations for feeder voltage drops
- Methods of voltage control
- Fault types, causes and effects
- Determination of fault levels
- Fault level limitation

e) Protection and relaying encompassing:

- Protection system purpose and features
- Application of protection in a distribution network
- Protection system terminology

- Feeder protection systems

f) Distributed generation issues encompassing:

- Utility requirements for interconnection
 - Safety of personnel
 - Islanding
 - Grid Stability
- Voltage regulation
- Potential benefits of DG
- Limitations in design of distribution circuits (designed for 1-way operation)
- Match between supply and demand
- Operation: dispatchable and non-dispatchable supplies
- Factors affecting the sizing of distributed generation
- Use of energy storage
- Case studies

g) Renewable energy supplies issues encompassing:

- Limits to penetration
- Factors affecting the value of renewables on the grid
- Implications of renewable input on power system operation
- Connection of energy systems via inverters: AS 4777

h) Factors affecting the uptake of distributed generation encompassing:

- Institutional factors
- Regulatory factors
- Policy including mandated targets
- Green power market
- Financial issues
- Contractual issues
- Case studies

2.20.22 Environmentally sustainable work practice

Evidence shall show an understanding of environmentally sustainable work practice to an extent indicated by the following aspects:

- a) Notion of sustainable work practice
- b) Effects of neglecting sustainable work practice
- c) The greenhouse effect - causes, consequences.
- d) International and national greenhouse imperatives.
- e) The role of regulators and similar bodies

- f) Economic benefits of sustainable initiatives.
- g) Techniques for reducing carbon produced energy and hence greenhouse gases
 - domestic, commercial and industrial strategies
 - trade related technologies and methods
 - energy efficient retrofits (overview).
 - renewable energy technologies (overview)

2.20.23 Environmentally sustainable work practice, supervisory responsibilities

Evidence shall show an understanding of environmentally sustainable work practice, supervisory responsibilities to an extent indicated by the following aspects:

- a) Provisions of relevant environmental legislation
- b) Principles and practice of effective sustainable work practice management
- c) Workplace sustainable work practice non compliance, range and selection of control measures
- d) Organisational systems and policies and procedures needed for legislative compliance
- e) Impact of characteristics and composition of the workforce on sustainable work practice management
- f) Relevance of sustainable work practice management to other organisational management policies, procedures and systems.
- g) Analysis of entire work environment and judge sustainable work practice interventions
- h) Analysis of relevant workplace data
- i) Ability to assess resources needed for risk control

2.20.24 Reserved

2.20.25 RE installations, ELV installation requirements

Evidence shall show an understanding of requirements for RE installations, ELV installation requirements to an extent indicated by the following aspects:

- a) Requirements for installation of wiring and equipment
- b) Compliant methods for providing protection
- c) Requirements for installation planning and selection of equipment
- d) Testing and verification requirements
- e) Documentation encompassing:
 - results of tests conducted that comply with requirements and ensure the RE - ELV installation is safe, including any formal documents of the results of testing required by authorities.
 - documents of periodic inspection and testing of RE - ELV wiring and equipment including any tagging, in accordance with requirements.

2.2.21 System, control and automated

2.21 System, control and automated

2.21.1 Machine design and positioning

Evidence shall show an understanding of the design parameters of machines and their capability as well as the ability to redesign their operating performance as well as the location of machines in and assembly or manufacturing environment to maximise production efficiency to an extent indicated by the following aspects:

- a) Materials used in machine drive shafts
- b) Standard formulas and specifications to determine machine drive shaft sizes for power, deflection, torque, bending data, key sizes, spline size and pin size
- c) Selection of power prime movers from manufacturers catalogues
- d) Principles associated with systematic planning of material flow in a production process
- e) Adaptation of systematic layout planning to a production process
- f) Preparation of process layouts and materials flow patterns in a production process
- g) Materials handling methods and unit load concepts
- h) Types of materials handling systems
- i) Design of materials handling systems and the factors that guide the final selection of a system

2.21.2 Mechanical drives and engineering

Evidence shall show an understanding of mechanical drive components and engineering design concepts to an extent indicated by the following aspects:

- a) Function of common mechanical drive parts and components
- b) Australian Standards governing the design of parts and components in a drive system
- c) Selection criteria for a part or component or drive system to suit a particular application
- d) Design philosophy applicable to mechanical, civil and electrical engineering
- e) Essential features of a design specification
- f) Understanding of Australian Standards and Codes of practice for design
- g) Steps in a designing a design
- h) Ergonomics in design

2.21.3 Materials and strength of materials

Evidence shall show an understanding of materials used in engineering and the mechanical properties of these materials to an extent indicated by the following aspects:

- a) Structure of metals, polymers and ceramics
- b) Interpretation of phase equilibrium and isothermal transformation diagrams
- c) Heat treatment processes of low carbon steel, high carbon steel and tool steel as well as non-ferrous metals such as aluminium and copper
- d) Properties and specifications of metal and non-metal materials
- e) Common failures in materials
- e) Determining normal stresses, strains and deformations caused by axial load
- f) Shear stress on bolted connections
- g) Failures in fillet welds and determine appropriate weld size and length required on welded connections
- h) Centroid and second moment of gyration of plain figures
- i) Shear force and bending moment diagrams for supported and cantilever beams subjected to vertical point loads and UDLs
- j) Bending stress in beams
- k) Deflection of beams subjected to loads
- l) Torque distribution diagrams and calculation of torsional shear stress and angle of twist on circular shafts subjected to torque
- m) Coefficient of linear expansion to determine thermal stress in single members

caused by restraint and changes in temperature

2.21.4 Statics and dynamics

Evidence shall show an understanding of statics and dynamics to an extent indicated by the following aspects:

- a) Units of mass, length, time and force and distinguish between vector and scalar quantities
- b) Resultant and equilibrant of systems of coplanar concurrent and non-concurrent forces
- c) Principles of movement
- d) Reactions of structures using equations of equilibrium and including the moment effect of a couple
- e) Laws of dry sliding friction applicable to horizontal and inclined planes
- f) Reactions and internal forces acting on the members of a pin jointed framed structure subjected to point loads at the joint
- g) Pin and support reactions for a non-coplanar non-concurrent force system
- h) Linear and angular equations of motion for constant accelerations
- i) Principles of the conservation of energy
- j) Mechanical advantage, velocity ratio and efficiency of machines
- k) Acceleration experienced by connected bodies so their motions are dependent upon one another
- l) Principle of conservation of momentum related to elastic collisions and departure masses

2.21.5 Advanced fluid mechanics

Evidence shall show an understanding of advanced fluid mechanics to an extent indicated by the following aspects:

- a) The relationship between Reynolds Number and flow regime
- b) Head loss in pipes and fittings and system head curves
- c) Head loss in parallel and serial pipes and how systems can be reduced to an equivalent single pipe system for analytical purposes
- d) Flow rates through open channels
- e) Positive displacement and rotodynamics of fluid machinery
- f) Duty point for a pump in a system including flow rate and head pressure

- g) Cavitations and the influence of inlet system design and fluid temperature and pressure on cavitations
- h) Circuits and operation of fluid hydraulic componentry in a system
- i) Technical specifications and associated data for the selection of hydraulic components for machine control operation
- k) Installation requirements for the installation, commissioning and testing hydraulic components and systems

2.21.6 Electronic interfacing to mechanical processes

Evidence shall show an understanding of interfacing electronics with mechanical devices and systems to an extent indicated by the following aspects:

- a) Connection of sensors and actuators to an interface for communications with a discrete device electronic controller or programmable controller or computer for the operation of a process requiring continuously variable changes
- b) Description of the logic sequence for the integrated system including: operator actions, input signals, output actions, interlocks and safety and emergency requirements
- c) Transformation of the system logic into a program to carry out the desired task using a port address on a computer using programming software and codes
- d) Commissioning systems and perform fault diagnosis using computer automation
- e) Operation of circuits controlling hydraulics
- f) Technical specifications and data for the selection of hydraulic components for machine control
- g) Installation, commissioning and testing hydraulic systems

2.21.7 Electronic control of fluid processes

Evidence shall show an understanding of interfacing electronics with hydraulic and pneumatic devices and systems to an extent indicated by the following aspects:

- a) Determining control static and dynamic operating conditions for stages in a control process from block diagrams
- b) Identification of process characteristics from process test data and process flow diagrams
- c) Linearisation functions and feedback
- d) Placement of sensors and actuators to eliminate dead time
- e) Lag reduction strategies

- f) Consideration of steady state gain vs. offset and stability vs. performance
- g) Controller tuning and calibration
- h) Analyse control system functions
- i) Construct a time-displacement diagram for a functional system
- j) Design relay logic ladder diagram for the system
- k) Identification of components required by a fluid power circuit
- l) Selection of proportional valves to suit fluid applications
- m) Determination of ramp time for motor and cylinder circuits
- n) Determine maximum flow rates in cylinder circuits that accelerate and decelerate a load and selection of an appropriate valve spool
- o) Determine pressure in cylinder circuits
- p) Design fluid power circuits using proportional valves
- q) Adjust points on a proportional valve control card to meet specifications

2.21.8 Electronic interfacing to robotic processes

Evidence shall show an understanding of interfacing electronics with robot functions to an extent indicated by the following aspects:

- a) Robot types and selection and pre-selection planning
- b) Robot installation including pre-installation design, layout and system documentation
- c) Interfacing of robot controller with other external control systems
- d) Robot sensor devices, characteristics and application
- e) Diagnostic functions
- f) Maintenance scheduling and procedures
- g) Special features including safety, palletising and sub-routines

2.21.9 Material science

Evidence shall show an understanding of materials and their characteristics to an extent indicated by the following aspects:

- a) Classification of materials on the basis of state
- b) Difference between elements, compounds and mixtures
- c) Atomic structure and bonding of materials

- d) Properties of ferrous and non-ferrous materials
- e) Properties of ceramic and composite materials
- f) Chemical, physical and mechanical properties of materials
- g) Corrosion and corrosion protection of metallic structures and systems
- h) Causes of degradation of polymer materials
- i) Non-destructive testing and types of test equipment
- j) Corrosion testing
- k) Evaluation and suitability of materials for specific applications
- l) Principles, advantages and limitations of casting, forging, extrusion and powder metallurgical processes
- m) Methods of joining materials, including limitations
- n) Methods used for surface finishing of materials, including limitations

2.21.10 Thermodynamics

Evidence shall show an understanding of thermodynamics to an extent indicated by the following aspects:

- a) Relationship between energy usage and standard of living
- b) Energy conversion and conversion efficiencies
- c) Energy sources and their advantage in engineering processes
- d) Energy conservation
- e) State of matter in terms of molecular theory
- f) Relationship between mass, volume, density, force, pressure and temperature in thermodynamic concepts
- g) Compression ratio and pressure ratio calculations in a basic piston and cylinder mechanism
- h) Concepts, theorems and calculations related to potential energy, kinetic energy, work and power, heat and internal energy of object.
- i) Relationship between work and pressure/volume
- j) Concept and calculations related to energy transfer in a closed loop system
- k) Concept of and calculations about property changes and work, heat and internal energy transfer in gases in typical engineering processes
- l) Principle, operation and performance of common types of heat engines
- m) Heat engine performance parameters and typical performance tests

2.21.11 Pneumatics

Evidence shall show an understanding of pneumatics to an extent indicated by the following aspects:

- a) Terms and there definitions used in pneumatic components and systems
- b) Application, operation and installation requirements of pneumatic components and systems
- c) Interpretation and selection of manufacturers equipment specifications to establish the performance of pneumatic components
- d) Construct circuits from control diagrams
- e) Location and correction of faults on pneumatic components and systems

2.21.12 Hydraulics

Evidence shall show an understanding of hydraulics to an extent indicated by the following aspects:

- a) Terms and there definitions used in hydraulics components and systems
- b) Application, operation and installation requirements of hydraulic components and systems
- c) Interpretation and selection of manufacturers equipment specifications to establish the performance of hydraulic components
- d) Construct circuits from control diagrams
- e) Location and correction of faults on hydraulics components and systems

2.21.13 Fluid power control

Evidence shall show an understanding of fluid power control to an extent indicated by the following aspects:

- a) Terms and there definitions used in fluid power systems
- b) Applications of fluid power
- c) Pascal's law as it relates to force transfer, multiplication and intensification
- d) Mathematical relationships involving temperature and volume (Charles law), pressure and volume (Boyles law), pressure and volume (Boyles law) and there combinational relationships
- e) Fluid power principles related to components and the identification of

components

- f) Operation of fluid power components
- g) Interpretation of fluid system operation from circuit diagrams
- h) Operation and construction of basic pneumatic circuit
- i) Operation and construction of a basic hydraulic circuit
- j) Routing maintenance procedures
- k) Safety requirement

2.2.22 Hazardous Areas

2.22 Hazardous Areas

2.22.1 Hazardous areas and explosion-protection principles

Evidence shall show an understanding of hazardous areas and explosion-protection principles to an extent indicated by the following aspects:

- a) Properties of combustible substances and their potential to create an explosive hazard encompassing:
 - condition in the workplace that will lead to an explosion;
 - the terms ‘combustion’, ‘ignition’ and ‘propagation’;
 - explosive range of substances encountered in the workplace i.e. LEL/UEL;
 - explosive parameters of substances as given in tables of substance properties

Note:

Combustible materials are gases, vapours (from liquids), and dusts; flash point.

- the difference between gases and vapours; and
 - the toxic nature of gases and vapours and potential harmful consequences.
- b) The nature of hazardous areas encompassing:
 - the Standards definition of a ‘hazardous area’;
 - the recommended methods for classifying the type and degree of explosion hazard in an area;
 - hazardous area classifications as defined by Standards; and
 - factors that are considered when a hazardous area is classified.
 - c) The basics of how explosion-protection is achieved by the methods of exclusion, containment, energy limitation, dilution, avoidance of ignition source.
 - d) Occupational Health and Safety responsibilities related to hazardous areas

encompassing:

- the main features and purpose of a ‘clearance to work’ system;

NOTE: ‘Clearance to work’ includes hot work permit systems.

- typical safety procedures that should be followed before entering a hazardous area;
- the purpose of gas detectors and their limitations;
- effects of temperature on gas and vapour detection;
- frequency of monitoring for presence of gas or vapours, i.e. effects of temperature rise;
- factors affecting the accuracy of gas detectors, for example, contamination, condensation, temperature;
- safety in use of gas detectors, for example, ‘read and run concept’
- the safety precautions to be taken when working in a hazardous area.

e) The roles of the parties involved in the safety of hazardous areas encompassing:

- common Acts and Regulations related to the safety of hazardous areas and the Authorities responsible for their implementation;
- where assistance and further information can be obtained to assist persons with hazardous area responsibilities, for example, Standard bodies, experienced consultants; and
- the hazardous area responsibilities of the owner of premises in which a hazardous area exists; the occupier of premises in which a hazardous area exists; enterprises and personnel engaged in installation and/or maintenance of explosion-protection systems; enterprises and personnel engaged in the classification of hazardous areas and/or design of explosion-protection systems; enterprises and personnel engaged in the overhaul, modification and/or assessment of explosion-protected equipment; enterprises and personnel engaged in the inspection of explosion-protection installations; manufacturers of explosion-protected equipment; designated authorities; insurers.

2.22.2 Explosion-protected equipment

2.22.2.1 Principles

Evidence shall show an understanding of the principles of the following explosion-protection techniques: Flameproof (Ex ‘d’); Increased safety (Ex ‘e’); Non-sparking (Ex ‘n’); Intrinsic safety (Ex ‘i’) and Pressurization (Ex ‘p’) for gas atmospheres and Dust-exclusion enclosures (Ex ‘tD’); Pressurization (Ex ‘pD’); Encapsulation (Ex ‘mD’); and Intrinsic safety (Ex ‘iD’) for dusts. The following aspects indicate the extent of understanding required:

a) The principles of each explosion-protection technique, the methods used and how

each technique works.

- b) How explosion-protected equipment is identified by the 'Ex' symbol marked on the equipment, including old equipment and equipment certified in another country.
- c) Visible conditions or actions that would void the explosion-protection provided by a particular technique.

2.22.2.2 Ex certification schemes

Evidence shall show an understanding of Ex certification schemes to accepted Standards to an extent indicated by the following aspects:

- (a) Purpose and scope of certification schemes.
- (b) Schemes accepted in Australia and New Zealand.
- (c) Schemes commonly used in countries other than Australia and New Zealand.
- (d) Processes for having equipment certified under the acceptable Ex schemes encompassing—
 - scheme procedures;
 - quality management requirements;
 - conformance testing and assessment; and
 - requirements for on going certification.

2.22.3 Flameproof (Ex'd') explosion-protection technique

Evidence shall show an understanding of the characteristic and application of Flameproof (Ex 'd') explosion-protection technique to an extent indicated by the following aspects:

- a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex 'd') technique.

Note:

Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

- b) Typical situations where the flameproof explosion-protection technique is used;
- c) Actions or conditions that would void the protection provided the Flameproof technique; and
- d) The use of Standards in determining the requirements to which the installation of flameproof explosion-protected apparatus shall comply.

2.22.4 Increased safety (Ex‘e’) explosion-protection technique

Evidence shall show an understanding of the characteristic and application of Increased safety (Ex ‘e’) explosion-protection technique to an extent indicated by the following aspects:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex ‘e’) technique.

Note:

Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used;

c) Actions or conditions that would void the protection provided the Increased safety technique; and

d) The use of Standards in determining the requirements to which the installation of Increased safety explosion-protected apparatus shall comply.

2.22.5 Non-sparking (Ex‘n’) explosion-protection technique

Evidence shall show an understanding of the characteristic and application of Non-sparking (Ex ‘n’) explosion-protection technique to an extent indicated by the following aspects:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex ‘n’) technique.

Note:

Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used;

c) Actions or conditions that would void the protection provided the Non-sparking technique; and

d) The use of Standards in determining the requirements to which the installation of Non-sparking explosion-protected apparatus shall comply.

2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique

Evidence shall show an understanding of the characteristic and application of Intrinsic safety (Ex ‘i’) explosion-protection technique to an extent indicated by the

following aspects:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

Note:

Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic safety explosion-protection technique is used;

c) Actions or conditions that would void the protection provided the Intrinsic safety; and

d) The use of Standards in determining the requirements to which the installation of Intrinsic safety explosion-protected apparatus shall comply.

2.22.7 Pressurization (Ex'p') explosion-protection technique

Evidence shall show an understanding of the characteristic and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by the following aspects:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

Note:

Examples of characteristics and design features are exclusion and dilution; purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used;

c) Actions or conditions that would void the protection provided the pressurization technique; and

d) The use of Standards in determining the requirements to which the installation of pressurization explosion-protected apparatus shall comply.

2.22.8 Explosion-protection techniques for dusts

Evidence shall show an understanding of the characteristics and application of the enclosures (Ex 'tD') (for dusts) explosion-protection technique. The following aspects

indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

Note:

Examples of characteristics and design features are for enclosures; pressurization; encapsulation; and intrinsic safety.

b) Typical situations where the each dust explosion-protection technique is used;

c) Actions or conditions that would void the protection provided the each dust technique; and

d) The use of Standards in determining the requirements to which the installation of dust explosion-protected apparatus shall comply.

2.22.9 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by the following aspects:

a) The purposes of ‘temperature classification’ and ‘gas grouping/apparatus grouping’.

b) Compliance plate markings.

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose of conformity and certification/approval for equipment used in hazardous areas.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE: Other techniques include encapsulation Ex ‘m’; oil-immersion Ex ‘o’; powder-filling Ex ‘q’; ventilation Ex ‘v’ and special protection Ex ‘s’.

(g) Features and purpose of conduit seals and cable termination devices designed for use

in hazardous areas.

NOTE: These include conduit seals and barrier and compression glands for cables with or without armouring, screening and/or drain wires.

2.22.10 Hazardous areas installation and maintenance requirements

2.22.10.1 Hazardous areas installation requirements

Evidence shall show an understanding of hazardous area installation principles and

maintenance techniques to an extent indicated by the following aspects:

a) Preparation to install and maintain explosion-protected equipment in hazardous areas encompassing:

- OHS procedures to be followed when working in a hazardous area;
- the significance of information provided on the certification documentation and schedules for a given item of explosion-protected equipment;
- the typical contents of a verification dossier and their purpose; and
- limitations in the use of tools and testing devices in hazardous areas.

b) The relationship between explosion-protected equipment, their certification documents and required locations given in specifications and layout drawings and/or written instructions encompassing:

- the purpose of markings on the compliance plate and certification documents for a given item of explosion-protected equipment;
- matching explosion-protected equipment with certification documents and the equipment specified for an installation; and
- the location the items of explosion-protected equipment for an installation from specifications and layout drawings and/or instructions.

c) Installation Standards and requirements applicable to hazardous encompassing:

- the wiring systems permitted and not permitted in or above hazardous areas;
- equipment not permitted in or above hazardous areas;
- the regulations and Standards to which explosion-protected equipment and wiring must be installed in a hazardous area and how these are applied; and
- the documentation required as a record of the installation process, including certification documentation.

•

2.22.10.2 Hazardous areas maintenance requirements

Evidence shall show an understanding of maintenance procedures in hazardous areas that will ensure the integrity of the explosion-protection technique to an extent indicated by the following aspects:

d) Maintenance procedures in hazardous areas that will ensure the integrity of the explosion-protection technique encompassing:

- the purpose of a maintenance schedule;
- the purpose and extent of ‘close’, ‘sample’ and ‘periodic’ inspections;
- the features of each explosion-protection techniques that should be included in a maintenance schedule;
- the impact of environmental conditions on explosion-protected equipment, including corrosion and frequency of maintenance;
- the documentation requirements for recording the maintenance process and

results; and

- the use of Standards in determining the requirements with which the design of explosion-protected apparatus shall comply.

2.22.11 Hazardous areas cable termination devices and techniques

2.22.11.1 Hazardous area cable termination devices and applications

Evidence shall show knowledge and skills cable termination types suitable for use in hazardous areas to an extent indicated by the following aspects:

- a) Explosion protection features of cable terminations devices.
- b) Selecting compliant cable termination devices.

2.22.11.2 Hazardous areas cable termination techniques

Evidence shall show knowledge and skills in terminating cables suitable for use in hazardous areas to an extent indicated by the following aspects:

- (a) Installing conduit systems, where applicable, including seals to meet hazardous areas requirements. (Gases only.)
- (b) Terminating a cable with a barrier gland. (Gases only.)
- (c) Terminating a multipair, SWA, overall screened, individual screened cable into an enclosure.
- (d) Testing termination/connections of installed cables/circuits.

2.22.12 Hazardous areas detailed inspection techniques

Evidence shall show an understanding of techniques used in inspecting installations of explosion-protected and associated apparatus and hazardous area wiring. The following aspects indicate the extent of understanding required.

- a) The relationship between the documentation held in a verification dossier and the installed equipment encompassing:
 - consistency between the location and type of equipment with the area classification details in the verification dossier; and
 - equipment certification and any attached conditions that relate to the equipment as it is installed.
- c) Inspecting a hazardous area installation encompassing:
 - typical processes for undertaking the inspection of a hazardous area

installation;

- requirements applicable to a given installation; and
- reporting of an inspection of a hazardous area installation.

2.22.13 Explosion-protected equipment overhaul and repair

2.22.13.1 General requirements

Evidence shall show an understanding of overhaul and repair procedures of explosion-protected equipment to an extent indicated by the following aspects:

a) The scope and limitations for overhaul and repair of explosion-protected equipment encompassing:

- the requirements for registration of a workshop;
- the requirements of a ‘competent person’ for a registered workshop engaged in the overhaul/repair of explosion-protected equipment; and
- the scope and limitations of work permitted under workshop registration.

b) Overhaul and repair (technical) Standard encompassing:

- the documentation/information required to enable overhaul/repair to be undertaken;
- categories of work, for example, overhaul; no repair; overhaul-repair;
- modifications that are, and are not, permitted within the equipment certification; and
- the requirements for overhaul/repair processes relevant to the type of protection and equipment.

c) Requirements for documentation and identification of overhauled/repared explosion-protected encompassing:

- overhaul/repair report document; and
- requirements for distribution of overhaul/repair reports.

d) Quality management systems as covered by international Standards encompassing:

- documentation regime of a quality management system;
- principle of document and data control covering both internally and externally generated documents and data; and
- principles of process control as applied to the overhaul and repair of explosion-protected equipment.

2.22.13.2 Explosion-protected equipment overhaul and repair — Overhaul and repair requirements specific to each explosion-protection technique

Evidence shall show an understanding of overhaul and repair for specific explosion-protection techniques to an extent indicated by the following aspects:

a) The level of overhaul/repair required encompassing:

- Standards and their use for determining the requirement for a specific explosion-protection technique;
- measurement/tests and equipment required to determine whether an item of equipment meets the certification requirements;
- requirements for maintaining the accuracy/calibration of measuring/test equipment;
- measurement/test procedures for determining whether an item of equipment meets the certification requirements;
- level of overhaul/repair required from comparisons of test results and requirements specified in the original certification; and
- specifying overhaul/repair work required to restore an item of explosion-protected equipment to conform with the original certification.

b) Measurement/tests procedures to verify that an item of equipment meets the original certification requirements

2.22.14 Explosion-protected equipment modification

2.22.14.1 General requirements

Evidence shall show an understanding of modifications to explosion-protected equipment to an extent indicated by the following

a) The scope and limitations for design and development of modifications of explosion-protected equipment encompassing:

- the requirements of a ‘competent person’ for a registered workshop engaged in design and development of modifications to explosion-protected equipment; and
- the scope and limitations of modification work permitted.

b) The requirements for documenting and identifying modified explosion-protected equipment encompassing:

- modification report document; and
- requirements for distribution of reports on modifications.

2.22.14.2 Modification requirements specific to each explosion-protection technique

Evidence shall show an understanding of modifications to specific

explosion-protection techniques to an extent indicated by the following aspects

a) Design and development of modifications encompassing:

- verification that equipment to be modified complies with its certification;
- assessing the viability and impact of the requested modification in terms of the explosion-protection properties;
- document of modifications specifications;
- verification tests that can be carried out within a workshop; and
- assessing modified equipment and test results for conformance with applicable Standards.

b) Processes and procedures for obtaining certificate of compliance for modified explosion-protected equipment encompassing:

- Requirements for organizations to be recognised as testing/ certification bodies for explosion-protected equipment.
- Processes used in certifying/approving modified explosion-protected equipment.

2.22.15 Hazardous areas installation planning

Evidence shall show an understanding of hazardous area electrical installations planning and the selection of appropriate explosion-protected equipment and wiring. The following aspects indicate the extent of understanding required.

a) Interpretation of documents showing the classification of a hazardous area encompassing:

- the methods used for classifying hazardous areas;
- the delineation of zones, temperature classes and gas groups of a given hazardous area from classification documents;
- the delineation of zones, temperature classes and gas groups of a given hazardous area from similar situations previously classified, such as those given in Standards; and
- situations where classification needs to be undertaken by a person competent in non-specific area classification i.e. a person who has attained Unit UEENEEM???? Classify hazardous areas

b) Selecting and checking equipment, wiring and accessories encompassing:

- the impact of environmental conditions, such as corrosion and maintenance requirements, on explosion-protected equipment and accessories;
- explosion-protected equipment and accessories to suit the requirements of given hazardous areas;
- wiring systems to suit the requirements of a hazardous area, load and duty requirements and consideration of capacitive/inductive effects and inductance/resistance ratio where applicable;

- earthing and equipotential bonding requirements for a hazardous area installation;
- procedures used to check the compliance certification of equipment used in a hazardous area; and
- electrical protection systems and devices, for example, overloads, earth fault protection) appropriate to an explosion-protection technique.

c) Documentation of hazardous area installation design encompassing:

- the items that should be included in the documentation for the design of a hazardous area installation;
- installation layout, specification, work schedule and other documentation required for inclusion in a verification dossier; and
- the essential documentation that needs to be specified/requested from manufacturers when purchasing explosion-protected equipment/ accessories.

2.22.16 Common classified hazardous areas

Evidence shall show an understanding of common and specific hazardous areas for which classification examples are given in Standards. The following aspects indicate the extent of understanding required.

a) The example classifications given in Standards

b) Application of the classifications given in Standards to similar situations for the purpose of planning of electrical installations.

2.22.17 Hazardous areas classification techniques

Evidence shall show an understanding of processes involved in gathering and analysing technical data to classify non-specific hazardous areas. The following aspects indicate the extent of understanding required.

a) The process of classifying hazardous areas encompassing:

- methods by which an area can be classified;
- the characteristics/attributes of an area that should be considered in the classification process, for example, type of process, nature of plant, source and nature of release;
- the requirements and Standards for classifying a hazardous area; and
- the responsibilities of the owner/occupiers for classification of a hazardous area.

b) The likelihood (zoning) or risk assessment method of an explosive hazard encompassing:

- ignition properties of materials relevant to determining the likelihood and

extent of an explosive hazard;

- sources for obtaining data on ignition properties of materials under the conditions in which they could be present in a given process;
- methods for assessment and calculation of factors such as release rate , ventilation and dispersion characteristics; and
- means for reducing hazard risk.

c) The extent of an explosive hazard and classifying an area accordingly encompassing:

- the extent of zones for an area given data on the likelihood of the explosive hazard for that area;
- requirements for documenting the classification of a hazardous area; and
- the extent of the zones, temperature classes and gas groups on site drawings in a hazardous area.

2.22.18 Hazardous areas visual inspection requirements

Evidence shall show an understanding of the purpose and process of visual inspections to an extent indicated by the following aspects:

a) Occupational, health and safety procedures encompassing:

- occupational, health and safety procedures to be followed before entering hazardous areas; and
- occupational, health and safety procedures to be followed while conducting visual inspection.

b) Requirements for a verification dossier and relationship to as-built electrical installation.

c) Purpose, scope and limitations of visual inspections.

d) Documentation requirements resulting from a visual inspection.

2.22.19 Hazardous areas management

Evidence shall show an understanding of the management responsibilities related to hazardous areas, the strategies used to maintain the safety of hazardous areas and the maintenance requirements. The following aspects indicate the extent of understanding required.

a) The responsibilities of a person managing activities or a site related to a hazardous area, encompassing:

- OHS procedures that are to be established;
- responsibilities for ensuring that a hazardous area is safe; and
- responsibilities and processes for establishing and maintaining a verification

dossier.

b) Explosion-protection strategies in relation to a hazardous area, encompassing:

- the process of classifying a hazardous area;
- various ways in which electrical systems /apparatus can be treated to prevent them from becoming an ignition source; and
- the cost of the different ways of treating electrical systems/apparatus associated with hazardous areas.

c) Requirements for the maintenance of electrical systems associated with hazardous areas, encompassing:

- the type and grades of inspection of hazardous areas;
- maintenance programs for electrical explosion-protected systems/apparatus; and
- documentation requirements associated with maintenance procedures.

2.22.20 Explosion-protected electrical systems design

Evidence shall show an understanding of explosion-protected electrical system design to an extent indicated by the following aspects:

a) Process for establishing a design brief for an explosion-protected electrical system encompassing:

- consultation processes for establishing client requirements and preparing a design brief; and
- system requirements using site and plant specifications, hazardous area classifications and organization requirements.

b) System design encompassing:

- major considerations influencing explosion-protected electrical system designs;
- requirements in Standards and regulations that affect the electrical system design; and
- typical design process incorporating explosion-protection in an electrical system.

c) Design documentation required for a hazardous area encompassing:

- procedures for checking and approval of explosion-protected system design; and
- requirements for documenting a final design including documents to be included in a verification dossier.

2.22.21 Explosion-protected equipment conformity assessment

Evidence shall show an understanding of explosion-protected equipment compliance assessment with to an extent indicated by the following aspects:

a) The compliance certification and the 'Ex' scheme for recognition of certification encompassing:

- the purposes of certification of explosion-protected equipment;
- the parties involved in the assessment/testing and certification of explosion-protected equipment and their responsibilities; and
- the process for recognition of assessment/testing and certification of explosion-protected equipment from other countries.

b) The preparation required to assess explosion-protected equipment for compliance with Standards encompassing:

- the special safety measures that should be taken when assessing/testing explosion-protected equipment;
- documentation required prior to conducting conformity assessment;
- tests necessary to establish that an item of explosion-protected equipment conforms with relevant Standards; and
- situations where testing is not applicable or required.

c) Assessing and testing explosion-protected equipment encompassing:

- assessment and test requirements; and
- procedures for conducting a conformity assessment.

d) Recording and reporting requirements of conformity assessment.

2.22.22 Hazardous areas installation testing

Evidence shall show an understanding of testing installations of explosion-protected equipment, wiring and circuits associated with hazardous areas. The following aspects indicate the extent of understanding required.

a) Preparation for conducting installation testing in a hazardous area encompassing:

- OHS procedures to be followed for working in a hazardous area; and
- procedures for determining whether a given hazardous area is safe to conduct electrical testing.

b) Characteristics and limitations of testing equipment used to test installation in hazardous areas encompassing:

- testing devices required to test an installation in a hazardous area; and
- the suitability of testing device for use in a hazardous area.

d) Documentation of results of hazardous area installation tests encompassing:

- test results that should be recorded in a verification dossier; and
- procedures and options for dealing with test results that show

non-conformance.

2.22.23 Explosion-protection visual checks

Evidence shall show an understanding of visible conditions of explosion-protection equipment that indicate the protection is void and changes in the nature of the explosion hazard that may render the explosion-protection unsafe. The following aspects indicate the extent of understanding required.

- a) Occupational, health and safety procedures encompassing:
 - occupational, health and safety procedures to be followed before entering hazardous areas; and
 - occupational, health and safety procedures to be followed while conducting visual inspection.
- b) Visible defects in explosion-protected equipment and wiring.
- c) Conditions that may indicate a change in a given explosion hazard.
- d) Reporting defects in explosion-protected equipment and wiring encompassing:
 - the purpose of a verification dossier; and
 - various ways for reporting defects in explosion-protected equipment and wiring.
- e) procedures to be followed in the event of a change in the explosion hazard.

2.22.24 Gas detection—portable devices

Evidence shall show an understanding of the principles of gas detection and the use and care of portable gas detection devices to an extent indicated by the following aspects:

- a) Fundamental principles in the use of gas and vapour instruments.
- b) Use of manufacturer's instruction manual.

Note:

Instruction manuals include operating instructions, adjustment procedures, operational limitations, and storage.

- c) Calibration and response checking.

2.22.25 Gas detection—Fixed equipment installation and maintenance

Evidence shall show an understanding of requirements and techniques for the installation and maintenance of fixed gas detection equipment to an extent indicated

by the following aspects:

- (a) Use of manufacturer's instruction manual; for example, operating instructions, adjustments procedures and operational limitations.
- (b) Installation and maintenance of Standards and/or Codes of Practice for gas detection equipment.
- (c) Location of fixed sample points or sensors encompassing—
 - optimal sensing;
 - maintainability and ease of calibration; and
 - protection against environmental and mechanical damage.
- (d) Gas and vapour releases encompassing—
 - the nature of a site; and
 - natural and mechanical ventilation.
- (e) Common problems with fixed gas detectors.
- (f) Calibration and response checking.

2.22.26 Evaluation and selection of gas detection equipment — Portable and fixed

Evidence shall show an understanding of the factors to consider in the evaluation and selection of portable and fixed gas detection equipment to an extent indicated by the following aspects:

- a) Requirements for gas detection for a given situation encompassing:
 - sources for obtaining data on physical chemistry of the gas to be detected; and
 - sources for obtaining data on the conditions under which the gas may be present.
- b) Processes of assessing the specifications of gas detection equipment against established requirements.

2.22.27 Basic properties, behaviour and detection of gases and vapours

Evidence shall show an understanding of basic properties, behaviour and detection of gases and vapours to an extent indicated by the following aspects:

- (a) Detecting gases and vapours encompassing—
 - apparatus capability and users' knowledge;
 - propagation of gases;

NOTE: This includes release of gas and vapours, ventilation, density, temperature and location.

- gases to be detected and not to be detected;
 - intended application;
 - environmental effects;
 - safety when monitoring for flammable gases where personnel could be present;
 - common properties of gases and vapours; and
-

NOTE: This includes density of gases, vapours and their mixtures; effect of temperature on density; LEL and UEL of combustibles and toxicity.

(viii) the differences between detecting gases and vapours.

NOTE: These include added complication of evaporation, condensation and temperature effects of vapours and their effect on propagation, calibration and

detection, including sampling.

(b) Oxygen deficiency and effects on safety encompassing—

- chemical reaction of oxygen with solid products;
- chemical reaction of oxygen with gaseous products; and
- dilution of the air by displacement by some other gas or vapour.

(c) Measuring principles of catalytic sensors, electrochemical sensors, infrared sensors

and semi-conductor sensors encompassing—

- common applications;
 - limitations and safety;
 - interferences of other gases with the measurement; and
 - poisoning of the sensor.
-

NOTE: Detailed information on gas detection is given in AS/NZS 60079.29.2.

2.22.28 Gas detection—Instructions in the use of portable devices

Evidence shall show an understanding of the instructions to be given in the use of portable gas detection devices to an extent indicated by the following aspects:

(a) Limits of gas detection of flammable (combustible) gas equipment, encompassing—

- limit to which flammable gas detection equipment will only detect gases and vapours that are present in the vicinity of the detector (or in the line of sight of open path apparatus); and

- limit to which flammable gas equipment will not detect combustible liquids as such, or combustible mists, dusts, or fibres.

(b) Limits of vapour detection of flammable (combustible) gas equipment.

NOTE: For example, flammable gas detection equipment will only detect those vapours that do not condense at the temperature of the detector or its sampling equipment (where applicable).

(c) Interpretation of gas detection instrument readings (behaviour) encompassing

- upscale reading in the presence of a gas for which an instrument is not calibrated;
- causes of erratic indications;
- reading of low concentrations of gas of interest; and
- off-scale readings.

(d) Toxicity level of flammable gases and vapours and their potential for occurring in a given situation.

(e) Issues with gas and vapour detection in confined spaces.

(f) Use of the manufacturer's instruction manual.

NOTE: For example, operating instructions, adjustment procedures, operational limitations, storage.

2.22.29 Gas detection selection and installation design

Evidence shall show an understanding of basic properties, behaviour and detection of gases and vapours to an extent indicated by the following aspects:

(a) Measuring principles of thermal conductivity sensors, flame ionization, detectors (FID), flame temperature analyzers (FTA), photo ionisation detectors (PID) and paramagnetic oxygen detectors.

(b) Selection of apparatus encompassing—

- environment;
- system response delay; and
- gas to be detected with respect to measurement principles.

(c) Behaviour of gas and vapour releases encompassing—

- rate of release;
- density; and
- temperature/pressure.

(d) Design and installation encompassing—

- sensor, sampling or open path;

- location;
- site; and
- environmental conditions.

NOTE: These include adverse weather, excess temperature, vibration and other mechanical interference, hosing, airborne contaminants and corrosion.

(e) Integrity and safety encompassing—

- redundancy; and
- protection against loss of power supply.

(f) Commissioning and scheduled maintenance encompassing—

- sample lines;
- diffusion sensor screens;
- initial gas calibration;
- adjustment of alarm set points; and
- plans and records.

2.22.30 Conformity assessment of explosion-protected equipment

2.22.30.1 Documentation

Evidence shall show an understanding of the documentation used in assessing explosion-protected equipment for conformance to accepted Standards to an extent indicated by the following aspects:

- (a) The documentation and Standard(s) required to begin an assessment.
- (b) The differences between the test requirements of Standards from other countries and the compliant/acceptable Standards against which the equipment is being assessed.
- (c) Results given in equipment test reports.
- (d) Conformity assessment processes and procedures.

2.22.30.2 Conformity assessment processes

Evidence shall show an understanding of the processes used in assessing explosion-protected equipment for conformance to accepted Standards to an extent indicated by the following aspects relating to overall processes and procedures:

- (a) Assessing to a current acceptable Standard existing equipment that has been certified to previously acceptable Standards encompassing—
 - processes and procedures used; and
 - possible outcomes.
- (b) A clause by clause assessment between the equipment manufacturing

Standard(s) and the current acceptable Ex Standards encompassing —

- processes and procedures used; and
- differences between the Standards that may be detected.

2.22.31 Fitness-for-purpose of equipment for use in a hazardous area

Evidence shall show an understanding of techniques used in fitness-for purpose assessment of equipment for use in hazardous areas to an extent indicated by the following aspects:

(a) Processes for verifying that a design specification meets the integrity of the equipment, showing the equipment is fit-for-purpose and is safe to use, encompassing—

- Standards against which fitness-for-purpose assessment is made;
- the need to maintain the accuracy/calibration of measuring/test devices/tools;
- assessment and measurements/tests requirements for determining that an item of explosion-protected equipment complies with the relevant Standards and meets the certification requirements;
- testing that is/is not required to determine compliance of the equipment being assessed; and
- development of different tests to those given in Standards and justification as to how they achieve the same result.

(b) Typical specification for the equipment to be assessed as fit-for-purpose.

2.22.32 Hazardous areas auditing processes

Evidence shall show an understanding of processes used in auditing hazardous areas to an extent indicated by the following aspects:

(a) Requirements to retain hazardous areas documentation on site.

(b) Components of an audit encompassing—

- authenticity of documentation;
- hazardous areas delineations shown in site diagrams;
- location and operating parameters of equipment shown in certification documents;
- compliance of equipment location;
- compliance of wiring systems; and
- alignment of hazardous areas documentation to as- built installation.

(c) Reporting non-conformance of an installation.

2.22.33 Reeling, trailing and flexible cables and repair techniques

Evidence shall show an understanding of reeling, trailing and flexible cable and repair techniques to an extent indicated by the following aspects:

(a) Cable types encompassing—

- cable construction, materials and design features;
- function of each design feature;
- conditions under which cables should be stored;
- Standards to which cables are manufactured; and
- typical applications.

(b) Cable repair preparation and conductor splicing methods encompassing—

- criteria for determining the section of cable suitable to be joined;
- cable preparation and methods; and
- splicing methods and application for power, pilot and earthing conductors.

(c) Replacement of cable insulation encompassing—

- preparation of a power conductors prior to the application of insulation;
- types of insulation repair tapes and their application; and
- techniques for applying insulation repair tape.

(d) Techniques for joining pliable wire armour.

(e) Replacing and repairing cable sheath encompassing—

- techniques used in replacing cable sheath;
- setting up a vulcanizer to vulcanize a repair; and
- vulcanizing techniques and issues.

2.22.34 Electrical fundamentals and cables testing techniques

Evidence shall show an understanding of electrical fundamentals and testing techniques to an extent indicated by the following aspects:

(a) Nature of electrical current and charge.

(b) Sources of electricity.

(c) Effects of current.

(d) Single-source single-load circuits encompassing—

- components that make up the circuit; and
- the relationship between voltage and current.

(e) Consequences of a short-circuit and an open-circuit.

- (f) Insulation materials encompassing—
 - insulating properties; and
 - types and applications in cable technology.
- (g) Conducting materials encompassing—
 - conducting properties;
 - factor affecting resistance; and
 - types and applications in cable technology.
- (h) Semiconducting materials encompassing—
 - semiconducting properties; and
 - types and applications in cable technology.
- (i) Electrical parameters of cables and their measurement.
- (j) Care and handling of testing devices and requirement of measuring instruments to have current calibration certification.
- (k) Types of devices used for testing cables.
- (l) Testing design parameters of cables and cable assemblies encompassing—
 - causes of inaccuracies and overcoming them;
 - test device set up and safety procedures;
 - interpreting test readings; and
 - test results that show a cable complies with the Standards requirements.

NOTE: Cable tests include continuity, phase rotation, insulation resistance, high-voltage proof test, partial break test, symmetrical load test and sheath hardness tests.

2.22.35 Reeling, trailing and flexible cable plug and coupler inspection and fitting techniques

Evidence shall show an understanding of reeling, trailing and flexible cable plug and coupler inspection and fitting techniques to an extent indicated by the following aspects:

- (a) Types of plugs and couplers.
- (b) Inspection process and techniques encompassing —
 - parts of plug and couplers that are required to be inspected;
 - inspection procedures; and
 - condition of each part effecting fitness for service.
- (c) Fitting processes and techniques encompassing—
 - factors affecting the correct fitting of plug and coupler;

- cable preparation requirements and techniques; and
- conductor termination methods and techniques.

2.2.23 HV Switching

2.4 HV Switching

T2.4.3 High voltage switching principles

Evidence shall show an understanding of high voltage switching principles to an extent indicated by the following aspects:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to switching of high voltage to a given schedule
- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:
 - Types, characteristics and capabilities of electrical apparatus
 - Use, characteristics and capabilities of specialised tools and testing equipment
 - Network interconnectors source of possible backfeed
- Role of the HV switching operator
- Operational forms, access authorities and permits associated with HV switching encompassing:
- Types of operational forms, access authorities and permits
- Purpose and procedure for operational forms, access authorities and permits
- Use and operation of equipment associated with HV overhead and substation equipment encompassing:
 - Test instruments
 - Sticks
 - Interrupters
 - Arc strangles
- Types and categories of HV switchgear
- Application, function and operating capabilities of switchgear
- Restrictions pertaining to HV switching equipment
- Procedures for the isolation of HV transmission main and working earths
- Earthing HV electrical apparatus practices and procedures for access encompassing:
 - Purposes of "Operational" and additional work part "on-site" earths
 - Factors determining the location and effectiveness of "Operational" earthing

- Acceptable industry procedures
- Personal protective equipment
- High voltage switching techniques
- Operate switching apparatus encompassing:
 - Identifying hazards, assessing and controlling risks associated with HV switchgear operation
 - Systematic and defensive techniques
 - Mobile radio procedures
 - Double isolation procedures

T2.4.4 High voltage fault switching principles

Evidence shall show an understanding of high voltage fault switching principles to an extent indicated by the following aspects:

- Primary causes, effects and types of HV electrical faults
- HV protection devices encompassing:
 - Main components
 - Types
 - Categories
 - Applications
 - Functions
- Basic principle of operation of HV system protection devices
- Protection co-ordination and protection "zoning"
- HV feeder auto-reclosing suppression encompassing:
 - Function
 - Application
- Circuit condition requirements and switching considerations when paralleling and separating HV feeders

T2.4.5 High voltage distribution transformer principles

Evidence shall show an understanding of high voltage distribution transformer principles to an extent indicated by the following aspects:

- Operation of HV distribution transformers encompassing:
 - Principle governing factors for transformer ratings
 - Protection and alarms
 - Operating limitations and the relationship between transformer and HV fuse rating
 - Purpose and principle operation of HV distribution transformer tap changers

HV distribution transformer and transformer - cable combination switching practices

Paralleling requirements

Isolation and earthing procedures for access

Common distribution transformer and associated electrical apparatus faults

- HV underground switching equipment

Note:

Examples include arc strangers, switch operation, load break elbows, switching cubicles, canister fuses, bayonet fuses, F & G switching cubicles, voltage indicators and phasing testers

T2.4.6 High voltage SWER system

Evidence shall show an understanding of high voltage SWER system to an extent indicated by the following aspects:

- Application and function of SWER system components
- Circuit arrangement
- Principle of operation
- Hazards and procedures associated with faulty SWER earth systems
- Procedure to isolate, energise and commission SWER substations

T2.4.7 Feeder automation system

Evidence shall show an understanding of feeder automation system to an extent indicated by the following aspects:

- Function of feeder automation system and the main components
- Operation procedure for a remote field device from a local control station
- Functions of "System Control and Data Acquisition" (SCADA) (or any other relevant Data Acquisition and Control) systems and its main components
- SCADA system security interlocks and access restrictions
- SCADA system operation when switching apparatus or retrieving data via a remote access device such as; Remote Access Terminal (RAT), Dial Up Voice Enunciated System and Local Control Station
- Function of the main components of a local/remote control system
- Operation of a field devices using SCADA systems via a Remote Access Terminal (RAT), Dial Up Enunciated System and Local Control Station

2 Discipline A - Assembly

Discipline A – Assembly

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

2 Discipline B - Broadcast - EKAS for this discipline are yet to be classified.

Discipline B – Broadcast

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code

2 Discipline C – Commercial

Discipline C – Commercial

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

2 Discipline D - Computerised Systems - EKAS for this discipline are yet to be classified.

Discipline D – Computerised Systems

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

2 Discipline E – Cross-Discipline

Discipline E – Cross-Discipline

KS01-EE080 Multiple Path d.c. Circuit A

Evidence shall show an understanding of ethical standards and their application to an extent indicated by the following aspects:

- T1 Purpose of ethical standards.
- T2 The common tenets of ethical standards.
- T3 Ethical standards of professional bodies in the electrotechnology industry
- T4 Application of ethical standards

KS02-EE080A Development of community standards

Evidence shall show an understanding of the development of community standards to an extent indicated by the following aspects:

- T1 Purpose of standards and how they are applied
- T2 Difference between ‘standards’, ‘codes of practice’ and ‘guidelines’
- T3 Legal implications of ‘standards’, ‘codes of practice’ and ‘guidelines’
- T4 Standards development organisations and compliance systems
- T5 Standards development process and community involvement.

KS01-EE082A Electro Engineering Physics

Evidence shall show an understanding of electro engineering physics to an extent indicated by the following aspects:

- T1 Measurement encompassing
 - SI units in measurement of physical phenomena
 - Uncertainty and tolerance
- T2 Linear motion
- T3 Angular motion
- T4 Simple harmonic motion and vibration
- T5 Wave theory
 - Interference
 - Diffraction
- T6 Electromagnetic waves and propagation
- T7 Optics
 - Mirrors and lenses
 - Optical fibre
- T8 Acoustics and ultrasonics
- T9 Heat capacity and heat transfer
- T10 Fluid power
- T11

KS01-EE083A Engineering competency development

Evidence shall show an understanding of engineering competency development to an extent indicated by the following aspects:

- T1 Components of a competency development plan encompassing:
- Competencies to be achieved
 - Course work and timetable
 - Assessment scheme
 - Aspects of competency to be developed in the workplace
 - Methods of monitoring and recording relevant workplace activities.
- T2 Obligations and expectations under a competency development plan
- T3 Scope for industry/enterprise policies and procedures
- Policies and procedure related to safety, effective work outcomes, customer relations, conflict resolution and competency development.
- T4 Monitoring and reporting work activities.

KS01-EE101 Occupational Health and Safety principles

A

Evidence shall show an understanding of Occupational Health and Safety to an extent indicated by the following aspects

- T1 The basic legal requirements covering occupational health and safety in the workplace encompassing:
- underlying principles of OH&S
 - general aims and objectives of the relevant state or territory legislation relating to OH&S.
 - employer and employee responsibilities, rights and obligations.
 - major functions of safety committees and representatives.
 - powers given to Occupational Health and Safety Inspectors
 - housekeeping and potential hazards in relation to improper housekeeping
 - selecting appropriate personal protective equipment (PPE) given hazardous situations
- T2 The work environment encompassing:
- typical hazards associated with a range of work environments
 - procedures used to control the risks associated with these hazards
 - principles of risk assessment / management and state the purpose of each.
 - hierarchy of OH&S hazard control measures.
 - required documentation for risk assessment.
 - commonly used workplace safety signs.
 - workplace emergencies that pose a threat to health and safety and suitable procedure

for an emergency workplace evacuation.

- appropriate fire extinguisher for a given type of fire.
- requirements for the location, mounting and maintenance of portable fire extinguishers.
- basic process of fighting a fire.
- Importance of safe premises, buildings and security in an industrial setting and the consequences of non-compliance.
- standard work procedure.

T3 Manual Handling encompassing:

- typical manual handling injuries and the effect they can have on lifestyle
- situations that may cause manual handling injuries
- correct procedures for lifting and carrying to prevent manual handling injuries

T4 Chemicals in the workplace encompassing:

- hazardous substances and dangerous goods.
- classification of chemicals as hazardous substances and/or dangerous goods
- requirements for labelling of chemicals in the workplace
- safe storage procedures for chemicals
- purpose and interpretation of material safety data sheet (MSDS)

T5 Working at heights encompassing:

- dangers associated with working on ladders and scaffolds
- identification of work area as a height risk and use appropriate safety equipment to prevent a fall
- selecting an appropriate ladder for a given situation and perform a safety check before use
- precautions that should be taken when ascending and working off a ladder
- precautions that should be taken when working on and around a scaffold and elevated platforms.

T6 Confined spaces encompassing:

- hazards associated with working in a confined space
- identifying workplace situations that could be classified as a confined space
- control measures for working in a designated confined space

T7 Physical and psychological hazards encompassing:

- short and long term effects of excessive noise and techniques to avoid damage to hearing due to excessive noise
- effects of vibration on the human body and work practices to protect against vibration
- effects of thermal stress on the human body and work practices to protect against thermal stress
- effects of ultraviolet (UV) radiation on the human body and work practices to protect against UV radiation.

- dangers associated with laser operated equipment and tools and suitable protective measures to overcome the danger.
- occupational overuse syndrome, how it occurs and means to overcome it
- factors that cause stress in the workplace, symptoms of a person suffering from stress and personal stress management techniques
- detrimental effects and dangers of drug and alcohol use in the workplace

T8 Working safely with electricity encompassing:

- effects of electric shock on the human body
- common causes of electrical accidents
- precautions that can minimise the chance of electric shock (earthing, extra low voltage, fuses, circuit breakers and residual current devices – RCDs)
- protection offered by a residual current device (RCD)
- need for ensuring the (safe) isolation of an electrical supply
- appropriate method of removing an electric shock victim from a live electrical situation

T9 Life support - CPR in the workplace encompassing:

- First Aid.
- responsibilities of the First Aider.
- priorities of first aid management for any accident or injury.
- procedures required at an accident scene.
- legal and ethical issues, which may impact on the management of care.
- 'Duty of Care'.
- examination of a casualty for injuries.
- effect of cardio pulmonary arrest on the body.
- Managing simulated conditions of: airway obstruction; respiratory arrest and cardio pulmonary arrest,
- single and two-person cardio pulmonary resuscitation (CPR).
- signs and symptoms of an altered level of consciousness
- management of simulation of a casualty with an altered level of consciousness.
- signs and symptoms of shock.
- management of simulation of a casualty in shock

KS01-EE102A Hand and power tools and their application

Evidence shall show an understanding of hand and power tools and their application to an extent indicated by the following aspects:

T1 Mechanical drawing interpretation and sketching encompassing:

- drawing standards and conventions used in drawings of mechanical components as specified in AS1100

- basic abbreviations and symbols used in drawing of mechanical components
- interpretation of mechanical drawings commonly used in the electrotechnology industry (orthogonal projection, third angle - detail and assembly drawings, pictorial views)
- laying out a drawing of mechanical components using engineering drawing convention.
- freehand drawings of mechanical components showing all information needed for its manufacture/fabrication

T2 Workshop planning and materials encompassing:

- methods used to work safely in an industrial work environment.
- typical non-electrical hazards in the workplace
- control measures for dealing with hazards identified.
- Conducting a risk assessment on a given work environment, documenting and assessing the risks identified
- type of metallic and non-metallic materials used in the electrotechnology industry and application of the common materials
- planning process

T3 Measuring and marking out encompassing:

- reasons for measuring and marking out
- tools used for marking out
- measuring and marking out a project accurately following correct procedures.
- sustainable energy work practices related to reducing waste when marking out.

T4 Holding and cutting encompassing:

- common tools for holding (bench vices, multi-grips, vice grips, wrenches).
- common tools for cutting metallic and non-metallic material (hacksaws, wood saws, chisels, pliers, files)
- procedure for using a range of tools for cutting, shaping, and finishing metallic and non-metallic materials
- safety procedures when using holding and cutting tools

T5 Drills and drilling encompassing:

- types of drills used in the electrotechnology industry
- sharpening twist drills
- drilling metallic and non-metallic components
- safe use of a bench drill

T6 Tapping and threading encompassing:

- type and size of commonly used threads used in electrotechnology work
- taps and tap wrenches
- tapping metallic and non-metallic components
- stock and die tools

- threading metallic and non-metallic components
- T7 General Hand Tools encompassing:
- hammers used in electrotechnology work
 - screwdrivers used in electrotechnology work
 - spanners and sockets used in electrotechnology work
 - pliers used in electrotechnology work
 - assembling components applicable to electrotechnology industry using a variety of hand tools.
- T8 Joining techniques encompassing:
- types of machine screws and nuts
 - forms of welding (Oxy-acetylene, electric arc welding).
 - forms of brazing and hard soldering
 - process of soft soldering
 - joining components using machine screws
 - joining components using welding, brazing or soldering techniques
- T9 Portable electric power tools encompassing:
- portable electric power tools (grinders, drills, jigsaws, saws)
 - applications of portable electric power tools used in the electrotechnology work.
 - using portable power tools.
 - fabricating components using power tools (drills, grinders)
- T10 Sheet metal work encompassing:
- types of sheet metal materials used in the electrotechnology work.
 - names and applications of the types of fabrication materials.
 - tools used with sheet metals in electrotechnology work (hacksaw, tinsnips, guillotines, punches, notching tools, folding machines)
 - techniques used in fabricating sheet metal (cutting, bending, drilling/punching, joining, cutting mitres).
 - marking out, cutting, bending, drilling and/or cutting and/or punching holes, joining and cutting mitred joints using sheet metal.
 - sustainable energy work practices to reducing waste when fabricating using sheet metal.
 - fabricating components using sheet metal and fabrication tools.
- T11 Low tolerance measurement encompassing:
- tolerance
 - techniques in using vernier callipers
 - techniques in using micrometers.
 - using vernier callipers to measure engineering components
 - using micrometers to measuring engineering components
- T12 Dismantling and assembly techniques encompassing:

- tools used in dismantling and assembling electrotechnology equipment (spanners, screwdrivers, bearing pullers, etc).
- procedures for ensuring the safe treatment of dismantled components.
- dismantling electrical, electronic, instrumentation or refrigeration/air conditioning piece of equipment using correct procedures.
- assembling electrical, electronic, instrumentation or refrigeration/air conditioning piece of equipment using correct procedures.

KS01-EE103A**Single Path d.c. Circuits**

Evidence shall show an understanding of single path d.c. circuits to an extent indicated by the following aspects:

T1 Basic electrical concepts encompassing:

- electrotechnology industry
- static and current electricity
- production of electricity by renewable and non renewable energy sources
- transportation of electricity from the source to the load via the transmission and distribution systems
- utilisation of electricity by the various loads
- basic calculations involving quantity of electricity, velocity and speed with relationship to the generation and transportation of electricity.

T2 Basic electrical circuit encompassing:

- symbols used to represent an electrical energy source, a load, a switch and a circuit protection device in a circuit diagram
- purpose of each component in the circuit
- effects of an open-circuit, a closed-circuit and a short-circuit
- multiple and sub-multiple units

T3 Ohm's Law encompassing:

- basic d.c. single path circuit.
- voltage and currents levels in a basic d.c. single path circuit.
- effects of an open-circuit, a closed-circuit and a short-circuit on a basic d.c. single path relationship between voltage and current from measured values in a simple circuit
- determining voltage, current and resistance in a circuit given any two of these quantities
- graphical relationships of voltage, current and resistance
- relationship between voltage, current and resistance

T4 Electrical power encompassing:

- relationship between force, power, work and energy
- power dissipated in circuit from voltage, current and resistance values

- power ratings of devices
 - measurement electrical power in a d.c. circuit
 - effects of power rating of various resistors
- T5 Effects of electrical current encompassing:
- physiological effects of current and the fundamental principles (listed in AS/NZS 3000) for protection against the this effect
 - basic principles by which electric current can result in the production of heat; the production of magnetic fields; a chemical reaction
 - typical uses of the effects of current
 - mechanisms by which metals corrode
 - fundamental principles (listed in AS/NZS3000) for protection against the damaging effects of current
- T6 EMF sources energy sources and conversion electrical energy encompassing:
- basic principles of producing a emf from the interaction of a moving conductor in a magnetic field.
 - basic principles of producing an emf from the heating of one junction of a thermocouple.
 - basic principles of producing a emf by the application of sun light falling on the surface of photovoltaic cells
 - basic principles of generating a emf when a mechanical force is applied to a crystal (piezo electric effect)
 - principles of producing a electrical current from primary, secondary and fuel cells
 - input, output, efficiency or losses of electrical systems and machines
 - effect of losses in electrical wiring and machines
 - principle of conservation of energy
- T7 Resistors encompassing:
- features of fixed and variable resistor types and typical applications
 - identification of fixed and variable resistors
 - various types of fixed resistors used in the Electro technology Industry. e.g. wire-wound, carbon film, tapped resistors.
 - various types of variable resistors used in the Electro technology Industry e.g. adjustable resistors: potentiometer and rheostat; light dependent resistor (LDR); voltage dependent resistor (VDR) and temperature dependent resistor (NTC, PTC).
 - characteristics of temperature, voltage and light dependent resistors and typical applications of each
 - power ratings of a resistor.
 - power loss (heat) occurring in a conductor.
 - resistance of a colour coded resistor from colour code tables and confirm the value by measurement.
 - measurement of resistance of a range of variable' resistors under varying conditions of light, voltage, temperature conditions.

- specifying a resistor for a particular application.
- T8 Series circuits encompassing:
- circuit diagram of a single-source d.c. 'series' circuit.
 - Identification of the major components of a 'series' circuit: power supply; loads; connecting leads and switch
 - applications where 'series' circuits are used in the Electro technology industry.
 - characteristics of a 'series' circuit - connection of loads, current path, voltage drops, power dissipation and affects of an open circuit in a 'series' circuit.
 - the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities
 - relationship between voltage drops and resistance in a simple voltage divider network.
 - setting up and connecting a single-source series dc circuit
 - measurement of resistance, voltage and current values in a single source series circuit
 - effect of an open-circuit on a series connected circuit

KS01-EE104A Direct current circuits

Evidence shall show an understanding of electrical fundamentals and direct current multiple path circuits to an extent indicated by the following aspects:

- T1 Basic electrical concepts encompassing:
- electrotechnology industry
 - static and current electricity
 - production of electricity by renewable and non renewable energy sources
 - transmission of electricity from the source to the load
 - utilisation of electricity by the various loads
- T2 Basic electrical circuit encompassing:
- symbols used to represent an electrical energy source, a load, a switch and a circuit protection device in a circuit diagram
 - purpose of each component in the circuit
 - effects of an open-circuit, a closed-circuit and a short-circuit
 - multiple and sub-multiple units
- T3 Ohm's Law encompassing:
- basic d.c. single path circuit.
 - relationship between voltage, currents and resistance
 - effects of an open-circuit, a closed-circuit and a short-circuit on a basic d.c. single path
 - determining voltage, current and resistance in a circuit
- T4 Electrical power encompassing:
- relationship between force, power, work and energy

- power dissipated in circuit from voltage, current and resistance values
 - power ratings of devices
 - measurement of electrical power in a d.c. circuit
 - effects of power rating of various resistors
- T5 Effects of electrical current encompassing:
- physiological effects of current
 - basic principles by which electric current can result in the production of heat; the production of magnetic fields; a chemical reaction
 - typical uses of the effects of current
 - mechanisms by which metals corrode
 - fundamental principles for protection against the damaging effects of current as required by standards
- T6 EMF Sources energy sources and conversion electrical energy encompassing:
- basic principles of producing a emf by electromagnetic induction, thermocouple effect, photoelectric effect and Piezo effect.
 - principles of producing a electrical current from primary, secondary and fuel cells
 - input, output, efficiency or losses of electrical systems and machines
 - effect of losses in electrical wiring and machines
 - principle of conservation of energy
- T7 Resistors encompassing:
- features of fixed and variable resistor types and typical applications.
 - characteristics of temperature, voltage and light dependent resistors and typical applications of each.
 - meaning of the terms - Positive Temperature Coefficient (PTC) and Negative Temperature Coefficient (NTC)
 - specifying a resistor for a particular application.
 - resistance of a colour coded resistor from colour code table and confirm the value by measurement.
- T8 Series circuits encompassing:
- schematic diagram of a single-source d.c. ‘series’ circuit.
 - major components of a ‘series’ circuit (power supply, loads, connecting leads and switch)
 - applications where ‘series’ circuits are used in the Electrotechnology industry.
 - characteristics of a ‘series’ circuit. (load connection, current paths, voltage drops, power dissipation, affects of an open and short circuit in a ‘series’ circuit).
 - setting up and connecting a single-source series dc circuits.
 - measurement of resistance, voltage and current values in a single source series circuit.
 - calculation of voltage, current, resistances or power dissipated from measured or given values given any two of these quantities.
 - relationship between the voltage drops around a circuit and the applied voltage.

- relationship between voltage drops and resistance in a simple voltage divider network.
- output voltage and current levels of connecting cells in series.

T9 Parallel circuits encompassing:

- schematic diagram of a single-source d.c. 'parallel' circuit.
- major components of a 'parallel' circuit (power supply, loads, connecting leads and switch)
- applications where 'parallel' circuits are used in the Electrotechnology industry.
- characteristics of a 'parallel' circuit. (load connection, current paths, voltage drops, power dissipation, affects of an open circuit in a 'parallel' circuit).
- relationship between currents entering a junction and currents leaving a junction
- relationship between branch currents and resistances in a two branch current divider network.
- calculation of the total resistance of a 'parallel' circuit.
- calculation of the total current of a 'parallel' circuit.
- Calculation of the total voltage and the individual voltage drops of a 'parallel' circuit.
- setting up and connecting a single-source d.c. parallel circuit
- resistance, voltage and current measurements in a single-source parallel circuit
- voltage, current, resistance or power dissipated from measured values of any of these quantities
- output current and voltage levels of connecting cells in parallel.

T10 Series/parallel circuits encompassing:

- schematic diagram of a single-source d.c. 'series/parallel' circuit.
- major components of a 'series/parallel' circuit (power supply, loads, connecting leads and switch)
- applications where 'series/parallel' circuits are used in the Electrotechnology industry.
- characteristics of a 'series/parallel' circuit. (load connection, current paths, voltage drops, power dissipation, affects of an open circuit in a 'series/parallel' circuit).
- relationship between voltages, currents and resistances in a bridge network.
- calculation of the total resistance of a 'series/parallel' circuit.
- calculation of the total current of a 'series/parallel' circuit.
- calculation of the total voltage and the individual voltage drops of a 'series/parallel' circuit.
- setting up and connecting a single-source d.c. series/ parallel circuit
- resistance, voltage and current measurements in a single-source d.c. series / parallel circuit
- the voltage, current, resistances or power dissipated from measured values of any two of these quantities

T11 Factors affecting resistance encompassing:

- four factors that affect the resistance of a conductor (type of material, length, cross-sectional area and temperature)

- affect the change in the *type of material* (resistivity) has on the resistance of a conductor.
- affect the change in '*length*' has on the resistance of a conductor.
- affect the change in 'cross-sectional area' has on the resistance of a conductor.
- effects of temperature change on the resistance of various conducting materials
- effects of resistance on the current-carrying capacity and voltage drop in cables.
- calculation of the resistance of a conductor from factors such as conductor length, cross-sectional area, resistivity and changes in temperature
- using digital and analogue ohmmeter to measure the change in resistance of different types of conductive materials (copper, aluminium, nichrome, tungsten) when those materials undergo a change in type of material length, cross-sectional area and temperature.

T12 Effects of meters in a circuit encompassing:

- selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application.
- measuring resistance using direct, volt-ammeter and bridge methods.
- instruments used in the field to measure voltage, current, resistance and insulation resistance and the typical circumstances in which they are used.
- hazards involved in using electrical instruments and the safety control measures that should be taken.
- operating characteristics of analogue and digital meters.
- correct techniques to read the scale of an analogue meters and how to reduce the 'parallax' error.
- types of voltmeters used in the Electrotechnology industry – bench type, clamp meter, Multimeter, etc.
- purpose and characteristics (internal resistance, range, loading effect and accuracy) of a voltmeter.
- types of voltage indicator testers. e.g. LED, neon, solenoid, volt-stick, series tester, etc. and explain the purpose of each voltage indicator tester.
- operation of various voltage indicator testers.
- advantages and disadvantages of each voltage indicator tester.
- various types of ammeters used in the Electrotechnology industry – bench, clamp meter, multimeter, etc.
- purpose of an ammeter and the correct connection (series) of an ammeter into a circuit.
- reasons why the internal resistance of an ammeter must be extremely low and the dangers and consequences of connecting an ammeter in parallel and/or wrong polarity.
- selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application
- connecting an analogue/digital voltmeter into a circuit ensuring the polarities are correct and take various voltage readings.
- loading effect of various voltmeters when measuring voltage across various loads.
- using voltage indicator testers to detect the presence of various voltage levels.

- connecting analogue/digital ammeter into a circuit ensuring the polarities are correct and take various current readings.

T13 Resistance measurement encompassing:

- Identification of instruments used in the field to measure resistance (including insulation resistance) and the typical circumstances in which they are used.
- the purpose of an Insulation Resistance (IR) Tester.
- the parts and functions of various analogue and digital IR Tester (selector range switch, zero ohms adjustment, battery check function, scale and connecting leads).
- reasons why the supply must be isolated prior to using the IR tester.
- where and why the continuity test would be used in an electrical installation.
- where and why the insulation resistance test would be used in an electrical installation.
- the voltage ranges of an IR tester and where each range may be used. e.g. 250 V d.c, 500 V d.c and 1000 V d.c
- AS/NZS3000 Wiring Rules requirements – continuity test and insulation resistance (IR) test.
- purpose of regular IR tester calibration.
- the correct methods of storing the IR tester after use
- carry out a calibration check on a IR Tester
- measurement of low values of resistance using an IR tester continuity functions.
- measurement of high values of resistance using an IR tester insulation resistance function.
- volt-ammeter (short shunt and long shunt) methods of measuring resistance.
- calculation of resistance values using voltmeter and ammeter reading (long and short shunt connections)
- measurement of resistance using volt-ammeter methods

T14 Capacitors and Capacitance encompassing:

- basic construction of standard capacitor, highlighting the: plates, dielectric and connecting leads
- different types of dielectric material and each dielectric's relative permittivity.
- identification of various types of capacitors commonly used in the Electrotechnology industry (*fixed value capacitors* -stacked plate, rolled, electrolytic, ceramic, mica and *Variable value capacitors* – tuning and trimmer)
- circuit symbol of various types of capacitors: standard; variable, trimmer and polarised
- terms: Capacitance (C), Electric charge (Q) and Energy (W)
- unit of: Capacitance (Farad), Electric charge (Coulomb) and Energy (Joule)
- factors affecting capacitance (the effective area of the plates, the distance between the plates and the type of dielectric) and explain how these factors are present in all circuits to some extent.
- how a capacitor is charged in a d.c. circuit.
- behaviour of a series d.c. circuit containing resistance and capacitance components. - charge and discharge curves

- the term '*Time Constant*' and its relationship to the charging and discharging of a capacitor.
- calculation of quantities from given information: Capacitance ($Q = VC$); Energy ($W = \frac{1}{2}CV^2$); Voltage ($V = Q/C$)
- calculation one time constant as well as the time taken to fully charge and discharge a given capacitor. ($\tau = RC$)
- connection of a series d.c. circuit containing capacitance and resistor to determine the time constant of the circuit

T15 Capacitors in Series and Parallel encompassing:

- hazards involved in working with capacitance effects and the safety control measures that should be taken.
- safe handling and the correct methods of discharging various size capacitors
- dangers of a charged capacitor and the consequences of discharging a capacitor through a person
- factors which determine the capacitance of a capacitor and explain how these factors are present in all circuits to some extent.
- effects of capacitors connected in parallel by calculating their equivalent capacitance.
- effects on the total capacitance of capacitors connected in series by calculating their equivalent capacitance.
- Connecting capacitors in series and/or parallel configurations to achieve various capacitance values.
- common faults in capacitors.
- testing of capacitors to determine serviceability.
- application of capacitors in the Electrotechnology industry.

KS01-EE105 Fixing and support devices/techniques

A

Evidence shall show an understanding of accessories and support and fixing device and methods and their use to an extent indicated by the following aspects:

T1 Device for securing and mounting electrical/electronic/instrumentation/refrigeration/air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories to hollow walls encompassing:

- types and safe application of devices for hollow wall fixing and support
- methods/techniques used to fix/support to wood, hollow wall, masonry blocks, plasterboard, panelling
- types and safe application of fixing devices used in the electrotechnology industry for wood and hollow wall structures (wood screws, coach bolts, self-tappers, self drilling,

metal thread, hollow wall anchors, behind plaster brackets, stud brackets, plasterboard devices, toggle devices)

- types of tools used for hollow wall fixing and supporting.
- using various fixing methods to fix/support to hollow walls.

T2 Device for securing and mounting electrical/electronic/instrumentation/refrigeration/air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories to solid walls encompassing:

- types and safe application of devices used for solid wall fixing and support
- methods/techniques used in to fix to masonry and concrete structures
- fixing devices used in the electrotechnology industry for solid wall structures (wall-plugs, expanding concrete fixing devices, gas powered fixing tools, powder actuated fixing tools, loxins, dynabolts, chemical devices)
- regulatory requirements for use of powder fixing tools.
- hand and power tools used in fixing and supporting accessories
- using various fixing methods to fix/support to solid walls

T3 Device for securing and mounting electrical/electronic/instrumentation/refrigeration/air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories to metal fixing encompassing:

- accessories that may be fixed to metal (saddle clips, conduits, brackets, switches)
- techniques for fixing to metal
- fixing devices: coach bolts, self-tappers, metal thread bolts, hollow wall anchors, rivets
- fixing tools - spanners, screwdrivers, power screw drivers, pop riveters, files, reamers
- OH&S issues related to drilling, cutting, eye protection, metal filings, swarf, noise
- Using power drills, drill bits, change drill speeds.
- Install a fixing device and accessory capable of supporting up to 20 kg on the metal plate.

T4 Securing and mounting electrical/electronic/instrumentation/refrigeration/air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories using fixing adhesives and tapes encompassing:

- types and safe application of using adhesives and tapes as fixing devices (load limits of different commercial products)
- accessories that may be fixed using adhesives and tapes
- techniques for the application of adhesives and tapes
- tools used to apply and cut adhesives and tapes
- hazards and safety measures when working with adhesives and chemical fixing devices (fumes, cutting, eye protection, physical contact, hand protection, ingestion)

KS01-EE107 Drawings, diagrams and schedules

A

Evidence shall show an understanding of drawings, diagrams and schedules used in electrotechnology work to an extent indicated by the following aspects:

T1 Architectural drawings encompassing:

- site plans, floor plans detailed drawings and standard drawings
- architectural floor plan to determine the power and lighting or communications / audio/ video layouts required in a domestic installation
- site plan to locate the service point, consumers mains, communication services, main switchboard, distribution boards and/or builders supplies.
- standard drawing scales to determine the actual lengths represented by dimensions on an architectural drawing.
- reading and interpretation of floor plans to determine the location of the electrical/ communication/audio accessories and appliances.
- Australian standard symbols used on floor plans to show the location of the accessories and appliances as detailed in an electrical schedule.

T2 Electrical drawings encompassing:

- types of electrical drawings: block, circuit, wiring and ladder diagrams
- purpose and application of block, circuit, wiring diagrams and ladder diagrams
- Australian standard symbols used to represent components on electrical diagrams.
- conventions used in and the features of circuit diagrams
- converting a circuit diagram to a wiring diagram
- identification of cable type, origin and route from a cable schedule.
- developing a cable schedule for a given installation.

T3 Circuit diagrams encompassing:

- purpose of circuit diagrams in the electrotechnology industry
- conventions used in and the features of circuit diagrams
- sketching basic circuit diagrams
- common symbols used in circuit diagram (Australian Drawing Standard AS/NZS 1102)
- developing switching charts to identify the terminals of various types of switches
- connecting equipment using circuit diagrams.

T4 Wiring diagrams encompassing:

- purpose of wiring diagrams in the electrotechnology industry
- conventions used in and the features of wiring diagrams
- sketching basic wiring diagrams
- common symbols used in wiring diagram (Australian Drawing Standard AS/NZS 1102)
- connecting equipment using wiring diagrams.

T5 Building construction drawings and diagrams encompassing:

- building types: timber frame, brick veneer, double brick and metal frame.
- identification of different types of: footings, floors, external walls, roofs, interior walls
- typical cable routes through buildings, structures and premises
- sequence of each constructional stage for brick, brick veneer and timber cottages
- identification of the stages at which the electrical/communications - first and second fixing occurs in the constructional sequence
- areas of cooperation between electrical/communications and other building trades

KS02-EE107 Introduction to regulations, compliance standards and codes

A

Evidence shall show an understanding of regulations, compliance standards and codes that apply to electrical work to an extent indicated by the following aspects:

T1 Regulation for undertaking electrical work encompassing:

- scope of work covered by licensing in the electrotechnology industry (Electrical licensing)
- legislative requirements for ensuring electrical or electronic equipment is safe i.e. compliance requirements of electrical installations

T2 Standards philosophy and format

- performance verses prescriptive requirements
- purpose of technical standards and their development
- role of standards Australia/New Zealand, International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC)
- how standards use in compulsory and accreditation compliance schemes.
- arrangement and use of technical standards in relation to electrical and electronic work
- how to read and apply a standards.
- Standards and codes that apply to all types of electrical installations
 - Standards include Standards mandated under regulation (e.g. Wiring Rules) or by an authority, deemed-to-comply standard and local service requirements (e.g. Service rules).
 - Codes include those applicable to electrical safe working practices and some aspects of the Building Code of Australia.

T3 Purpose, format and content of typical job specifications

- NATSPEC specification system provide the most common templates on which job specification are written.

KS01-EE125 Circuit analysis

A

Evidence shall show an understanding of circuit analysis to an extent indicated by the following aspects:

- T1 Voltage/Current Sources and Kirchhoff's Law for d.c. Linear Circuits encompassing:
- calculating the effect of the internal resistance on terminal voltage and current delivered for practical voltage sources and current sources
 - calculating current and voltage in any d.c. network of up to two loops and three sources.
 - Kirchhoff's Law using a circuit simulation program.
 - function and operation of an electronics circuit simulation program.
 - using electronics circuit simulation program.
- T2 Superposition Principles for d.c. Linear Circuits encompassing:
- d.c. networks (two loops, three sources)
 - using simulation programs
 - calculating current and voltage in any d.c. network of up to two loops and three sources.
 - Superposition theorem using a circuit simulation program.
- T3 Mesh and Nodal Analysis for d.c. Linear Circuits encompassing:
- writing mesh equations for d.c. networks containing up to three loops.
 - writing Nodal equations for d.c. networks containing up to three nodes.
 - using mesh analysis to find currents in d.c. networks of up to two loops.
 - using nodal analysis to find node voltage and branch currents in d.c. networks of up to two nodes
 - using a circuit simulation program to confirm the results of Mesh analysis or Nodal analysis of d.c. networks.
- T4 Thévenin's principles for d.c. Linear Circuits encompassing:
- calculating the effect of the internal resistance on terminal voltage and current delivered for practical voltage sources and current sources.
 - calculating the Thévenin equivalent voltage and resistance for d.c. networks and determining the load current, voltage and power.
 - converting the Thévenin equivalent circuit to a Norton equivalent circuit and vice versa.
 - verifying the equivalence of Thévenin equivalent circuits by measurement.
- T5 Norton's principles for d.c. linear circuits encompassing:
- calculating the effect of the internal resistance on terminal voltage and current delivered for practical voltage sources and current sources.
 - calculating the Norton equivalent current and resistance for d.c. networks and determining the load current, voltage and power.

- converting the Thévenin equivalent circuit to a Norton equivalent circuit and vice versa.
- verifying the equivalence of Norton equivalent circuits by measurement.

T6 Phasors encompassing:

- time domain and frequency domain
- frequency, angular frequency and units of measurement
- defining rms and convert between time domain and rms phasor values for a sine wave.
- converting between angular frequency and frequency.
- using a calculator to convert between polar and rectangular forms of phasor.
- representing a.c. voltages on a phasor diagram.

T7 Complex Impedance encompassing:

- defining impedance, resistance and reactance.
- defining admittance, conductance and susceptance.
- converting between conductance to resistance.
- converting between susceptance and reactance.
- converting between impedance and admittance.
- sketching impedance and admittance diagrams.
- calculating two-component series equivalent circuits and two-component parallel equivalent circuits and convert between these forms.

T8 Series and parallel a.c. linear circuits encompassing:

- Kirchhoff's Laws
- series equivalent impedance
- parallel equivalent impedance
- voltage divider and current divider rules
- calculating and measuring voltage and currents in a series a.c. circuit and draw the phasor diagram.
- calculating and measuring currents in a parallel a.c. circuit and draw the phasor diagram.
- calculating and measuring voltage and currents in a series/parallel a.c. circuit and draw the phasor diagram.

T9 Superposition principles and Kirchhoff's Laws applied to a.c. linear circuits encompassing:

- calculating current and voltage in any a.c. network of up to two loops and two sources.
- using circuit simulation programs to demonstrate the superposition theorem.
- function and operation of an electronics circuit simulation program.
- entering given circuit specifications into an electronic circuit program.
- setting the circuit simulation program operation parameters including input and output values, ranges and graduation.
- producing hardcopies of the circuit and analyse results.

T10 Mesh and Nodal analysis for a.c. linear circuits encompassing:

- Mesh analysis
- Node voltages and nodal analysis
- matrix representation
- method of determinants
- writing mesh equations for a.c. networks containing up to three loops.
- writing nodal equations for a.c. networks containing up to three nodes.
- using mesh analysis to find currents in a.c. networks of up to two loops.
- using nodal analysis to find node voltage and branch currents in a.c. networks of up to two nodes.
- using a circuit simulation program to confirm the results of mesh analysis or nodal analysis of a.c. networks.

T11 Thévenin and Norton theorems applied to a.c. linear circuits encompassing:

- calculating the effect of the internal resistance on terminal voltage and current delivered for practical voltage sources and current sources.
- calculating the Thévenin equivalent voltage and impedance for a.c. networks and determining the load current, voltage and power.
- calculating the Norton equivalent current and impedance for a.c. networks and determining the load current, voltage and power.
- converting the Thévenin equivalent circuit to a Norton equivalent circuit and vice versa.
- verifying the equivalence of Thévenin and Norton equivalent circuits by measurement.

T12 Star-delta conversions encompassing:

- Star connections
- Star-delta transformation formula equations
- selection of appropriate conversion
- calculating the delta connected equivalent of a star connected balanced a.c. or d.c. load and vice versa.
- converting a complex non-series/parallel network to a series/parallel network by means of star-delta or delta-star conversions.
- verifying star-delta and delta-star network conversions by measurements.
- T13 Complex a.c. power and maximum power transfer theorem encompassing:
 - true power, reactive power and apparent power
 - maximum power transfer
 - calculating real, reactive and apparent power for series/parallel a.c. circuits and state the appropriate units of measurement.
 - calculating the power factor of a.c. series/parallel circuits.
 - drawing power triangle for a given circuit.
 - calculating the load value which would consume maximum power and calculate this power for d.c. networks.

- calculating the load value which would consume maximum power in an a.c. network when the load is a pure resistance and calculate the power.
- calculating the load value which would consume maximum power in an a.c. network when the load is an impedance of variable resistance and reactance and calculate the power.
- verifying load selection by measurement.

T14 Transients encompassing:

- transients in R-C and R-L circuits
- growth and decay
- calculating voltage and currents in R-C series circuits using exponential equations.
- calculating voltage and currents in R-L series circuits using exponential equations.

KS01-EE126 Electrotechnology engineering maths

A

Evidence shall show an understanding of electrotechnology engineering maths to an extent indicated by the following aspects:

T1 Rational, irrational numbers and basic algebra

- simplification of expressions involving square roots and cube roots
- scientific and engineering notation
- evaluation of expressions using a calculator
- convert units of physical quantities using unity brackets
- substitute given values into formulae to find physical quantities
- manipulate algebraic expressions using mathematical operations in their correct order, the laws of indices, expansion of brackets and collecting like terms

T2 Algebraic manipulation

- Factorise algebraic expressions using common factors
- Factorise quadratic expressions using trial and error on the factors of the coefficients
- Simplify algebraic fractions using common denominators and cancelling
- Solve simple one variable equations including algebraic fractions
- Find the quotient and remainder given a linear divisor.
- Transpose formulae to find a required variable.

T3 Laws of indices

- Conversion between decimal notation, scientific notation and engineering notation

- Laws of indices: positive /negative values, multiplication/division, fractional values, index equals zero
- Logarithmic laws: multiply/divide
- solution of exponential equations using logarithms, substitution and solution of relevant formulae involving exponents or logarithms
- Graphs of exponential functions, 10^x and e^x and the inverses $\log_{10}(x)$ and $\log_e(x)$ functions on log-linear graphs
- Convert numbers into scientific and engineering notation using the laws of indices
- Manipulate and simplify arithmetic and algebraic expressions using the laws of indices and logarithms
- Express logarithms as indices.
- Perform logarithmic operations.
- Determine logarithms and antilogarithms to base 10, using a scientific calculator.
- Determine logarithms and antilogarithms to base e, using a scientific calculator.
- Convert logarithmic values from base 10 to base e and vice versa.
- Sketch given functions on log-linear graphs

T4 Estimations, errors and approximations

- Errors in measurement
- Maximum probable error
- Show awareness of errors in measurement and of giving results in appropriate number of significant figures
- Use estimations and approximations to check the reasonableness of results.

T5 Plane figures – triangles and basic trigonometry

- Angles in a triangle
- Isosceles and equilateral triangles
- Congruent triangles
- Similar triangles
- Pythagoras' theorem
- Area of triangles
- Basic trigonometry functions
- Degrees, radians
- The ratios: sin, cos, tan, cosec, sec, cot.
- Inverse trig functions
- Sine and cosine rules

T6 Plane figures - quadrilaterals and circles

- Types and properties of quadrilaterals

- Areas and perimeters of regular quadrilaterals
- Lengths of arcs
- Angles in a circle - degrees
- Angles in a circle - radians
- Lengths of chord segments
- Tangents to circles
- Circumference and area of circles
- Names and characteristics of common polygons

T7 Graphs of Trigonometric functions

- Graph trigonometric functions and solve trigonometric equations.
- Simplify trigonometric expressions using trigonometric identities
- Convert angular measure in degrees to radians and vice versa
- Graph trigonometric functions including graphs of $y = \sin x$ and $y = \cos x$
- Using vocational applications of current or voltage as a function of time, consider changes in amplitude, consider changes in frequency.
- Examine relationships of frequency, period and angular velocity.
- Sketch graphs of the form $f(t) = a \sin \phi t$ and $f(t) = a \cos \phi t$, where a is the peak voltage or current, and ϕ is the angular velocity
- Solve graphically equations of the form $f(t) = a \sin \phi t$ and $f(t) = a \cos \phi t$
- Show a positive or negative angle on the unit circle.
- Use symmetry properties to find trigonometric ratios for angles greater than $\pi/2$.
- Solve simple vocational problems relating period, frequency and angular velocity.

T8 Graphs of linear functions

- The number plane
- Gradient and x and y intercepts of a straight line
- Equation of a straight line length and mid-point of a straight line segment
- Function notation

T9 Simultaneous equations

- Graphical solutions
- Substitution
- Elimination
- Solve 2 linear simultaneous equations both algebraically and graphically.

T10 Matrices

- Perform the basic operations on matrices up to 3×3
- Manipulate matrix equations and expressions

- Recognise inverse and identity matrices up to 3×3 and use to solve systems of linear equations.
- Find determinants up to 3×3 and use to solve systems of linear equations.
- Solve problems involving more than two simultaneous equations.
- State the limitations of graphical methods of solution.
- Distinguish between a matrix and an array.
- Describe the null, diagonal and unit matrix
- Describe and identify a singular/non-singular matrix

T11 Quadratic functions

- Graphs of quadratic functions represented by parabolas and the significance of the leading coefficient.
- Graph quadratic functions and solve quadratic equations.
- Sketch and interpret the graphs of quadratic functions showing the significance of the leading coefficient and the zeros
- Solve quadratic equations by factoring or using quadratic formula
- Solve simultaneously linear and quadratic equations algebraically and geometrically
- Interpret verbally formulated problems involving quadratic and linear equations and solve.

T12 Exponential and logarithmic functions

- Transform non-linear functions (including exponential) to linear forms and plot data.
- Draw curves of best fit, interpolate data and estimate constants in suggested relationships.
- Interpret verbally formulated problems involving growth and decay, and solve.
- Graph exponential and logarithmic functions and solve exponential and logarithmic equations.
- Sketch the graphs of simple exponential and logarithmic functions showing behaviour for large and small values

T13 Vectors and Phasors

- The vector as an expression of magnitude and direction
- The vector sum of x and y values in terms of magnitude and direction
- Rectangular components of vectors in the form $x = r \cos \theta$ and $y = r \sin \theta$
- Rectangular-polar and polar-rectangular conversion
- Vector addition and subtraction
- Express rectangular components of vectors in the form $x = r \cos \theta$ and $y = r \sin \theta$

T14 Complex numbers

- Definitions and notation of complex numbers
- Complex numbers as vectors on an Argand diagram
- laws of complex numbers and apply the laws in suitable calculations.
- Plot complex numbers on the Argand plane.
- Express vectors as complex numbers and perform suitable calculations.
- Calculate the conjugate of a complex number.
- Using a calculator for rectangular-polar and polar-rectangular conversions.
-

KS01-EE137 Risks and control measures for dealing with workplace hazards A

Evidence shall show an understanding of risks and control measures for dealing with workplace hazards to an extent indicated by the following aspects:

T1 Risk management and assessment of risk encompassing:

- Principle and purpose of risk management, and
- Processes for conducting a risk assessment
- Hazard identification by job analysis and work-site inspections
- Recording hazards and assessing the risk.

T2 Hazards and risks and control measures in working on construction sites.

Hazards include manual and mechanical handling; working at heights; working in confined spaces; noise; dusts, gases, chemicals.

T3 Hazards associated with extra-low voltage, low-voltage and high-currents encompassing:

- Arrangement of power distribution and circuits in an electrical installations
- Parts of an electrical system and equipment that operate at low-voltage and extra-low voltage,
- Parts of an electrical system and equipment where high-currents are likely.

T4 Hazards and risks and control measures associated with high-voltage encompassing:

- Parts of an electrical system and equipment that operate at high-voltage,
- The terms ‘touch voltage’, ‘step voltage’, ‘induced voltage’ and ‘creepage’ as they relate to the hazards of high-voltage
- Control measures used for dealing with the hazards of high-voltage.

T5 Hazards and risks and control measures in working with low voltage equipment encompassing:

- Risks in modifying electrical installations, fault finding, maintenance and repair.
- Control measures before, while and after working on electrical installations, circuits or equipment.
- Isolation and tagging-off procedures.

- Risks and restrictions in working live.
 - Control measures for working live.
- T6 Hazards and risks and control measures associated with harmful, devices, materials, gases, dusts and airborne contaminant encompassing:
- Harmful devices; gas touches, welding equipment, laser equipped devices and the like.
 - Harmful materials; gases (refrigerants) and some industrial cleaning agents, fibres of optical cable, thermal insulation
 - Harmful air borne contaminants are; fibres of thermal insulation, fibres of optical cable, fibrous cement materials, asbestos and other fibres in insulation materials.
- T7 Determine the degree of the risk encompassing:
- The three recognised levels of risk are:
 - High (potential to kill or permanent disability);
 - Medium (potential to cause an injury or illness of a permanent nature);
 - Low (potential to cause a cause minor injury requiring first aid but no permanent disability)
- T8 Use control measures to eliminate or control the risk encompassing:
- Hierarchy of control measures are:.
 - eliminate the risk by discontinuing the activity.
 - control the risk by redesigning the equipment
 - adopt administrative procedures
 - use of personal protective equipment.
 - Control measures are formally documented in Job Safety Analysis (JSAs) or Safe Work Methods (SWMs).
- T9 Engaging in monitoring and reviewing processes to ensure control measures remain valid.

2 Discipline F - Data and Voice

Discipline F – Data and Voice

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

2 Discipline G – Electrical

Discipline G – Electrical

KS01-EG006 Single and three-phase transformers

A

Evidence shall show an understanding of single and three phase transformers to an extent indicated by the following aspects:

T1 Transformer construction encompassing:

- types of lamination style and core construction used in single-phase, three-phase, double wound, auto transformers and instrument transformers.
- identification of different winding styles/types used in transformers.
- methods used to insulate low and high voltage transformers.
- construction of transformer tanks for distribution transformers.
- transformer auxiliary equipment. (Bushings, surge-diverters, tap-changers, hot oil & winding indicators, breather, Buchholz relay and conservator).
- function of transformer auxiliary equipment.
- types of information stated on transformer nameplates.
- application of transformers.
- performing basic insulation resistance, continuity and winding identification tests.

T2 Transformer operation encompassing:

- principles of mutual induction of a transformer.
- factors that determines the induced voltage in a transformer winding.
- determining the value of a transformers secondary voltage and current given one winding's electrical details and turns ratio.
- identification of voltage and current components of a phasor diagram for a transformer on no-load.
- principles of power transferred from the primary to secondary when a load is connected using a phasor diagram neglecting impedance drops.
- selecting transformers for specific application/s.
- safety features specified in AS/NZS3000 with respect to transformers and isolating transformers.

T3 Transformer losses, efficiency and cooling encompassing:

- power losses which occur in a transformer.
- tests which allow the power losses of a transformer to be determine.
- determine transformer losses and efficiency using test results.
- relationship between transformer cooling and rating.

- methods used for natural and forced cooling of transformers.
- properties of transformer oil.
- tests conducted on transformer oil.

T4 Transformer voltage regulation and percent impedance encompassing:

- voltage regulation as applicable to a transformer.
- reasons for voltage variation in the output of a transformer.
- determine the voltage regulation of a transformer from voltage and percentage impedance values.
- percentage impedance as applied to transformers.
- determine the percent impedance by using test results.
- determine percent impedance of a transformer by calculation.

T5 Parallel operation of transformers and transformer auxiliary equipment encompassing:

- determine polarity markings for an unidentified single phase double wound transformer.
- need for parallel operation of transformers.
- conditions/restrictions required before two transformers can be connected in parallel.
- connecting transformers in parallel to supply a single load (loading on transformers operating in parallel).
- the consequences/effect of an incorrect connection.

T6 Auto-transformers and instrument transformers encompassing:

- identification of auto-transformers, voltage transformers and current transformers from their winding diagrams.
- determining voltage and current in the windings of an auto-transformer by calculation.
- advantages and disadvantages of an auto-transformer.
- AS/NZS3000 requirements with respect to transformers.
- construction of voltage transformers.
- ratings of voltage transformers.
- construction of current transformers.
- ratings of current transformers.
- precautionary measures taken to connect and disconnect instrument transformers.
- connection diagrams for instrument transformers.
- applications for auto-transformers and instrument transformers.

KS02-EG006 Alternating current rotating machines**A**

Evidence shall show an understanding of alternating current rotating machines to an extent indicated by the following aspects:

- T1 Operating Principles of three phase induction motors encompassing:
- determining circuit operating characteristics by using the right hand (grip) rule for conductors and solenoids and Fleming's left and right hand rules.
 - characteristics of the magnetic field produced by a single, two and three-phase windings.
 - speed of rotation of a rotating magnetic field.
 - relationship between the rotor speed, slip and rotor frequency.
 - basic principle of operation of an induction motor.
 - reversing the direction of rotation of a three phase induction motor
- T2 Three phase induction motor construction encompassing:
- basic component parts of a three-phase induction motor.
 - types of rotors used in three-phase induction motors.
 - connecting three-phase induction motor in both star and delta.
 - dismantling three-phase induction motors.
 - testing insulation resistance of a three-phase induction motor prior to connection to the supply.
 - testing winding resistance (ohmic value and continuity) of a three-phase induction motor prior to connection to the supply
- T3 Three phase induction motor characteristics encompassing:
- relationship between torque, speed, and power and interpretation of speed/torque curves of induction motors.
 - squirrel cage motors operating characteristics conditions necessary for an induction motor to produce maximum torque.
 - operating characteristics of an induction motor from name plate information and by measurement.
 - induction motors efficiency and minimum energy performance standards (MEPS).
 - full load efficiency and power factor of induction motors.
- T4 Single phase motors – split phase encompassing:
- common types of single phase motor.
 - principles of operation of a split phase induction motor.
 - construction and basic characteristics of a split phase induction motor.

- applications of split phase induction motors.
 - connecting, running and reversing a split phase induction motor.
- T5 Single phase motors – capacitor and shaded pole types encompassing:
- identification of single phase induction motors including capacitor start, capacitor start/capacitor run, permanent split capacitor (PSC) and shaded pole
 - principles of operation of each motor type listed above.
 - operating characteristics and typical applications of each motor type listed above.
 - connection and running each type of motor listed.
 - reversing the direction of rotation of each of the capacitor type motors.
- T6 Single phase motors – universal encompassing:
- principles of operation of a series universal motor.
 - identification and functions of each of the basic parts of a series universal motor.
 - operating characteristics and typical uses for a series universal motor.
 - connecting, running and reversing a series universal motor.
- T7 Motor protection encompassing:
- reasons why motor protection is required.
 - requirements of the AS/NZS3000 Wiring rules with regards to motor protection.
 - types of motor overload protection.
 - operating principles of microtherm devices, thermal and magnetic motor protection devices.
 - electrical features of motor protection HRC fuses.
 - effects of under voltage and over voltage on motors and motor circuits.
 - effects of repetitive starting and/or reversing on motors.
 - special requirements for motor protection, in high humidity or moist environments, high temperature areas and corrosive atmospheres.
 - operating principles of phase failure protection.
 - selecting suitable protective devices for a given motor and starter combination.
- T8 Three phase synchronous machines- operation principles and construction encompassing:
- power transfer diagram of an a.c. synchronous machine.
 - need for the generation of a sinusoidal waveform.
 - principles of operation of a synchronous alternator.
 - principles of operation of a synchronous motor.
 - principles of operation of an asynchronous generator (induction generator).
 - identification of main parts of a synchronous alternator/motor.
 - methods used to provide the excitation of a synchronous alternator/motor.
 - block diagram of an alternator voltage regulator.
 - advantages gained by the parallel operation of alternators.

- starting methods of synchronous motors.

T9 Alternators and generators encompassing:

- effects on the generated voltage of variations in excitation.
- effects on generated voltage of variations in load.
- identification of characteristic curves of an alternator.
- types of prime movers used with single and three phase portable/standby alternators.
- manual operation of single and three phase portable/standby alternators.
- ratings of single and three phase portable/standby alternators.
- applications of single and three phase portable/standby alternators.
- construction details of single and three phase portable/standby alternators.
- common faults found in portable/standby alternators.

KS01-EG033A Electrical Apparatus and Circuits

Evidence shall show an understanding of electrical apparatus and circuits to an extent indicated by the following aspects:

T1 Lighting circuits – looping at the light/switch encompassing:

- the "loop at the light" method of wiring lighting circuits.
- the "loop at the switch" method of wiring lighting circuits
- wiring diagrams for the lighting circuit of an installation that incorporates one-way, two-way and two-way and intermediate switching of light points using the loop at the light/switch methods of TPS wiring.
- TPS cabling requirement for the loop at the light/switch circuit.
- installation methods of accessories and wiring for a lighting circuit incorporating one-way, two-way and two-way and intermediate switching of lighting points using the loop at the light/switch method of TPS wiring.
- correct operation of the install circuits including testing for correct compliance with Australian Standards.

T2 Circuits for socket outlets encompassing:

- the purpose of socket outlets.
- requirements concerning the polarity of switched socket outlets.
- correct cable size to supply 10 A, 15 A and 20 A socket outlets (single and three phase), for given installation conditions.
- number of socket outlets connected to a 16 A and 20 A circuit breaker.
- installation methods of a single phase socket outlet circuits.
- correct operation of the install circuits including testing (dead testing only) for correct compliance with Australian Standards.

T3 Final sub-circuits and segregation encompassing:

- purpose of mixed circuits.
- circuit loading for a mixed circuit.
- purpose of segregation of circuits and the AS/NZS3000 requirements.
- Installation methods a single phase mixed circuits.
- correct operation of the install circuits including testing for correct compliance with Australian Standards.

T4 Electrical heating control devices encompassing:

- methods of manual heat control.
- methods of automatic heat control.
- types and application for common thermostats.
- operation of common thermostats.
- sensitivity and differential of thermostats.
- testing of a thermostat (including differential and correct operation)
- applications of simmerstats (infinite controls).
- operation of a simmerstat.
- electronic heat control (phase control and zero voltage switching).

T5 Fixed electrical heating appliances encompassing:

- Terms: heat energy, temperature, specific heat capacity, thermal conductivity and thermal stability.
- determining the heat energy in joules and kWh in a simple heating process.
- methods of heat transfer.
- Determining the heat energy input and output of a heating process.
- connections to a two phase stove.
- operation of reverse cycle air conditioning.

T6 Electrical water heater operation encompassing:

- types of water heaters (instantaneous and storage) and their methods of control.
- intrinsic safety (pressure relief and thermal cut-out).
- testing of over temperature cut-out point of a thermostat.
- switchboard requirements to supply a controlled load water heater.
- internal circuit of a twin element water heater, and supply connections.
- tariffs employed by local supply authorities.
- solar heating system and its integration into an installation.

T7 Alternative supplies encompassing:

- reasons for the installation of alternative supplies.
- types of alternative supply systems.
- characteristics and operation of UPSs.
- Australian Standards and local requirements for safety services supply systems.

T8 Installation of batteries encompassing:

- common types of primary cells and secondary batteries and typical applications.
- terminal voltage of common primary cells and secondary cells.
- correct storage, handling and disposal techniques for cells and batteries.
- charge/discharge cycle for a secondary cell.
- effect of internal resistance on a secondary cell.
- state of charge of a secondary cell.
- installation of batteries as per AS/NZS3011
- commissioning procedures for various secondary batteries.
- safe working procedures when working with secondary cells and batteries.

T9 Fire protection – residential fire and smoke alarms encompassing:

- types of fire and smoke alarms.
- regulations and standards requirements regarding residential fire and smoke alarms.
- locations for residential fire and smoke alarms.
- wiring methods for residential fire and smoke alarms.
- operation of typical residential fire and smoke alarms

T10 Emergency and evacuation lighting and lighting control encompassing:

- factors and requirements of emergency and evacuation lighting concerning illumination levels, luminaire positioning and operating period.
- characteristics of maintained, non maintained and sustained emergency lighting systems.
- arrangement of batteries in point and central bank emergency lighting supply systems.
- lighting control methods

T11 Lighting concepts and incandescent lighting encompassing:

- basic concepts of lighting.
- terminology, principles and standards relevant to lighting (energy efficiency as per BCA new lamp types and permitted replacements and their efficacy)..
- basic types of luminaires.
- operation of an incandescent lamp.
- types of incandescent lamps.
- expected lamp life, colour rendering and efficacy for typical incandescent lamps.
- lighting layout in terms of visual comfort and relevant Australian standards

T12 Fluorescent low intensity discharge lighting encompassing:

- types of low intensity discharge lamps.
- expected lamp life, colour rendering and efficacy for typical types of low intensity discharge lamps.
- operation of low intensity discharge luminaires including their control equipment.
- Australian Standard and local requirements for low intensity discharge lighting.

- methods for satisfying Australian Standards and local supply authority requirements regarding low intensity discharge lighting.

T13 High intensity discharge lighting encompassing:

- types of high intensity discharge lamps.
- expected lamp life, colour rendering and efficacy for typical types of high intensity discharge lamps.
- operation of high intensity discharge luminaires including their control equipment.
- Australian Standard and local requirements for high intensity discharge lighting.
- methods for satisfying Australian Standards and local supply authority requirements regarding high intensity discharge lighting.
- LED lighting and its applications.
- Neon, Argon and Xenon lighting and their applications.
- comparison of incandescent, low intensity discharge, high intensity discharge, LED and other types of lighting

KS01-EG063A Electrical installations — arrangement, control and protection

Evidence shall show an understanding of circuit arrangements, control and protection of electrical installations that comply with the Wiring Rules and Service Rules to an extent indicated by the following aspects:

T1 Safety principle to which electrical systems in building and premises shall comply.

- Safety principles are given in Part1 (Section 1) of the Wiring Rules AS/NZS 3000 with deemed-to-comply requirements given in Sections 2 to 8.
- Compliant methods for providing protection - include those for providing protection against direct and indirect contact; thermal effects; unwanted voltages; overcurrent; fault currents; overload; overvoltage; injury from mechanical movement.
- Requirements for installation design and selection of equipment - includes compliant protection arrangements; correct functioning; compatibility with supply; estimation of maximum demands; voltage drop considerations; arrangement of circuits and the like

T2 Circuit and control arrangements encompassing:

- reason for dividing electrical installations into circuits
- factors that shall be considered in determining the number and type of circuits required for an installation.
- daily and seasonal demand for lighting power, heating and other loads in a given installation.
- number and types of circuits required for a particular installation.
- diagrams/schedules of circuits for given installations.
- application and arrangements of SELV and PELV circuits

- application and arrangement of an isolated supply
- T3 Hazards and risks in an electrical installation encompassing:
- effects on the human body of various levels of a.c. and d.c. current and duration of current flow for various current paths.
 - risk of ignition of flammable materials due the thermal effects of current or electric arcs in normal service of an electrical installation.
 - risk of injury from mechanical movement of electrically actuated equipment.
- T4 Protection against direct contact (basic protection)
- acceptable methods
 - use of extra-low voltage
- T5 Protection against indirect contact encompassing:
- indirect contact with live parts of an electrical installation may occur.
 - methods and devices that comply with the Wiring Rules for providing protection against indirect contact.
 - components of the 'automatic disconnection of supply' method of protection against indirect contact.
 - the terms 'touch voltage' and 'touch current'.
 - the current path when a short circuit fault to exposed conductive parts of an appliance occurs.
 - protection against indirect contact is by the use of Class II equipment and by electrical separation.
 - additional protection by use of Residual Current Devices (RCDs)
 - protection against indirect contact by use of extra-low voltage and electrical separation.
 - Protection requirements for damp situations.
-
- T6 Earthing encompassing:
- the terms: earthed, earthed situation, earth electrode, equipotential bonding, multiple earthed neutral (MEN) system, protective earth-neutral (PEN) conductor, main earthing conductor, protective earthing (PE) conductor, functional earthing, MEN link.
 - selection of minimum size-earthing conductor for a range of active conductor sizes and materials.
 - parts of an earthing system and the purpose of each.
 - typical arrangement for a MEN earthing system.
 - arrangements of protective earthing conductors that comply with the Wiring Rules.
 - requirements for equipotential bonding in a range of installation situations.
 - Installation of a MEN earthing system for a single phase installation
- T7 Protection against overload and short circuit current encompassing:
- overload current or fault currents in an electrical installation.

- equivalent circuit of an earth fault-loop
- level of fault current possible at a given point in an installation from the fault-loop impedance and data from the electricity distributor.
- methods and devices that comply with the Wiring Rules AS/NZS 3000 for providing protection against the damaging effects of overload and fault current
- requirements for co-ordination between protective devices and conductors
- requirements for co-ordination of protection devices for discrimination and back-up protection.

T8 Devices for automatic disconnection of supply encompassing:

- operating principles of thermal/magnet circuit breakers.
- operating principles of common types of fuses.
- operating principles of residual current devices (RCD).
- time/current curves tripping characteristics of various types of circuit breakers that comply with the requirements of the Wiring Rules.
- time/current curves fusing characteristics of various types of fuses that comply with the requirements of the Wiring Rules.
- time/current curves tripping characteristics of various types of RCDs that comply with the requirements of the Wiring Rules.
- factors in a fault loop that will affect the impedance of the circuit.
- maximum impedance of an earth fault-loop to ensure operating of a protection device.
- selecting a fuse for fault current limiting protection.
- drawing switchboard wiring arrangements of 2-pole RCDs, 4-pole RCDs, combination RCD/MCBs.

T9 Protection against over voltage and under voltage encompassing:

- causes of over voltage and how this may affect the electrical system.
- methods for protection against over voltage.
- causes of under voltage and how this may affect the electrical system.
- methods for protection against under voltage.

T10 Control of an electrical installation and circuits encompassing:

- switch types, current and voltage ratings and IP rating and where these apply.
- switching requirements for isolation, emergency, mechanical maintenance and functional control.
- control arrangement for complete installations with and without safety services and an alternative supply.

T11 Switchboards / distribution boards encompassing:

- Purpose, types and applications.
- Physical and circuit arrangements for whole current and CT metering.
- Physical and circuit arrangements of main switches, circuit protection devices, fault-current limiters and metering equipment and other distributor equipment.

- compliance requirements (includes location and access, arc fault protection, identification, construction suitability, equipment marking, wiring, fire protection and arc-fault protection).

KS01-EG076A Low voltage current transformer metering

Evidence shall show an understanding of low voltage current transformer metering to an extent indicated by the following aspects:

T1 Current Transformers (CTs) encompassing:

- uses and functions
- AS60044.1-2007 requirements
- characteristics and saturation
- differences between metering and protection CTs
- standard ratios and outputs
- accurate range of loading
- thermal current limit
- burden and connecting cable length
- short circuiting secondary as a safety issue
- accuracy class

T2 Revenue meter types used with CTs encompassing:

-

T3 CT installations encompassing:

- uses in the regulated market and relevant regulations
- types and mounting methods
- switchboard layouts (various Distributors)
- minimum spacing of CTs
- connections to single and polyphase revenue meters
- consequence of polarity reversal in one phase of a polyphase meter.

KS01-EG101 Electromagnetic devices and circuits

A

Evidence shall show an understanding of electromagnetic devices and circuits to an extent indicated by the following aspects:

T1 Magnetism encompassing:

- magnetic field pattern of bar and horse-shoe magnets.
- magnets attraction and repulsion when brought in contact with each other.
- common magnetic and non-magnetic materials and groupings (diamagnetic, paramagnetic and ferromagnetic materials).
- principle of magnetic screening (shielding) and its applications.
- practical applications of magnets
- construction, operation and applications of reed switches.

T2 Electromagnetism encompassing:

- conventions representing direction of current flow in a conductor.
- magnetic field pattern around a single conductor and two adjacent conductors carrying current.
- Using the "right hand rule" to determine the direction of magnetic field around a current carrying conductor.
- direction of force between adjacent current carrying conductors.
- effect of current, length and distance apart on the force between conductors (including forces on bus bars during fault conditions).
- magnetic field around an electromagnet.
- Using the "right hand rule" to determine the direction of magnetic field around a current carrying coil.
- magnetomotive force (m.m.f.) and its relationship to the number of turns in a coil and the current flowing in the coil.
- practical applications of electromagnets.

T3 Magnetic circuits encompassing:

- magnetic characteristic curve for various materials and identify the various regions.
- Identify the various conditions of a magnetic material from its Hysteresis loop.
- factors which determine losses in magnetic material.
- methods used to reduce electrical losses in a magnetic circuit.
- magnetic flux (definition, unit and symbol).
- reluctance as the opposition to the establishment of magnetic flux.
- permeability (definition, symbol and unit).
- difference for magnetic and non-magnetic materials in regards to reluctance and permeability.
- relationship between the magnetomotive force (m.m.f.) established in a coil and the current and number of turns on the coil.
- calculation of m.m.f., flux or reluctance given any two values.

- flux density (definition, symbol, unit and calculation).
- magnetising force (definition, symbol, unit and calculation).
- common magnetic circuit types.
- effect of an air gap in a magnetic circuit.
- term "magnetic leakage" and "magnetic fringing".

T4 Electromagnetic induction encompassing:

- principle of electromagnetic induction (Faraday's law of electromagnetic induction).
- applying "Fleming's right hand rule" to a current carrying conductor under the influence of a magnetic field.
- calculation of induced e.m.f. in a conductor given the conductor length, flux density and velocity of the conductor.
- calculation of induced e.m.f. in a coil given the number of turns in a coil and the rate of change of flux.
- calculation of force on a conductor given the flux density of the magnetic field, length of the conductor and the current being carried by the conductor.
- Lenz's law
- applications of electromagnetic induction

T5 Inductance encompassing:

- construction of an inductor, including a bifilar winding inductor.
- Australian Standard circuit diagram symbol for the four types of inductor.
- effect of physical parameters on the inductance of an inductor.
- common types of inductor cores.
- applications of the different types of inductors.
- definition of terms self induction, inductance and mutual inductance.
- calculation of value of self induced e.m.f. in a coil.
- mutual induction occurs between two coils.
- graphical relationship between load voltage, current and self induced e.m.f. in a single d.c. circuit having inductance.
- practical applications for the effects of self and mutual induction.
- undesirable effects of self and mutual induction.
- definition of term "time constant" and draw the characteristic curve as applied to a series circuit containing an inductor and a resistor. (LR circuit)
- Calculation of value of the time constant for an LR circuit given the values of the components.
- time constants required for the current in an LR circuit to reach its final value.
- determining of instantaneous values of voltage and current in an LR circuit using a universal time constant chart.

T6 Measurement Instruments encompassing:

- moving coil, moving iron, dynamometer meter movements and clamp testers.
- practical applications for moving coil, moving iron and dynamometer meter movements.
- Calculation of resistance of shunts and multipliers to extend the range of ammeters and voltmeters.
- factors to be considered in selecting meters for a particular application.
- safety category of meters and their associated applications.
- steps and procedures for the safe use, care and storage of electrical instruments.

T7 Magnetic devices encompassing:

- construction, operation and applications of relays.
- construction, operation and applications of contactors.
- magnetic methods used to extinguish the arc between opening contacts.
- construction, operation and applications of Hall Effect devices.
- operation and applications of magnetostriction equipment.
- construction, operation and application of magnetic sensing devices.

T8 Machine principles encompassing:

- basic operating principle of a generator.
- applying Fleming's right hand rule for generators.
- basic operating principle of a motor.
- applying Fleming's left hand rule for motors.
- calculation of force and torque developed by a motor.

T9 Rotating machine construction, testing and maintenance encompassing:

- components of a d.c. machine.
- difference between a generator and a motor in terms of energy conversion.
- nameplate of a machine.
- using electrical equipment to make electrical measurements and comparison of readings with nameplate ratings.
- Identification of faults in a machine from electrical measurements.
- care and maintenance processes for rotating machines
- safety risks associated with using rotating machinery.

T10 Generators encompassing:

- basic operation of a d.c generator.
- calculation of generated and terminal voltage of a d.c. shunt generator
- prime movers, energy sources and energy flow used to generate electricity.
- types of d.c. generators and their applications.
- methods of excitation used for d.c generators.
- equivalent circuit for a d.c. generator.
- importance of residual magnetism for a self excited generator.
- open circuit characteristics of d.c. generators.
- load characteristics of a d.c generator.
- reversing the polarity of a d.c. generator
- Connect and test a d.c generator on no-load and load
- Identify safety risks associated with using generators.

T11 Motors encompassing:

- operation of a motor and its energy flow.
- effect of back e.m.f. in d.c. motors
- torque as the product of the force on the conductors and the radius of the armature/rotor.
- types of d.c. motors and their applications.
- circuit diagrams for the types of d.c. motors.
- equivalent circuit for the types of d.c. motors.
- calculation of power output of a motor.
- characteristics of the different types of d.c. motors.
- connection and testing a d.c. shunt motor on no-load and load
- reversing the direction of rotation of a d.c. motor.
- safety risks associated with using motors (include risks of series d.c. motors).

T12 Machine efficiency encompassing:

- losses that occur in a d.c machine.
- methods used to determine the losses in a d.c. machine.
- calculation of losses and efficiency of a d.c machine.
- efficiency characteristic of a d.c. machine and the conditions for maximum efficiency.
- application of Minimum Energy Performance standards (MEPS).
- methods used to maintain high efficiency.

KS01-EG102 Alternating current power circuits**A**

Evidence shall show an understanding of alternating currents power circuits to an extent indicated by the following aspects:

T1 Alternating Current Quantities encompassing:

- sine, cosine and tangent ratios of a right angle triangle
- Pythagoras Theorem to a right angle triangle.
- use of the CRO to measure d.c. and a.c. voltage levels
- sinusoidal voltage generated by a single turn coil rotated in a uniform magnetic fields
- terms 'period', 'maximum value', 'peak-to-peak value', 'instantaneous value', 'average value', 'root-mean-square (r.m.s.) value', in relation to a sinusoidal waveform.
- calculation of the instantaneous value of induced voltage of a generated sinusoidal waveform.
- measurement of instantaneous, peak, peak-to-peak values and the period of a sinusoidal waveform.
- calculation of root-mean-square (r.m.s.) value and frequency of a sinusoidal waveform from values of peak voltage and period.

T2 Phasors Diagrams encompassing:

- purpose of phasor diagrams
- 'in-phase', 'out-of-phase', 'phase angle' lead' and 'lag'.
- phase angle between two or more alternating quantities from a given sinusoidal waveform diagram.
- convention for representing voltage, current and the reference quantity in a phasor diagram.
- drawing phasor diagrams to show the relationship between two or more a.c. values of voltage and/or current.
- determination of phase relationship between two or more sinusoidal waveforms from a given diagram and measurements..

T3 Single Element a.c. circuits encompassing:

- setting up and connect a single-source resistive a.c. circuit and take voltage and current measurements to determine the resistance
- determining the voltage, current resistances from measure of given values of any tow of these qualities.
- relationship between voltage drops and current in resistive a.c. circuit
- applications of resistive a.c. circuits

- defining ‘inductive reactance’.
- calculation of inductive reactance for a given inductor and the relationship between inductive reactance and frequency.
- applying Ohm’s Law to determine voltage, current of inductive reactance in a purely inductive a.c. circuit given any two to these quantities.
- applications of inductive a.c. circuits.
- calculation of capacitive reactance
- applying Ohm’s Law to determine voltage, current or capacitive reactance in a purely capacitive a.c. circuit given any two of the quantities.
- applications of capacitive a.c. circuits

T4 RC and RL Series a.c. circuits encompassing:

- impedance’ and impedance triangle.
- determining the impedance, current and voltages for a series RC circuit given the resistance, capacitance and supply voltage.
- drawing and labelling the impedance triangle for a series RC circuit
- drawing phasor diagrams for a series RC circuit
- AS/NZS 3000 requirements for the installation of capacitors.
- examples of capacitive components in power circuits and systems and the effect on the phase relationship between voltage and current.
- determining the impedance, current and voltages for a series RL circuit given the resistance, inductance and supply voltage.
- drawing and labelling the impedance triangle for a series RL circuit
- drawing the equivalent circuit of a practical inductor
- Draw phasor diagrams for a series RL circuit.
- examples of inductive components in power circuits and systems and describe their effect on the phase relationship between voltage and current

T5 RLC Series a.c. circuits encompassing:

- measuring component voltages in a series RLC circuit and using a phasor diagram to determine the supply voltage and phase angle between circuit voltage and circuit current.
- determining the impedance, current and voltages for a series RLC circuit given resistance, inductance, capacitance and supply voltage.
- drawing and labelling the impedance triangle for a series RLC circuit.
- calculation of total impedance for a series RLC circuit.
- calculation of voltage drop for cables using the values for reactance and a.c. resistance from AS/NZS 3008.
- comparison of current limiting characteristics of inductors and resistors.
- practical examples of RLC series circuits

T6 Parallel a.c. Circuits encompassing:

- determining the branch currents of a parallel circuit that contain RL, RC or LC in two branches.
- using a phasor diagram to determine the total circuit current and phase angle in parallel RL, RC or LC circuits.
- determining the total circuit impedance of parallel RL, RC or LC circuits.
- measuring the branch currents in a parallel RLC circuit and use a phasor diagram to determine the total current and phase angle between circuit voltage and circuit current.
- determining the branch impedances, branch currents and phase angles voltages for a parallel RLC circuit given resistance, inductance, capacitance and supply voltage.
- calculation of impedance for a parallel RLC circuit.
- practical examples of parallel circuits.

T7 Power in an a.c. circuit encompassing:

- difference between true power, apparent power and reactive power and the units in which these quantities are measured.
- drawing the power triangle to show the relationships between true power, apparent power and reactive power
- defining the term "power factor" and phase angle.
- methods used to measure single phase power, energy and demand.

T8 Power Factor Improvement encompassing:

- effects of low power factor.
- requirements for power factor improvement.
- methods used to improve low power factor of a installation.
- local supply authority and AS/NZS 3000 wiring rules requirements regarding the power factor of an installation and power factor improvement equipment.
- methods used to measure single phase power factor.
- using manufacturers catalogues to select power factor equipment for a particular installation

T9 Harmonics and Resonance Effect in a.c. Systems encompassing:

- term "harmonic" in relation to the sinusoidal waveform of an a.c. power system.
- sources in a.c. systems that produce harmonics.
- problems that may arise in a.c. circuits as a result of harmonics and how these are overcome.

- methods and test equipment used to test for harmonics
- methods used to reduce harmonics in a.c. power system
- conditions in a series a.c. circuit that produce resonance.
- dangers of series resonance circuits
- conditions in a parallel a.c. circuit that produce resonance.
- dangers of parallel resonance circuits
- AS/NZS3000 and the local supply authority requirements concerning harmonics and resonance effect in a.c. power systems.

T10 Three Phase Systems encompassing:

- features of a multiphase system.
- comparison of voltages generated by single and multiphase alternators.
- reasons for the adoption of three phases for power systems.
- how three phases is generated in a single alternator.
- Calculation of r.m.s. value of voltage generated in each phase given the maximum value.
- relationship between the phase voltages generated in a three phase alternator and the conventions for identifying each.
- term "phase sequence" (also, referred to as "phase rotation").
- determining the phase sequence of a three phase supply

T11 Three phase star-connections encompassing:

- connecting a three phase star-connection load.
- phase relationship between line and phase voltages and line and phase currents of a star-connected system.
- determining the r.m.s. value of line and phase voltage given any one of these quantities.
- determining the r.m.s. value of line and phase current given any one of these quantities.
- terms "balanced load" and "unbalanced load".
- effect of a reversed phase winding of a star connected alternator.
- example of balanced and unbalanced loads in typical power systems.

T12 Three phase four wire systems encompassing:

- purpose of the neutral conductor in a three phase four wire systems.
- determining the effects of an high impedance in the neutral conductor of a three phase four wire system supplying an unbalanced load where MEN earthing is employed.
- determining the value and phase relationship of neutral current in an unbalanced

three phase four wire systems given line currents and power factors.

- AS/NZS 3000 requirements regarding neutral conductors.
- AS/NZS 3008.1.1 method for determining voltage drop in unbalanced three phase circuits

T13 Three phase delta-connections and Interconnected systems encompassing:

- connecting three phase delta loads.
- phase relationship between line and phase voltages and line and phase currents of a delta-connected system.
- determining the r.m.s. value of line and phase voltage given any one of these quantities.
- determining the r.m.s. value of line and phase current given any one of these quantities.
- limitations and uses of open delta connections
- effect of a reversed phase winding of a delta connected transformer
- example of loads in typical power systems.
- drawing the typical combinations of three phase interconnected systems using star-connections and a delta-connection.
 - relationship between line and phase voltages and line and phase currents in the typical interconnected systems using star-connections and delta-connections.

T14 Energy and power requirements of a.c. systems encompassing:

- purposes for measuring power, energy, power factor and maximum demand of a.c. power systems and loads.
- difference between true power, apparent power and reactive power and the units in which these quantities are measured in a three phase system.
- drawing the power triangle to show the relationships between true power, apparent power and reactive power in a three phase system.
- methods used to measure three phase power, energy, power factor and demand.
- determining how the power factor of a three phase installation can be improved.
 - using manufacturers catalogues to select measurement equipment for a particular installation

T15 Fault Loop Impedance encompassing:

- term fault loop impedance of a a.c. power system
- determining fault loop impedance using resistance and reactance values from AS/NZS 3008.1.1
- measuring fault loop impedance of typical circuits
- procedures for testing fault loop impedance

KS01-EG103 Installation of wiring systems

A

Evidence shall show an understanding of the installation of wiring systems that comply with standards to an extent indicated by the following aspects:

T1 Standards, codes and requirements applicable to the installation of wiring systems encompassing:

- Cables and methods of mechanical protection and support
- Protection against and from other services.
- Prohibited cable locations
- Building codes affecting the installation of cables in buildings, structures and premises (limitation on penetration of structural elements, maintenance of fire protection integrity, and wiring above suspected ceilings)
- Issues affecting electrical installations in heritage buildings and premises (limitation on penetration of structural and finished elements, accessing cable routes, types and colour of exposed accessories).

T2 Use of other installation standards called up by the Wiring Rules for special situations encompassing:

- standards that apply to Electromedical treatment areas.
- additional requirements for construction and demolition sites.
- Relocatable installations and their site supply
- additional requirements for caravan park.
- additional requirements for marinas and pleasure craft at low voltage.
- additional requirements for shows and carnivals.

T3 Hazardous areas encompassing:

- Conditions that apply in an areas that require them to be classified as a 'Hazardous area'.
- Responsibility for classifying a hazardous area
- Awareness of standards called up by the Wiring Rules for selection of equipment and installations in Hazardous areas. (AS/NZS 3000 requirements for hazardous areas).

T4 Requirement for the installation of cables and accessories in damp situations and ELV installations encompassing:

- restricted zones around baths, showers, fixed water containers, pools, sauna heaters and fountains/water features for given installations.
- selecting equipment suitable for installation in given damp situations.
- voltage range that defines extra-low voltage.
- 'Separated extra-low voltage (SELV) system' and a 'Protected extra-low voltage (PELV) system'.

- AS/NZS 3000 requirements for selecting extra-low voltage systems and devices for a range of installations and conditions.
- T5 Aerial cabling encompassing:
- Describe the types of aerial cabling.
 - State the AS/NZS 3000 and local supply authority requirements for aerial cabling.
 - Termination of aerial cables in accordance with AS/NZS 3000 and local requirements.
 - installation of consumers mains for connection via overhead consumers terminals in accordance with AS/NZS 3000 and local requirements.
- Testing of installed cables compliance with Australian Standards
- T6 Underground cabling encompassing:
- Describe permissible underground cabling systems.
 - Identify other underground services.
 - State the AS/NZS 3000 and local supply authority requirements for underground cabling.
 - List the advantages and disadvantages of underground wiring systems
 - selection of underground consumers mains in accordance with AS/NZS 3000 and local requirements
- T7 Techniques for installing cables and wiring systems encompassing:
- Typical cable routes through buildings, structures and premises.
 - Application of wiring accessories
 - Drawing-in, placing and fixing of cables
 - Cable and conductor terminations
 - Maintaining fire rating integrity.
 - Inspecting and testing installed and terminated cables to ensure they comply with continuity and insulation resistance and are safe to connect to the supply.

KS01-EG104A

Evidence shall show an understanding of the installation of appliances (current-using equipment) and accessories to an extent indicated by the following aspects:

- T1 Installation standards, codes and requirements applicable to installing electrical equipment encompassing.
- Protection against thermal effects
 - Connection of electrical equipment (appliances, switchgear and accessories include switchgear and controlgear, switchboards, socket-outlets, lighting equipment and accessories, lamps and luminaires, smoke and fire detectors, cooking appliances, appliances producing hot water or steam, room heaters, electric heating cables for floors and ceilings, space heating, duct heaters, electricity converters, motors,

transformers, capacitors, and batteries).

- Required and permitted locations current-using equipment and accessories
- Control, switching and over current and RCD protection

T2 Terminal configuration for connection of phase, neutral and protective earthing conductors for each type of equipment.

T3 Building codes affecting the installation of current-using equipment and accessories in buildings, structures and premises encompassing:

- maintenance of fire protection integrity, requirements for emergency services (safety services) and the like.

T4 Issues affecting electrical installations in heritage buildings and premises encompassing:

- limitation on types and colour of exposed accessories.

KS01-EG105A

Electrical installations — verification and testing

Evidence shall show an understanding of electrical installations — verification and testing to an extent indicated by the following aspects:

T1 Electrical safety encompassing:

- safety procedures to work on electrical systems, circuits and/or apparatus.
- safe working practices as a normal part of carrying out electrical installation work
- isolation and lockout procedures
- selection of tools and test equipment for inspection and testing

T2 Legislated regulations encompassing:

- relevant commonwealth, state/territory legislation and regulations that require installations and equipment to be inspected and tested to ensure they are safe.
- the person/bodies responsible for the various aspects of ensuring electrical installations are safe.
- results of tests that show an electrical installation is safe for connection to the supply.
- results of periodic inspection and tests that show construction site wiring and equipment is safe to use.
- results of periodic inspection and tests that show electrical equipment are safe to use.

T3 Visual inspecting of installations for compliance the Wiring Rules encompassing:

- wiring systems are suitable for given environment
 - cable size based on current-carrying capacity, voltage drop and fault-loop impedance limitations (consumers mains/submains, final sub circuits)

- switchgear and controlgear
- switchboard and switchboard markings
- protection methods and devices to protect against overload, short-circuit current and overvoltage (fuses, circuit breakers, surge diverters)
- suitability of protection devices for a given situation
- RCDs
- MEN system (supply neutral, MEN link, protecting earth conductor, main earth, earth electrode, equipotential bonding)
- MEN connection at separate buildings/structures within a single electrical installation.
- electrical apparatus complies with safety requirement (source of evidence and identification of compliant markings)
- identify actions/conditions that would void the compliant status of given item(s) of equipment

T4 Testing installations encompassing:

- mandatory tests to ensure: correct connections, insulation resistance is adequate; earth continuity is such that it will ensure the operation of protection devices under earth fault conditions; polarity of active/s and neutral for mains, submains and final subcircuits is correct; there is no transposition of earthing and neutral conductors; fault-loop impedance is sufficiently low; RCD for correct operation and sensitivity.
- functional tests to ensure active/s and neutral for the same circuit are clearly identified with their circuit protection device.
- optional tests that show all circuits and devices operate as intended such as apparatus calibration, load current of appliance/apparatus, appliance/apparatus performance characteristics tests.
- tests to determine the fault level at a particular point in an installation.
- non-compliance test results and faults
- Recommendations for rectification of non-compliance faults

T5 Documentation encompassing:

- results of tests conducted on an installation comply with requirements and ensure the installation is safe.
- documents of the results of testing an installation as required by the local supply authority.
- documents of periodic inspection and testing of construction site wiring and equipment in accordance with requirement.
- documents of periodic testing and inspection of electrical equipment including tagging requirements.

Evidence shall show an understanding of electrical installations and equipment principles and requirements to an extent indicated by the following aspects:

- Effects of electric current encompassing:
 - Physiological effects of current.
- Basic principles by which an electric current can produce heat, light, motion and a chemical reaction.
- Single path practical circuit encompassing:
 - Arrangement of energy source, protection device, switch and load in a circuit.
 - The purpose of each component in the circuit.
 - Consequences of an open-circuits, closed-circuits and short-circuits.
- Single-source multiple-path d.c. circuits encompassing:
 - Circuit configurations and connection.
 - Relationship between parameter of voltage, current, resistance power dissipation in the whole or any part of the circuit.
 - Safely measuring the parameters for the whole or any part of the circuit.
- Methods of determining circuit behaviour for variation in any of the parameters from measured and calculated values.
- Alternating voltage and current generation, phase relationships, energy in an a.c. circuit encompassing:
 - Sinusoidal voltage generation and resulting current.
 - The terms period; maximum value; peak-to-peak value; instantaneous value; average value; root-mean-square (r.m.s.) value; and frequency.
- Three-phases generation.
- Relationship between the phase voltages generated in a three-phase alternator and the conventions for identifying each.
- Method of determining the phase sequence or phase rotation of a three-phase supply.
- Methods of determining power and energy supplied by three phase circuits.
- Fundamental safety principles of the AS/NZS 3000 Part 1 (Section 1) and deemed to comply solution given in Part 2 encompassing:
 - Definition of terms
- Fundamental safety principles of protection against direct and indirect contact with live parts; thermal effects; overcurrent; earth faults; abnormal voltages; spread of fire; mechanical injury and external influences.
- Fundamental principles of installation design; selection and installation of equipment; means of compliance (including alterations, additions and repairs) and verification of compliance.
- Electric motor selection, starting method and overload protection encompassing:
 - Types of motor enclosures suitable for given environmental conditions
 - Criteria for selecting motor starters and overload protection.
 - Types and connection arrangements for direct-on-line and reduced voltage starters.
 - Thermal, magnetic and thermistor overload protection methods.
- Ability to apply AS/NZ 3000 requirements for protective and functional earthing encompassing:

- Purpose of protective and functional earthing.
- Parts of the protective earthing systems.
- Earthing arrangements, earthing of equipment and equipotential bonding.
- Methods of determining the maximum fault loop impedance for a circuit.
- Selection of protective conductor and active conductor sizes for each circuit to ensure earth-fault loop impedance is sufficiently low to operate the circuit protective device.
- MEN system and its application encompassing:
 - The roles of the protective earthing (PE) and neutral (N) conductors in an a consumer's installation and their relationship to the protective earth neutral (PEN) conductor in the electricity distributor's system or sub-main to an outbuilding.
 - The importance of the MEN link when a fault occurs.
 - The likely consequences of the absence of the MEN link or high impedance in the PEN conductor when a fault occurs.
 - The requirements for installation of an MEN link in an installation and an outbuilding.
- Knowledge of the application of transformers encompassing:
 - Transformers used in distribution and transmission systems and large consumer installations.
 - Transformers used in welding machines.
- Applications in appliances
- Risks and safety control measures associated with connection and disconnection of instrument transformers
- Safe working procedures when connecting and testing transformers.
- AS/NZS 3000 requirements and restriction on the installation and use of transformers.
- Ability to apply AS/NZ 3000 requirements for protection of circuit against overcurrent and abnormal voltages encompassing:
 - Minimum fault levels specified by electricity distributors
- Methods and arrangement for protection against short-circuit currents and overload currents.
- Coordination of overload and short-circuit protection devices.
- Coordination between conductors and overload protection device.
- Causes of over and undervoltage.
- Device and requirements for protection against over and undervoltage.
- Additional protection by use of RCDs and use of extra-low voltage for basic and fault protection encompassing:
 - Limitation of an RCD to protect against contact with live parts
- AS/NZS 3000 requirements for use of RCDs.
- Conditions for use of extra-low voltage to provide for basic and fault protection
- AS/NZS 3000 requirements for installation of SELV and PELV systems
- Ability to select cables for single and three phase mains and sub-mains for single and multiple installations that comply with requirements of AS/NZS 3000 and AS/NZS 3008.1 encompassing:
 - Methods of determining maximum demand.
- Types of cables available.

- Installation methods and external influences effecting cable current-carrying capacity
- Voltage drop limitation
- Short-circuit performance consideration.
- Ability to select cables for final sub-circuits that comply with requirements of AS/NZS 3000 and AS/NZS 3008.1 encompassing:
- Maximum demand of final sub-circuits.
- Types of cables available.
- Installation methods and external influences effecting cable current-carrying capacity
- Effect of earth-fault loop impedance and voltage drop limitations on circuit route length.
- Short-circuit performance considerations.
- Ability to apply AS/NZS 3000 requirements for control and protection of installations encompassing:
- Devices for functions of isolation; emergency; Mechanical maintenance and functional control.
- Method for assessing prospective short circuit current.
- Devices and arrangement for protection against overload and short-circuit current.
- Additional protection by RCD
- Protection against switchboard internal arc faults.
- Ability to apply AS/NZS 3000 requirements for the installation of electrical equipment in given damp situations encompassing:
- Limitation of installation of equipment in classified zones.
- Selection and location of equipment suitable for installation in given classified zones.
- Additional protection by RCD.
- Equipotential bonding in showers and bathrooms and swimming and spa pools.
- Ability to install, modify and test electrical equipment for construction and demolition sites, complying with AS/NZS 3012 and applicable workplace safety legislation encompassing:
- Supply and installation requirements.
- Protection of circuits.
- Initial and periodic inspection and testing
- Portable tool safety testing and tagging system in accordance with AS/NZS 3760.
- Knowledge of AS/NZS 3000 requirements for the installation of aerial conductors and underground wiring encompassing:
- Types and application of aerial conductors
- Aerial span limitations and required clearances
- Selection of aerial supporting poles/post and struts for a given application.
- Use and requirements of catenary support systems
- Acceptable cable types and protection for underground wiring categories.
- Underground wiring depth layer and protection
- Underground wiring clearances from other services
- Knowledge of AS/NZS 3000 requirements for electrical installations in hazardous areas encompassing:
- Types of areas classified as a hazardous area

- Standards to which the selection, installation and maintenance of electrical equipment shall comply.
- Addition training required to work competently with electrical equipment for hazardous areas
- Ability to verify compliance of an electrical installation in accordance with AS/NZS 3000 encompassing:
 - Visual inspection to determine whether the installation complies with requirements set out in Section 2 to 7 of AS/NZS 3000 and relevant specific installation standards.
 - Mandatory tests following guidance given in AS/NZS 3017
 - Ability to perform effective safe isolation of any equipment encompassing:
 - Preparation of a 'safe work method statement' (SWMS) or Job Safety Analysis (JSA) for effective safe isolation.
 - Safe methods for identifying source of supply to be isolated.
 - Switching-off, lock-out and tagging procedures.
 - Safe methods for confirming effective and safe isolation
 - Ability to apply AS/NZS 3000 requirements to install and terminate thermoplastic insulated cables; elastomer sheathed cables; XLPE sheathed cables; and high temperature cables; armoured cables; and neutral screened cables in a wide range of applications.
 - Ability to perform the circuit tests required for electrical cables in a range of installations and final sub-circuit encompassing:
 - Following safe testing procedures.
 - Tests to show if the earth continuity and earth-fault loop impedance are sufficiently low.
 - Testing to show if insulation resistance is sufficiently high.
 - Testing to show if the polarity and circuit connections are correct.
 - Ability to install final sub-circuit wiring into switchboards and connect to switchboard equipment in accordance with AS/NZS 3000 and electricity distributor's requirements.
 - Ability to apply AS/NZS 3000 and electricity distributor's requirements for the installation and connect consumers mains encompassing:
 - Installing and underground and overhead consumers mains Terminating consumers mains at pillars, pits mains connection boxes and consumers switchboard.
 - Install unprotected consumers mains to reduce the risk of short-circuit of to a minimum.
 - Installing bonding conductors where required
 - Ability to read, sketch and interpret electrical diagrams encompassing:
 - Purpose and characteristics of schematic, block and wiring diagrams, plans and schedules.
 - Conventions used in documenting electrical information
 - Read and interpret schematic, block and wiring diagrams, plans and schedules
 - Sketch electrical diagrams using conventional symbols
 - Knowledge and understanding occupational safety and health encompassing:
 - Basics of Occupational Safety and Health regulations
 - Legal responsibilities for employers and employees
 - Employers' and employees' own "duty of care".
 - Safety committees and their role
 - Knowledge and understanding of the requirements for personal safety in the workplace encompassing:

- Purpose and use of Safe Work Method Statements (SWMS) or Job Safety Analysis (JSA).
- Purpose and process of reporting OHS incidents.
- Safety procedures for working with electrical circuits and equipment.
- Procedures for safe and effective isolation of electrical supply.
- Regulations for the supervision of apprentices and trainees.
- Process in rescuing a person in contact with live electrical conductors or equipment and the primary importance of the safety of the rescuer.
- Application of emergency first aid requirements for an electric shock victim encompassing:
 - Calling for help.
 - Applying cardiopulmonary resuscitation (CPR).
- Selection and use of fire extinguishers to control electrical fire at accident site.
- Dangers of high voltage equipment and distribution systems encompassing:
 - Step and touch and induced voltages.
 - Sources of induced voltage and stored energy
 - Creepage and clearance requirements.
- Application of safe working procedures in the vicinity of HV equipment.
- Systematic method of commissioning and decommissioning electrical equipment and installations encompassing:
 - Commissioning safety procedures
 - Circuit voltage testing
 - Phase rotation checks
 - Functional testing
 - Instrument and control parameter settings
 - Decommissioning safety procedures.
- Identification of circuits with their control and protection devices.
- Impact of isolation on other parts of an installation.
- Tagging, testing and earthing.
- Safe removal of equipment.
- Diagnosing and rectifying faults in electrical apparatus and associated circuits encompassing:
 - Faults such as open-circuit; short-circuit; incorrect connections; insulation failure; unsafe condition; apparatus/component failure; related mechanical failure;
 - Apparatus such as control devices; fixed appliances/accessories; lighting; electrical machines motors and controls; socket outlets, transformers; protection and metering devices.
- Circuits such as those supplying fixed appliances; lighting; socket outlets; motors and controls circuits; transformers; electronic or computer based equipment.

KS01-EG106 Wiring systems types, application and terminations**A**

Evidence shall show an understanding of wiring systems types, application and terminations to an extent indicated by the following aspects:

T1 Cable types and terminations encompassing:

- cable variates (single cables, flexible cables, flexible cords, shielded cables, armoured cables, ribbon cables, other similar and like cables)
- structural components of cables and their purpose (conductor material, stranding, insulation type, voltage rating, screening, sheathing, armour and serving)
- Australian and International colour standards for cords and cables
- construction of common cables
- identification of cords and cables by conductor size, type and rating
- application of various cords and cables types
- identification of hardware used in terminating cords and cables
- preparation and termination of cords and cables
- termination of cords and cables using crimp lugs, tunnel connectors, soldering and solderless lugs
- requirements to protect and support cables adequately (protection against mechanical damage, protection from adverse temperatures and corrosion and protection from magnetic field that may affect the performance of the cable).

T2 Cords, cables and plugs encompassing:

- selection of flexible cords for given applications
- preparation of cord ends for connection
- fitting standard three pin plug tops to a flexible cords
- fitting standard three pin extension sockets to a flexible cords
- connecting variety of plugs to different flexible cord types
- requirements of AS/NZS 3000 for flexible cords, cables and plugs
- using test equipment to test and locate various faults in flexible cords and cables.

T3 Flat TPS wiring systems encompassing:

- Australian Standards requirements for the termination and protection of flat TPS cable
- Installation of flat TPS cable in trunking and duct for the supply of socket outlets
- using flat TPS cable for lighting looms
- testing circuits to ensure they are safe and operate as intended

T4 Circular TPS wiring systems encompassing:

- Australian Standards requirements for the installation of circular TPS cable
- installation of circular TPS cables on cable ladder/tray
- installation circular TPS cable
- testing circuits to ensure they are safe and operate as intended

- T5 Thermoplastic insulated cables in non-metallic enclosures encompassing:
- Australian Standards requirements for the installation of non-metallic enclosures
 - cutting and setting rigid non-metallic ducting, trunking and conduit and accessories
 - installation of circuits using TPI cables in non-metallic enclosures
 - testing circuits to ensure they are safe and operate as intended
- T6 Thermoplastic insulated cables in metallic enclosures encompassing:
- Australian Standards requirements for the installation of metallic enclosures
 - fitting metallic conduit to metallic trunking and accessories
 - cutting, threading and setting metallic conduit
 - installation of circuits using thermoplastic insulated cables in metallic conduit, ducting and trunking
 - testing circuits to ensure they are safe and operate as intended
- T7 Fire protection cabling and systems encompassing:
- Australian Standards requirements for the installation of fire protection cable and mineral insulated metal sheathed cables
 - requirements when passing a wiring system through a fire rated wall or floor
 - recognising different fire protection cable types including Pyrolex, Radox and MIMS
 - termination of fire protection cable.
 - installation of circuits using fire protection cable.
 - testing circuits to ensure they are safe and operate as intended
- T8 Steel wire armoured (SWA) cables encompassing:
- Australian Standards requirements for the installation of SWA cables
 - identifying accessories used with SWA cables
 - installation of circuits using SWA cables
 - testing circuits to ensure they are safe and operate as intended
- T9 Trailing cables and catenary systems encompassing:
- Australian Standards requirements for the installation of trailing cables and catenary wiring
 - identifying equipment used with trailing cable and catenary systems
 - installation of catenary wiring systems
 - installation of trailing cable systems supplying a pendant sockets
 - testing the installation to ensure it is safe and operates as intended

KS01-EG107A Electrical installation — cable selection and co-ordination

Evidence shall show an understanding of selecting cables and ensuring co-ordination between protection device and conductors in electrical installations that comply with the Wiring Rules,

Selection of cables standards and Service Rules to an extent indicated by the following aspects:

T1 Performance requirements - design and safety encompassing:

- harmful effects against which the design of an electrical installation must provide protection.
- performance standards of a correctly functioning electrical installation.
- supply characteristics that shall be considered when designing an electrical installation.
- acceptable methods for determining the maximum demand in consumer's mains and sub-mains.
- AS/NZS 3000 requirements limiting voltage drop in an installation.
- reason for dividing electrical installations into circuits and the factors that shall determine their number and type.
- typical external factors that may damage an electrical installation and that shall be considered in the installation design.
- methods for protecting persons and livestock against direct and indirect contact with conductive parts and the typical application of each.
- acceptable methods of protection against the risks of ignition of flammable materials and injury by burns from the thermal effects of current, in normal service.
- likely sources of unwanted voltages and the methods for dealing with this potential hazard.
- acceptable methods for protecting persons and livestock against injury and property against damage from the effects of over current.
- requirement for protection against fault current.
- requirement for protection against the harmful effects of faults between live parts of circuits supplied at different voltages.
- need for protection against injury from mechanical movement and how this may be achieved.
- features of 'fire rated construction' and how the integrity of the fire rating can be maintained in relation to electrical installation.

T2 Final subcircuit arrangements encompassing:

- factors that shall be considered in determining the number and type of circuits required for an installation.
- daily and seasonal demand for lighting, power, heating and other loads in a given installation.
- number and types of circuits required for a particular installation.
- current requirements for given final subcircuits.
- layout/schedule of circuits for given installations.

T3 Factors affecting the suitability of wiring systems encompassing:

- wiring systems typically used with various construction methods and particular environments.
- installation conditions that may affect the current-carrying capacity of cables.
- external influences that may affect the current-carrying capacity and/or may cause

damage to the wiring system.

- AS/NZS 3000 requirements for selecting wiring systems for a range of circuits, installation conditions and construction methods into which the wiring system is to be installed. Note: Wiring systems include cable enclosures, underground wiring, aerial wiring, catenary support, emergency systems, busbar trunking and earth sheath return.

T4 Maximum demand on consumer's mains/submains encompassing:

- acceptable methods for determining the maximum demand on an installation's consumer's mains and submains.
- maximum demand for the consumer's mains for given installations up to 400 A per phase.
- maximum demand for given submains.

T5 Cable selection based on current carrying capacity requirements encompassing:

- installation conditions for a range of wiring systems and applications.
- external influences that require the use of a derating factor.
- AS/NZS 3000 requirements for coordination of cables and protection devices.
- AS/NZS 3008 used to select conductor size based on the maximum current requirement for a given installation condition including any applicable derating factors.

T6 Cable selection based on voltage drop requirements encompassing:

- AS/NZS 3000 requirements for maximum voltage drop in an installation.
- relevant tables in AS/NZS 3008 for unit values of voltage drop.
- calculation of the expected voltage drop in a given circuit.
- selecting cables to satisfy voltage drop requirements in addition to current carrying capacity requirements.

T7 Cable selection based on fault loop impedance requirements encompassing:

- AS/NZS 3000 requirements for maximum fault loop impedance in an installation.
- relevant tables in AS/NZS 3008 to determine cable impedances.
- calculation of the expected fault loop impedance for a given circuit arrangement.
- selecting cables to satisfy fault loop impedance requirements in addition to current carrying capacity requirements and voltage drop requirements.

T8 Selecting protection devices encompassing:

- acceptable methods of protection against indirect contact.
- AS/NZS 3000 requirements for selecting methods and devices to protect against indirect contact for a range of installation types and conditions.
- coordination between conductors and protection devices to ensure the protection of cables from over heating due to over current.
- possible injuries to persons and livestock from hazards due to a short circuit.
- AS/NZS 3000 requirements for selecting devices to protect against overload current for a range of circuits and loads.
- AS/NZS 3000 requirements for selecting devices to protect against short-circuit current for a range of installation conditions.

T9 Selecting devices for isolation and switching encompassing:

- requirements for the provision of the isolation of every circuit in an electrical installation.
- need for protection against mechanical movement of electrically activated equipment.
- AS/NZS 3000 requirements for selecting devices for isolation and switching for a range of installations and conditions.

T10 Switchboards encompassing:

- AS/NZS 3000 and local supply authority requirements for switchboards.
- tariff structures for the supply of electricity.
- equipment installed at the main switchboards with capacities up to 400 A per phase.
- layout of a main switchboard for an installation supplied with single phase single tariff whole current metering.
- layout of a main switchboard for an installation supplied with single phase multiple tariff whole current metering.
- layout of a main switchboard for an installation supplied with multiphase single tariff whole current metering.
- layout of a main switchboard for an installation supplied with multiphase multiple tariff whole current metering.
- layout of a main switchboard for a multiple tenancy installation with whole current metering.
- layout of a main switchboard, including metering, for an installation supplied with three phase CT metering.
- local supply authority requirements for connection of an electrical installation to the electrical supply system

KS01-EG108A

Circuit and equipment faults and fault finding techniques

Evidence shall show an understanding of circuit and equipment faults and fault finding techniques to an extent indicated by the following aspects:

T1 Troubleshooting concepts encompassing:

- need to understand the correct operation of a circuit or equipment, switching and control circuit arrangements.
- common faults with circuits and equipment including operator faults, incorrect connections, open-circuits, short-circuits, device faults (mechanical), supply faults.
- typical faults symptoms and their causes: operation of circuit protective device, appliance does not operate, single phase motor does not develop enough torque to drive the load, three phase motor does not develop enough torque to drive the load, motor overload trips
- factors to consider in clarifying the nature of a fault: initial fault report,

confirmation of symptoms of the fault, comparison of symptoms with normal operation

- effect to cause reasoning — assumptions of possible causes
- methods for testing assumptions: visual inspection, component isolation, test equipment, sectional testing, split-half tests
- repairing the fault and the steps needed to ensure fault doesn't re-occur
- dealing with intermittent faults (typical causes of intermittent faults are vibration, shock, changes in temperature and electromagnetic interference).
- final testing and re commissioning

T2 Troubleshooting water heater and appliance circuits/equipment encompassing:

- circuit diagrams of common single phase and three phase hot water systems
- single phase and three phase element resistance values (determine from measurement and calculation from power and voltage ratings)
- testing single and three phase elements for correct insulation resistance and continuity
- element replacement techniques
- operation of thermostats, thermal cut-outs and pressure relief valves, flow switches and checking sacrificial anodes
- locating faults in common single and three phase hot water systems
- repairing faulty water heating systems

T3 Troubleshooting electrical appliance circuits/equipment encompassing:

- circuit diagrams of common single phase and three phase appliances
- methods to determine the cause of an RCD operation
- identification of appliances that is causing an RCD to trip
- testing single and three phase appliances for correct insulation resistance and continuity
- operation of appliances controls
- locating faults in common single and three phase appliances
- repairing faulty appliances

T4 Troubleshooting lighting circuits encompassing:

- circuit and wiring diagrams of common lighting circuits including single light controlled by a single switch, multiple lights controlled by a single switch, two and three way switching using the loop at the light method and the loop at the switch method.
- causes of wiring faults from supplied symptoms and circuit and/or wiring diagrams
- causes of faults in ELV lighting devices, include transformer (iron core or electronic), voltage drop, heat, over-voltage, poor connections, incompatible dimmers
- diagrams of a basic fluorescent light circuit including lamp, ballast and starter
- locating faults in fluorescent light circuits
- operation of a range of lighting control including passive infra-red (PIR), dimmers,

- photo electric or day-light switches and time clocks
 - locating faults in lighting control circuits
- T5 Troubleshooting single phase motor and control circuits encompassing:
- circuit diagrams of split phase, capacitor start, capacitor start capacitor run, universal and shaded pole single phase motors
 - causes of single phase motor faults from supplied symptoms and circuit diagrams
 - causes of electrical faults in single phase motors, include open and partially open circuit winding, short and partially short circuit winding, open circuit rotor, burnt out winding, coil shorted to frame.
 - reasons for a thermal overload trip and how often they are to be reset before investigating a cause
 - internal mechanical faults and their consequences, include bearings, fans, bent shaft, locked rotor, blocked air vents, centrifugal switches, environmental factors
 - faults on driven loads and couplings and their consequences, include slipping belts, poorly aligned coupling (shims), vibration, loads bearing failing, load stalling.
 - locating faults in single phase motors and their controls
- T6 Troubleshooting three phase induction motor encompassing:
- circuit diagrams of three phase induction motors
 - causes of three phase motor faults from supplied symptoms and circuit diagrams
 - causes of electrical faults in three phase motors, include open and partially open circuit phase winding, short and partially short circuit phase winding, open circuit rotor, burnt out phase winding, coil shorted to frame.
 - reasons for a thermal overload trip and how often they are to be reset before investigating a cause
 - internal mechanical faults and their consequences, include bearings, fans, bent shaft, locked rotor, blocked air vents, environmental factors.
 - faults on driven loads and couplings and their consequences, include slipping belts, poorly aligned coupling (shims), vibration, loads bearing failing, load stalling.
 - locating faults in three phase induction motors and their controls
- T7 Troubleshooting electrical installations encompassing:
- circuit diagrams, wiring diagrams, cable schedules and specifications of electrical installations
 - causes of electrical installation faults from supplied symptoms and circuit diagrams include open and partially open circuit wiring, short and partially short circuit wiring, low insulation resistance, incorrect polarity, transposition of conductors, RCD tripping.
 - locating faults in electrical installations
 - repairing faulty electrical installation circuits components and wiring.

KS01-EG109A**Electrical control devices and circuits**

Evidence shall show an understanding of electrical control devices and circuits to an extent indicated by the following aspects:

T1 Basic relay circuits encompassing:

- Identification of given circuit diagrams (schematic) symbols and explain the operation of the components represented
- labelling wires and terminal (numbering systems)
- control relay - operating principles, basic contact configurations and identification and common applications
- push button - switching configurations and common applications
- selecting pushbuttons/pilot lamps from manufacturer's catalogues for specific applications
- development of simple stop-start relay circuit that incorporates pilot lights and latching circuit.
- connection and testing of control circuits

T2 Relay circuits and drawing conventions encompassing:

- circuit diagram drawing conventions
- selecting relays from manufacturers' catalogue for specified applications
- circuit development of electrical control circuit in accordance with a written description (specification) and list the sequence of operation of the circuit
- connecting simple electrical control circuit from circuit diagrams
- applying safe working practices when testing an electrical control circuit

T3 Remote STOP-START control and electrical interlocking encompassing:

- operation of local and remote start-stop control of relays
- operation of an electrically interlocked relay circuit
- development of a relay circuit incorporating local and remote start and stop buttons and electrical interlocking.
- connecting electrical circuits with local and remote start-stop control and with electrical interlocking.
- applying circuit checking and testing techniques to an electrical control circuit.

T4 Time delay relays encompassing:

- timers - operating principles, basic contact configurations and identification and common applications
- selecting timers for specified functions from manufactures' catalogues
- development of timer controlled circuits from a written description and list the sequence of circuit operation
- connecting a timer controlled circuit using a circuit diagram as a guide.
- timer circuit checking and testing procedures.

T5 Circuits using contactors encompassing:

- contactors - operating principles, basic contact configurations and identification and common applications
- thermal overloads - operating principles, basic contact configurations and identification and common applications
- circuit diagram symbols
- circuit development using a contactor
- using contactors for motor control.
- compliance requirements for devices for isolating circuits.

T6 Jogging and interlocking encompassing:

- purpose and application of jogging control of motors
- operation of motor control using start, stop and jog buttons
- purpose and application of electrical/mechanical interlocking
- developing a multiple motor starting circuit from a description of the circuit operation including jog and interlock functions.
- selecting circuit components using manufacturers' catalogues for appropriate duty ratings
- connecting and testing a multiple motor starting circuit which incorporates start, stop and jog control.

T7 Control devices encompassing:

- common control devices used in automatic control circuits: limit switches, proximity switches, photoelectric cells, pressure switches, float switches, light sensors and temperature sensors
- basic operating principles of common control devices
- advantages and disadvantages of common control devices
- applications for common control devices
- selecting control devices using manufacturers' catalogues for specified applications
- connection of control devices into control circuits

T8 Programmable relays encompassing:

- programmable relays - advantages over electromagnetic relay circuit control.
- typical applications of programmable relays.
- block diagram representation and basic operating principles
- input and output parameters, listing, connections and output types.
- connecting input and output devices to a programmable relay using a diagram
- basic programming of ladder circuits consisting of inputs, outputs i.e. stop-start circuit
- using the monitoring facility of the programmable relay to verify each ladder circuit operation.
- programming timers and using the monitoring facility of the programmable relay to check the values of the timer

- external devices
- implications of programming normally closed field devices
- conversion of control circuits
- installation of programmable control relays
- common faults and their symptoms

T9 Three-phase induction motor starters encompassing:

- reasons for limiting the starting current of large motors.
- requirements of the wiring rules (AS/NZS 3000) and the local supply authority service rules, with regard to starting and control of induction motors.
- DOL starter operating principles, applications and circuits
- electronic (soft) starter operating principles, applications and circuits
- connecting a DOL motor starter and testing the operation of the power and control circuits
- installation of DOL and soft starters

T10 Three-phase induction motor starters- reduced voltage encompassing:

- star-delta starter operating principles and circuits
- primary resistance starter operating principles and circuits
- auto-transformer starter operating principles and circuits
- secondary resistance starter operating principles and circuits
- common applications for each starter type
- comparison of motor starters basic characteristics
- selecting the most suitable motor starter for a given situation
- connecting motor starter power and control circuits for correct operation
- measuring starting current and torque of selected motor starters
- installation of reduced voltage starters

T11 Three-phase induction motor reversal and braking encompassing:

- reversing operating principles and control circuits
- plug braking operating principles and circuits
- dynamic braking operating principles and circuits
- regenerative braking operating principles and circuits
- eddy current brakes operating principles and circuits
- mechanical brakes operating principles and circuits
- comparison of the difference braking methods used.
- typical applications for each braking method.
- connecting a circuit with a braking feature to operate a three-phase motor.
- installation of motor braking control circuits

T12 Three-phase induction motor speed control encompassing:

- pole changing operating principles and circuits

- variable frequency drives operating principles and circuits
- slip-ring motors operating principles and circuits
- installation of motor speed controllers.

KS01-EG149 Polyphase power circuit analysis

A

Evidence shall show an understanding of polyphase power circuit analysis to an extent indicated by the following aspects:

T1 Polyphase supply system encompassing:

- advantage of three phase system compared to single phase systems
- double subscript notation
- phase sequence
- 120 degree operator
- given circuit component parameters, solve practically based problems using:
- equivalent circuits of transformers, lines and loads.
- component values using rectangular and polar notation.
- current divider and potential divider rules using complex impedances.
- The "per unit" values of voltage, current, VA and impedance to a common VA base.

T2 Types of three phase system connections encompassing:

- supply to balanced star, 3 and 4 wire loads
- supply to delta connected loads
- effects of phase reversal
- representation of currents and voltages as complex phasors for 3 phase and 3 phase and neutral quantities.
- calculation the values of and draw labeled phasor diagrams, not to scale, to represent complex values of current and voltage for balanced and unbalanced loads for star and delta systems.
- calculation of values of P, Q and S for balanced and unbalanced systems.
- draw and label single phase diagrams to represent 1 phase of a complex 3 phase system.
- represent unbalanced voltages or currents as symmetrical components.
- Phase to phase currents
- Phase to neutral/earth currents.

T3 Balanced three phase loads encompassing:

- calculations of balanced loads connected in star
- calculations of balanced loads connected in delta
- calculation of steady state values of fault current for various configurations.
- evaluation of the symmetrical component impedances for the various distribution system components. Transformers (earthed neutral case). Generators (high impedance earth)
- calculation of fault currents using the per unit approach.
- calculation using the "worst case" values based on transformer impedance only (ie., a short circuit fault)
- estimation of peak values using accepted multipliers.
- effects of the d.c. component on the instantaneous magnitudes of fault currents in transformers and generators.

T4 Unbalanced three phase loads encompassing:

- Star – 4 wire systems
- Delta systems
- Star – 3 wire systems
- Star 4 wire with neutral impedance

T5 Power in three-phase circuits encompassing:

- summation of phase powers and power in balanced loads
- measurement of power in balanced loads – 2 Wattmeter methods

T6 Reactive three phase power encompassing:

- power triangle calculation
- measurement of VAR
- power factor correction

T7 Fault currents encompassing:

- symmetrical components
- positive, negative and zero sequence impedance
- fault current breaking and let-through energy capacities of circuit breakers, fuses
- importance of fault/arc impedance
- calculation of fault currents - phase-to-earth faults
- calculation of fault currents - phase-to-phase faults
- analysis of asymmetrical faults currents.

T8 Harmonics in three phase systems encompassing:

- presence of triple in harmonics in 3 phase systems
- effects of 3 phase harmonics for different star and delta connections.
- methods for reducing harmonics in three phase systems.

KS01-EG171A Interval metering

Evidence shall show an understanding of interval metering to an extent indicated by the following aspects:

T1 Reasons for metering and the regulated market (Regulations)

T2 Metering layouts and requirements

- purpose, types and applications.
- metering equipment.
- varying arrangements for metering and meter layouts

T3 Interval metering concepts and installation

- Meter types
- Meter construction – block diagram
- Meter functions
- Importing and exporting energy
- Classes of meters
- Single and polyphase meters
- Purpose, types and applications.
- Installation and power connection arrangements.
- Communication methods and arrangements.
- Connections for gas metering.
- Procedures for setting meter parameters.
-

2 Discipline H - Electronic

Discipline H – Electronic

KS01-EH091A Electronic communications - air navigation systems

Evidence shall show an understanding of electronic communications - air navigation systems to an extent indicated by the following aspects:

- T1 Aviation navigation services and principles encompassing:
- role of navigation aids in providing Air Traffic Control Services.
 - functions provided by navigational aids
 - Rho Theta concept in context of navigational aids used within aviation.
 - relevant ICAO (Annex 10) specifications
 - Monitoring – equipment, status and pilot
- T2 Principle of operation of the NDB encompassing:
- simple block diagram of an NDB
 - frequency band of operation
 - parameters ICAO requires to be monitored
 - typical radiation hazard issues
 - simple block diagram of the aircraft Automatic Direction Finding (ADF) display
 - NDB is used by Pilots and ATC
- T3 Principle of operation of the CVOR/DVOR encompassing:
- simple block diagram of a CVOR labelling each part.
 - basic principles of variable and reference information
 - RF phasing and far field space modulation
 - frequency band of operation.
 - features of a typical aircraft display
 - possible errors and their cause in a CVOR.
 - typical CVOR and DVOR facilities.
 - main differences of operation between CVOR and DVOR.
- T4 Principle of operation of the DME encompassing:
- simple block diagram of a DME
 - typical timing diagram from interrogation to reply.
 - features of aircraft display system
 - frequency band of operation
 - modes of operation.
- T5 Principle of operation of the ILS
- frequency band of operation
 - simple diagram of the localiser antenna pattern marking on it the zero DDM line, the represented colour and modulating frequency of each lobe and the clearance signal.
 - simple sketch showing the glide path and the location of the marker beacons listing their identification, frequency and duration.
 - simple block diagram to show the generation of the Carrier and Sidebands and Sideband only signals.
 - ILS antenna arrays and farfield radiation patterns

- Far field phasing and space modulation
- terms DDM, and SDM.
- performance requirements for CAT I, CAT II and CAT III ILS

T6 Principle of Global Navigation Satellite System (GNSS)

- basic principles of the Wide Area Differential Global Positioning System (WADGPS)
- basic principles of the Local Area Differential Global Positioning System (LADGPS)

T7 NDB Technology and Maintenance.

- key functional modules of a contemporary NDB transmitter.
- function of the aerial coupling unit.
- radiation hazard issues, site restrictions and safety considerations in context of an NDB facility.
- signals in and out of the main components
- key features and theory of operation of an NDB antenna (Field Pattern, Capacity hat and Ground Plane)
- hardware configurations of current models of NDB used in the National Airways System of Australia.
- indicators on NDB equipment that may be used to determine status and locate a fault
- method(s) for conducting routine performance measurements on NDB equipment.
- process for removing an NDB from service.
- correct test equipment based on measurement tolerance and parameter being measured.
- correct use of selected test equipment.
- process for returning the aid to service
- locate and identify appropriate NDB documentation (AEIs)
- Flight Check of an NDB is mandated.

T8 DME Technology and Maintenance.

- key functional modules of a contemporary DME beacon.
- modes of operation and relevant channel spacing for the Interrogation and Reply of the Beacon.
- purpose of the "squitter".
- typical DME Block Diagram, the signal flow through the Beacon from incoming interrogation to outgoing Reply.
- function of each module in a contemporary DME.
- term "Gaussian Shaped Pulse" and why it is used.
- operation and purpose of the identification signal including test transmissions.
- define "Dead Time"
- monitored parameters of a DME.
- controls and indicators
- correct ON/OFF sequence
- process for removing a DME from service.

- auto-recycle operation
- typical function of the CTU for testing
- typical Alarm Registers
- measurement of parameters such as: Beacon Delay, Pulse Spacing, Pulse Width, Ident, Beacon Sensitivity, Selectivity, Reply Rate, Dead Time, Frequency, Monitor limits, Antenna VSWR, using the correct test equipment.
- correct use of test equipment.
- correlate the measurements to the Standard Operating Conditions (SOC)
- maintenance actions that may be performed without the requirements of a flight inspection
- Flight Calibration Check of an DME is mandated.
- process for returning the aid to service
- locate and identify appropriate DME documentation (AEIs)

T9 CVOR Technology and Maintenance.

- principles of operation of a VOR and how the component signals are generated in a contemporary CVOR beacon.
- basic operation and functionality of the; Transmitter, Goniometer, Modulation Eliminator, Monitor, Antenna
- typical monitored parameters for a CVOR
- purpose of monitor bypass
- correct use of test equipment and interpretation of results, SOC's
- measurement of performance parameters using the correct test equipment.
- correct use of test equipment.
- correlate the measurements to the Standard Operating Conditions (SOC).
- maintenance actions that may be performed without the requirements of a flight inspection
- maintenance actions that do require a flight inspection
- importance of beacon accuracy

T10 DVOR Technology and Maintenance.

- principles of operation of a DVOR and how the component signals are generated in a contemporary DVOR beacon.
- basic operation and functionality of the; modules used in the following sub systems; Carrier generation and modulation, Timing sequence generation, Sideband amplifier and modulator, Sideband antenna commutation, Monitor and Controller
- front panel indications under normal and fault conditions
- operation and functionality of the following circuits; Carrier amplifier and modulation (CGD, CPA, CDC, CMP), Timing signals generation (TSD), Reference phase generator (RPG), Antenna switching (ASD, ADS), Sideband generator (SGN, SMA, SCU), Control unit (CTU), Monitor unit (MRF, MSC, MFI, MBD, MSD).
- typical monitored parameters for a DVOR
- correct use of test equipment and interpretation of results, SOC's

- measurement of performance parameters using the correct test equipment
- correct use of test equipment.
- correlate the measurements to the Standard Operating Conditions (SOC).
- maintenance actions that may be performed without the requirements of a flight inspection
- maintenance actions that do require a flight inspection
- importance of beacon accuracy

T11 ILS Technology and Maintenance.

- ILS functional blocks and typical cabinet modules of a Localiser and Glide Path (NM7000 series).
- main functional elements of a contemporary marker beacon.
- location and function of modules and system interconnections; Transmitter, Changeover, Monitor, Transmitter controller, Remote control, RMS/RMM, Power
- block diagram illustrate at specified points, the signal flow out from the distribution side and/or return via the recombination side of a Localiser and/or Glide Path
- operation of a specified Localiser antenna array.
- operation of an 'M'-Array or other specified Glide Path antenna array
- the features and function of the RMM and/or RMS.
- performance requirements for CAT I, CAT II and CAT III ILS and how these are provisioned in the system hardware and monitoring.
- function of equipment indicators and controls, including the correct operation of controls to achieve a nominated function
- typical monitored parameters for a Localiser, Glide Path and Marker beacon
- correct use of test equipment (BITE and external) and interpretation of results, SOCs
- measurement of performance parameters using the correct test equipment.
- correct use of test equipment.
- correlate the measurements to the Standard Operating Conditions (SOC).
- maintenance actions that may be performed without the requirements of a flight inspection
- maintenance actions that do require a flight inspection
- typical tests and maintenance actions required during a flight calibration of an ILS

KS01-EH092A Electronic communications air surveillance systems

Evidence shall show an understanding of electronic communications - air surveillance systems to an extent indicated by the following aspects:

T1 Basic Radar Principles encompassing:

- requirement of surveillance to support efficient, safe and effective ATC operations
- aircraft aspects

- basic radar history
- electromagnetic waves
- radiation hazards and OHS considerations
- radar principles of operation
- types of radar and radar block diagram
- main inputs and outputs for designated blocks of a given diagram
- requirement for redundancy
- go / no go concept
- radar performance limitations
- different types of radar self testing
- surveillance- original environment, developing environment
- surveillance users
- radar locations and radar coverage map

T2 Principles of operation of a Primary Surveillance Radar (PSR) encompassing:

- purpose of a PSR
- principles of radar blind speed and measures to overcome this
- why radars use pulse compression and list the types of modulation used
- diversity operation is used in Primary radars
- radiation pattern for a 'cosec²' and slotted waveguide antenna
- radars use high / low coverage
- features of Primary radars currently in service

T3 Principles of operation of a Classical Secondary Surveillance Radar (SSR) encompassing:

- similarities and differences between PSR and SSR
- requirement to use wobble
- relevant ICAO (Annex 10) specifications
- modes of operation
- transponder special replies and their functions
- SSR radiation patterns
- reasons for "No Reply" from an aircraft
- define garbling
- define FRUIT
- function of a Site Monitor
- advantages and disadvantages of SSR over primary radar
- features of classical SSRs

T4 Principles of operation of a Mode S Secondary Surveillance Radar encompassing:

- improvements Mode S has over classical SSR
- ICAO requirements relating to the use of aircraft addresses and Interrogator Codes
- purposes of All-call and roll-call interrogations

- principles of acquiring aircraft
 - users of Mode S Transponders
 - protocols used to reduce FRUIT
 - principles of All-call Lockouts and Lockout Overrides
 - requirement for Classical SSR and Mode S SSR compatibility
 - benefits to a controller of using elementary and enhanced surveillance
 - features of Mode S SSRs
- T5 Principles of operation of Radar Track Processors encompassing:
- function of radar track processor currently in service
- T6 Principles of operation of Radar RCMS
- requirement for radar RCMS
 - Radar RCMS network layouts
- T7 Principles of operation of ADS encompassing:
- principles of operation of ADS-B
 - aircraft data transmitted by ADS-B
 - aircraft ADS-B transmission rates
 - principles of operation of ADS-C
- T8 Principles of operation of Multilateration encompassing:
- introduction, definition and history of Multilateration
 - TDOA concepts
 - Airport / local area concept
 - Airborne / wide area concept
 - Data and identification
 - Surveillance strategies
 - MLAT coverage
 - principles of operation of MLAT
 - message formats used by MLAT systems
 - similarities and differences between MLAT and ADS-B systems
- T9 Principles of Surveillance Track Messages encompassing:
- requirement for duplicated data paths
 - ATS Centre processing and displaying of surveillance tracks
 - contents of data messages sent from radar sites
 - contents of data messages sent from ADS-B radar sites
- T10 Principles of ACAS/TCAS encompassing:
- purpose and types of ACAS/TCAS
 - function of ACAS/TCAS
 - how ACAS/TCAS acquires and tracks aircraft
 - ICAO requirements with respect to complying with RAs

T11 Performance characteristics and checks encompassing:

- measurement of radar PRF
- measurement of radar pulse shape / timing check
- measurement of radar transmitter frequency
- performing radar spectrum check
- identification of radar performance with or outside documented performance limits
-

2 Discipline I - Instrument

Discipline I – Instrument

KS01-EI038 Electrical and pneumatic control fundamentals

A

Evidence shall show an understanding of electrical and pneumatic control fundamentals to an extent indicated by the following aspects:

T1 Electrical and pneumatic safety encompassing:

- Hazardous and safe working methods and procedures
- Pneumatic operating pressures
- Isolation procedures

T2 Electrical/pneumatic drawing types and applications encompassing:

- Drawing layouts and conventions (electrical and pneumatic schematics, wiring and piping diagrams)
- Drawing symbols

T3 Electrical and pneumatic control system components

- Electrical components include power, HMIs, relays, plug and socket connectors; Pneumatic components include air supply systems, HMIs, valves, actuators, tubing and connectors.

T4 Electrical relay types encompassing:

- Operation
- Contact configurations

T5 Pneumatic control valves and actuators encompassing:

- Types and their operation
- Activated and deactivated configurations

T6 Basic logic as applied to control systems

- Logic confined to AND, OR, NOT and NOR functions

KS02-EI038 Variable speed drive (VSD) functions and configuration**A**

Evidence shall show an understanding of variable speed drive (VSD) functions and set up to an extent indicated by the following aspects:

- T1 Basic function of a variable speed drive in controlling an induction motor.
- T2 Configuring a variable speed drive encompassing:
 - Configuration includes setting rated motor voltage and current, digital and analogue inputs, speed range, ramp times and the like.
- T3 Testing procedures

KS01-EI040A Integrated systems installation requirements

Evidence shall show an understanding of integrated systems installation requirements to an extent indicated by the following aspects:

- T1 Bus system parameters encompassing:
 - How bus systems work
 - Network topology
 - Voltage and current limits
 - Cable type and length limits
 - Network impedance
 - Network and device status indication
- T2 LV supply voltage parameters and quality.
 - Supply sources such as UPS and inverters may adversely effect voltage parameters and waveform.
- T3 Cabling encompassing:
 - Insulation resistance testing precautions and prohibitions
 - LV cable terminations and conductor size
 - Bus cable polarity and pairing
 - Bus cable termination requirements and techniques
 - Field and enclosure segregation requirements (Segregation is required by both AS/NZS 3000 and AS/ACIF S009).
- T4 Supply and load protection encompassing:
 - Conductors and protection device co-ordination (AS/NZS 3000:2007 Clause 2.5.3.1)

- Use of residual current devices
 - Protection on supply and load side of system devices (IEC 60669-2-1 protection requirements).
- T5 Output devices encompassing:
- Relays connections for ELV and LV loads
 - Dimmer types
 - Supply and load connections for the various dimmer types
- T6 Installation requirements for input devices encompassing:
- Passive infrared detectors
 - Light level control
 - Key inputs
 - Touch screens
- T7 Acceptable and unacceptable topologies for a single network
- T8 Devices and connections for other control methods encompassing:
- DSI (Distributed Signaling Interface) Gateway dimming and control
 - Devices and connections DALI (Digital Addressable Lighting Interface) dimming and control
 - Zero to 10 volts analogue control.

KS01-EI041A Integrated systems operating parameters and programming

Evidence shall show an understanding of integrated systems operating parameters and programming to an extent indicated by the following aspects:

- T1 Applications and advantages of integrated systems
- T2 System components encompassing:
- Support devices for control bus supply and control
 - Support devices for programming, interconnection between networks and integration with third party systems.
 - Types and capabilities of output devices.
 - Lighting dimmer capabilities and selection
 - Controlling DSI and communicating with DALI electronic ballasts
 - Types and capabilities of input devices
- T3 Network specifications encompassing:
- Bus system cable type, polarity, length and acceptable topologies.
 - Importance of the location of output and input devices and control bus power supplies

- Ensuring control bus stability (stability can be effected by number of units on a network, current drawn by devices in relation to current output of power supplies).
 - Multiple network connectivity
 - LV supply overcurrent and surge protection.
- T4 Software for system and device programming, monitoring and controlling
- T5 System and device programming encompassing:
- Addressing conventions for networks, devices, applications, output groups, types of control and outputs (Output include 'on', 'off', a specific level, over a specific time and the like).
 - PC programming tools and methods (programming includes configuring network data base using addressing tools and objects, function objects, editing, altering and transferring the data base to network)
 - Importance of project documentation and backup
- T6 System fault-finding processes
- Fault-finding includes the use of multimeters, oscilloscope, system analysers and diagnostic software.

KS01-EI042A Touch screen installation requirements and programming in integrated systems

Evidence shall show an understanding of the installation requirements and programming of touch screens in integrated systems to an extent indicated by the following aspects:

- T1 Integrated system touch screen types, features and parameters.
- T2 Touch screen mounting methods and manufacturer's instructions
- T3 Touch screen wiring and connection arrangements encompassing:
- Power supply
 - Integrated network
 - Audio
 - Video
 - IR control
 - Programming
 - Network
- T4 Electrical protection requirements
- T5 Programming requirements and process
- T6 Programming software specifications and tools
- T7 HMI programming techniques with proprietary software encompassing
- Component types
 - Component properties

- Arranging visible properties and creating screen embellishment
- Setting integrated system properties of components (components can be text, images, shapes, buttons, sliders, level indicators, clocks, monitors, HTML, web cam images and the like).

T8 Methods for transferring and project data and backing up.

KS01-EI043A Logic-based programming for integrated systems

Evidence shall show an understanding of logic-based programming for integrated systems to an extent indicated by the following aspects:

T1 Integrated system hardware parameters and limitations

T2 Integrated system configuration software features and options.

- Features include touch screen colours, file management, file import and export.

T3 Logic gates as they apply in integrated system control

T4 Logic-based software tools encompassing:

- Functions, actions, variables and limitations
- Basic code syntax
- Compiling and editing
- Exporting and archiving
- Monitoring usage

KS01-EI044A Multiple access to integrated systems programming

Evidence shall show an understanding of multiple access to integrated systems programming to an extent indicated by the following aspects:

T1 Gateway devices encompassing:

- Component
- Installation requirements
- Regulatory requirements

T2 Network set up encompassing:

- Terminology
- Network options
- Ethernet connectivity
- Wireless connectivity
- Router configuration

T3 Controller user interface

T4 Programming software and application

- Confined to proprietary software such as ‘wizards’, icons and widgets.

T5 Interface web browsers

2 Discipline J - Refrigeration and Air Conditioning

Discipline J – Refrigeration and Air Conditioning

KS01-EJ102A Refrigerant tubing and fittings techniques

Evidence shall show an understanding of cutting, bending and joining refrigeration piping and tubing tools, equipment and techniques, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Piping
 - Refrigeration & water grade copper tube
 - Maintaining cleanliness (always capped, do not blow out with mouth etc)
 - Soft and hard drawn tube
 - Tubing applications (soft, hard, pair coil, water grade etc)
 - Tube qualities - diameter, wall thickness (gauge) and pressure ratings (R410A etc)
 - Pipe insulation (types - tube, slit tube, sheet etc and joining methods - glue, tape etc)
 - Other tube materials (Bundy, steel, aluminum, brass)
- b) Cutting
 - Cutting tools (Imps, normal & large pipe cutters, tube cutting rings etc)
 - Precautions while cutting (sharp burrs, sharp blades etc)
 - Deburring tools (reamers, deburrers etc)
- c) Bending
 - Bending tools (springs, levers, presses etc)
 - Precautions while bending (work hardening, collapsing etc)
 - Bending hard drawn tube - the process of annealing
- d) Joining
 - Flare nuts (plain, short barrel, frost proof, reducing)
 - Flaring tools (flare block, eccentric with clutch for high pressure tube)
 - Precautions while flaring (deburred, length past block face, cleanliness)
 - Swaging tools (punch, flare block, expander etc)
 - Precautions while swaging (length past block face, tube shortening effect, cleanliness etc)
 - Other tube fittings (BSP to flare elbows, tees, unions, plugs, flare washers, Lokrings etc)
 - Thread sealants (tapes, pastes etc)
 - Access valves (Schrader, piercing, cut-away of service valve/s)

- Precautions using access valves (refrigerant leakage, core removal, limitations on piercing valves etc)
- e) Soldering and brazing equipment
 - Gas types (oxy acetylene, air acetylene, propane, Mapp gas)
 - Hazards associated with their use (cylinder transport, remove regulator, oil & oxy = bang)
 - Personal safety (MSDS - oxy, acetylene, propane, MAPP gas)
 - Flash back arrestors
 - Setting up equipment (fitting regulator, adjusting pressures, tip selection)
 - Igniting and flame types (flint guns, oxidising, neutral, carburising)
 - Care and maintenance of equipment (hoses, regulator, tips, cylinders, flash back arrestors)
- f) Silver solder
 - Types (yellow, brown, blue and their metal components)
 - Personal safety (MSDS - silver brazing alloys)
 - Flux and its use (dissimilar metals)
 - Personal safety (MSDS - flux)
 - Preparing surfaces (removing oxides, oils, applying flux)
- g) Soldering techniques
 - Dry nitrogen
 - Personal safety (MSDS - nitrogen)
 - Applying dry nitrogen to a piping circuit
 - Silver soldering copper to copper
 - Silver soldering copper to dissimilar metals
 - Annealing copper tube

KS01-EJ103A Basic operating conditions of vapour compression systems

Evidence shall show an understanding of basic operating conditions of vapour compression systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Refrigeration Industry
 - The history of the refrigeration industry (note that A/C is covered in another unit)
 - Applications, classifications and equipment used in the refrigeration industry
- b) Introduction to the Vapour Compression System
 - Basic Operation
 - Major Components
- c) Heat
 - Matter (atoms, molecules, energy and its different forms)

- Heat energy (definition, unit of measurement)
 - Enthalpy (definition, unit of measurement)
 - Heat flow (hot to cold)
 - Heat transfer
 - methods (conduction, convection, radiation)
 - requirements
 - effects
- d) Temperature and relative humidity
- Temperature
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Conversion to/from absolute values
 - Temperature difference/change (t_d , Δt , unit of measurement)
 - Relative humidity
 - Thermometer types and applications (digital, stem, dial, max/min, non-contact, data loggers)
 - Relative Humidity measurement devices and applications (dry bulb/wet bulb, sling, digital)
 - Hazards and related safe working practices (working near rotating machinery - fans, pulleys, belts etc)
 - Care and maintenance (bending stems, overheating, removing batteries after use, uncoiling capillary)
 - Calibration (boiling water, iced water, send to a specialist etc)
 - Appropriate and safe methods of use
 - Typical locations on a system
 - Fitting temperature and relative humidity instruments
- e) Sensible and Latent Heat
- Definition of specific heat capacity, latent heat and sensible heat (including units of measurement)
 - Types of latent heat
 - Heat calculations
- f) Pressure
- Pressure
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Vacuum scales (Pascals, microns)
 - Conversion to/from absolute values
 - The basic Gas Laws – Boyles, Charles and Daltons (excl combined or general gas law)
 - Pressure gauge types and applications (pressure, compound, vacuum, manometer, magnehelic, barometer)
 - Hazards and related safe working practices (dangerous system pressures)
 - Care and maintenance (ingress of oil and contaminants (dirt), avoiding needle bounce (esp. HP) etc)

- Calibration (atmospheric pressure, send to a specialist etc)
- Appropriate and safe methods of use
- Typical locations
- g) Refrigerant conditions
 - Saturation temperature
 - Saturated liquid / saturated vapour
 - Superheated vapour
 - Sub-cooled liquid
 - Pressure temperature relationships
 - P/T charts
 - Enthalpy
- h) The vapour compression cycle
 - Primary system components
 - High and low pressure sides
 - Basic system operation
- i) Working safely with refrigeration vapour compression systems
 - Risk management principles and processes
 - Hazards and risk control measures associated with:
 - refrigeration vapour compression systems and components
 - refrigerants
 - measuring and testing equipment
- j) Leak detectors
 - Detector types and applications (electronic, halide, bubble, ultra violet)
 - Hazards and related safe working practices (working around rotating machinery, open flame, ultra violet light etc)
 - Care and maintenance (delicate electronic equipment, changing sensor tip filters, changing gas cartridges etc)
 - Calibration (auto calibrating , send to a specialist etc)
 - Leak detection procedures
- k) Service gauges
 - Service Gauges
 - Types (dial gauges or electronic, manifolds with additional vacuum and charging ports & sight glasses)
 - Typical uses for service gauges (high & low side pressure readings, charging, evacuating)
 - Care and maintenance (oil and contaminants (dirt) in hoses, avoiding needle bounce, changing hose seals)
 - Calibration (hoses open to atmosphere, adjusting screw etc)
 - Hose shut-off valves and adaptors (access control valves, kwik couplers, Hansen lines etc)
 - System Access Fittings

- Types (Schrader, piercing, service valve, post valve, quick couplers etc)
 - Typical applications for each
 - Hazards and related safe working practices (oil or liquid spray, keeping clean, leaks etc)
 - Care and maintenance (gland nuts loosened/tightened, seal caps fitted, regulations on piercing valves)
 - Using Service Gauges
 - Service gauge manifold hose fitting
 - Purging
 - Pressure readings
 - Service gauge manifold hose removal
 - Pressure to temperature conversion
- l) Refrigeration Compressors
- Function of the compressor
 - Compressor styles (open drive, semi-hermetic, hermetic)
 - Types, construction and their applications (reciprocating, rotary, centrifugal, screw, scroll)
 - Basic types of compressor oil (Mineral, Polyolester (POE), Alkyl Benzene, Polyalkylene Glycols (PAG)) (brief overview - covered in more detail in J8)
 - Methods of lubrication (splash, forced)
 - Safe handling (MSDS - POE's, PAG's, Mineral, AB's - Residual acid's in used oil)
- m) Condensers and related components
- Function of the condenser
 - Types, construction and their applications (static, forced draught, water cooled)
 - Function of a cooling tower
 - Types, construction and their applications (natural, induced, forced, evaporative)
 - Function of water pumps
 - Basic Types and their applications
 - Function of liquid receivers
 - Types, construction and their applications (horizontal, vertical, combined condenser/receivers)
- n) Evaporators and related components
- Function of the evaporator
 - Evaporator styles (direct expansion, flooded)
 - Types, construction and their applications (static, forced draught, water cooling)
 - Refrigerant/air/water flow paths (forced/induced draft, parallel/counter flow)
 - Need for water treatment in water systems
 - Methods used to provide water treatment (brief overview)
 - Regulations governing water treatment (brief overview)
 - Secondary refrigerants (brief overview)

- Properties & applications of secondary refrigerants (water, sodium/calcium chloride, ethylene/propylene glycol)
- Hazards associated with their use (MSDS)
- o) Common Refrigerant Metering Devices
 - Function of a refrigerant metering device
 - Overview of common types and their applications (capillary tube and TX Valve)
 - Basic Operating Conditions
 - Ambient conditions
 - Common climate values (highest max temp, lowest min temp, mean daily temp, mean highest/lowest)
 - Typical climates for various common localities
 - Evaporator Td
 - Effect of changes in Evap. Td and typical industry reference values for water cooled, forced draught and static coils
 - Condenser Td
 - Effect of changes in Cond. Td and typical industry reference values for water cooled, forced draught and static coils
 - Typical storage conditions (temp & RH) for common products (dairy, produce, meat and frozen food rooms)
 - Typical high and low side system operating values (pressures and temperatures allowing 1K equivalent PD)
 -

KS01-EJ104A Basic air conditioning operating conditions

Evidence shall show an understanding of basic air conditioning operating conditions, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) The Air Conditioning Industry
 - Industry classifications (Domestic, Commercial, Industrial and Transport)
 - Applications (shopping centres, housing, offices) and typical equipment used in each classification (split systems, central plant, chemical production etc)
 - Types of systems commonly used such as self-contained units (RAC's), split systems, ducted systems, package units and central plant systems.
- b) Working safely with air conditioning systems
 - Risk management principles and processes
 - Hazards and risk control measures associated with:
 - air conditioning systems and components
 - measuring and testing equipment
- c) Temperature & relative humidity measuring devices
 - Thermometer types and applications (digital, stem, dial, max/min, non-contact, data loggers)

- Relative Humidity measurement devices and applications (dry bulb/wet bulb, sling, digital)
 - Hazards and related safe working practices (working near rotating machinery - fans, pulleys, belts etc)
 - Care and maintenance (bending stems, overheating, removing batteries after use, uncoiling capillary line)
 - Calibration (boiling water, iced water, send to a specialist etc)
 - Typical locations where values are commonly obtained (temp, RH %)
 - Obtaining temperature and relative humidity readings
 - Recording temperature and relative humidity readings (using DB/WB method and/or electronic)
- d) Air velocity measuring devices (Anemometers only)
- Anemometer types (digital vane, hot wire)
 - Typical applications for each
 - Air speed (velocity and its units of measurement)
 - Air flow rate (volume flow rate and its units of measurement)
 - Methods for setting up and using anemometers (hood, patch, sweep)
 - Hazards & safe working practices (working near rotating machinery - fans, pulleys, belts / working at height)
 - Care and maintenance (maintaining vane balance (bent blades), removing batteries after use etc)
 - Calibration requirements (by specialists)
 - Typical locations where air velocity measurements values are commonly obtained (grilles and outlets etc)
 - Obtaining and recording air velocity readings (using the patch method and/or sweep method)
 - Calculating volume flow rate from an outlet/grille
- e) Psychrometrics
- Composition of air
 - Psychrometric chart
 - Terms used in the study of air (and their units of measurement) (DB, WB, RH%, dew point, enthalpy, moisture content)
 - Sensible heat, latent heat and total heat
 - Sensible heat ratio
 - Plotting basic points on a chart (supply air, return air)
 - Reading additional information (dew point, moisture content, RH%, specific heat capacity, enthalpy)
 - Values relevant to a plotted process and plotting a simple process on a psychrometric chart
 - Basic air conditioning processes
 - Factors effecting human comfort (temp, RH%, air velocity, noise, cleanliness, fresh air)

- Industry recognised human comfort conditions
 - The comfort zone
 - Basic processes used to obtain comfort conditions (sensible cooling, dehumidifying, humidifying etc)
- f) Ventilation
- Basic needs for ventilation (removal of stale air, removal of toxic gases e.g. car parks, welding bays etc)
 - Methods used to ventilate an area (natural, supply, exhaust)
 - Typical applications for ventilation systems (car parks, kitchens, toilets etc)
- g) Regulations
- Covering ventilation (AS1668 parts 1 & 2)
 - Common council requirements/regulations (no DA required, noise levels not exceeding 5dBA above background, fresh air in residential situations etc)
 - Fresh air requirements for typical situations (calculate using floor area method and air change method)
- h) Heat loads
- Sources of sensible heat in an air conditioned space
 - Sources of latent heat in an air conditioned space
 - Changes in sensible/latent ratios and their effect on operating system capacity
 - Industry check figures
 - Basic room heat load calculation using check figures
 - Basic RAC/split system unit selection
 -

KS01-EJ105A Split air conditioning and water heating heat pump system installation

Evidence shall show an understanding of split air conditioning and water heating heat pump system installation, start-up and decommissioning, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Sustainable energy
- The earth's atmosphere
 - The greenhouse effect
 - Energy usage in Australia (gases, coal, fuel oil etc)
 - Projected population increase and its effects
 - International and national greenhouse imperatives: the role of regulators and similar bodies (Kyoto Protocol)
- b) Sustainable energy work practices
- Definitions
 - Renewable energy technologies (solar, wind, biomass, geothermal, tidal, hydro, nuclear)
 - The concept of co-generation
 - Economic benefits of sustainable energy initiatives

c) Heritage awareness

- Heritage listings (concept and types (world, national, commonwealth etc))
- Purpose of regulations related to maintenance of listed sites
- Responsibilities while working in and around listed sites
- Environmental protection
- Government agencies (AGO, EPHC, DEC etc)
- Environmental protection (land, water, atmosphere, human settlement, biodiversity etc)
- Purpose of regulations related to environmental protection
- Responsibilities while working in and around environmentally protected sites
- Protocols for working in and around protected sites (legislated acts - ozone protection etc)

d) Relevant installation codes

- Applicable standards and codes (building, electrical, health, environmental – OH&S act, ozone protection act, Refrigerant Handling Code of Good Practice
- Introduction to MEPS (minimum energy performance standards) and the star rating

e) Split air conditioning systems

a. Types and applications

- categories (high wall, floor mounted, ceiling mounted, cassette, ducted)
- sub categories (single head, multi head)
- types (cooling only, reverse cycle, inverter, dc)
- typical applications for each category / type
- system ratings (hp vs kw, standard ambient conditions for capacity ratings ,actual star rating examples)
- Components, construction and operation
- evaporators (finned induced and forced draught)
- metering devices (capillary, restrictor)
- service ports (ball valves, post valves, schrader valves)
- reverse cycle (reversing valves)
- air distribution – non-ducted (fans, filters, swing louvers etc)
- air distribution - ducted (ducting types, bto's, dampers, outlets, grilles, plenums, filters etc)
- typical ducting layouts (maps)
- typical mechanical system layouts (cooling only, reverse cycle)
- evaporating and condensing temperatures / pressures - design and typical operating values
- controls - operating and safety (encapsulated lp & hp sensors, compressor overload, de-ice stat etc)

f) Split water heating heat pump systems

- Types and typical applications. including hot water heating and swimming pool heating

- Components, construction and operation
 - Cooling coil
 - Heating coil
 - Metering devices (capillary, restrictor)
 - Service ports (ball valves, post valves, Schrader valves)
 - Typical mechanical system layouts
 - Evaporating and condensing temperatures / pressures - design and typical operating values
 - Controls - operating and safety (encapsulated LP & HP sensors, compressor overload, etc)
- g) Installation of unit and pipework
 - Respect for customers premises (on-time, respectful language, private commodities, toilets, clean-up etc)
 - Noise and vibration (problems for neighbours, typical council requirements)
 - Location & mounting - outdoor unit (suitable locations, slabs, brackets (wall/roof), machine pads (e.g. waffle) etc)
 - Location & mounting - indoor unit/water heater (suitable locations, penetrations, hanging, mounting methods)
 - Refrigerant piping (layout, installation, insulation, pair coil, protection (steel trunking, plastic pipe duct))
 - Condensate drains and pumps (correct drainage, safety drain on FCU, condensate pumps)
 - Personal safety (safe lifting, correct use of ladder and platforms)
 - Manufacturers installation instructions (examples of typical manufacturers installation guides)
 - Electrical connections by electrician
 - Mains water connections by plumber
- h) System start up
 - Manufacturers start-up instructions (examples of typical manufacturers guides)
 - Pressure testing refrigerant pipework and system (nitrogen)
 - Evacuation
 - Opening outdoor unit valves
 - Checking refrigerant charge (pressures, temperatures, sweat line, evaporator superheat etc)
 - Adding refrigerant (manufacturers recommended top-up values for longer pipework runs)
 - Leak detection
 - Customer familiarisation (completing warranty card, operating instructions, general maintenance instructions)
- i) De-commission split air conditioning systems
 - Closing isolation valves on outdoor unit.
 - Indoor unit pump down and recovery

- Sealing refrigerant components
- Electrical isolation and disconnection by electrician
- Mains water isolation and disconnection by plumber
- Unit, piping, drain and electrical cable removal
-

KS01-EJ106A Refrigerant pipework, flow controls and accessories

Evidence shall show an understanding of refrigerant pipework, flow controls and accessories, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Environmental and building regulation
 - types of heritage listings
 - purpose and principles of regulations related maintaining heritage sites
 - responsibilities of those working in and around heritage sites
 - scope of environmental protection and related regulations
 - purpose and principles of regulations related to environmental protection
 - responsibilities of those working in and around environmentally protected sites
 - the protocols for working in and around protected environments and heritage sites.
- b) Refrigeration pipework
 - appropriate piping arrangements for refrigerant lines including discharge lines, liquid lines, suction lines
 - position of equipment in relation pipework
 - requirements for vertical and horizontal pipe runs.
 - requirements for oil return and prevention of flood back
 - techniques for the prevention of noise and vibration
 - insulation requirements and materials
 - pipework insulation requirements, including relevant technical standards, regulations and codes
 - pipe work installation techniques
 - insulation requirements and materials
- c) Refrigerant pipework accessories
 - types
 - including pipe work fittings, hand valves, isolation valves, solenoid valves, check valves, reversing valves, filter/dryers, sight glasses, accumulators, oil separators, pressure relief devices
 - applications
 - operation
 - location and installation
 - testing

- replacement
- d) Refrigerant liquid flow controls and distributors
 - types
 - including capillary, hand expansion valve, thermostatic expansion valve, thermo-electric expansion valve, electronic expansion valve, low side floats, high side floats, liquid level controllers
 - applications
 - operation
 - location and installation
 - testing and adjusting settings
 - replacement
- e) Refrigerant vapour flow controls
 - types
 - including evaporator pressure regulators, crankcase pressure regulators, condenser bypass valves, electronic valves/controllers
 - applications
 - operation
 - location and installation
 - testing and adjusting settings
 - replacement
 -

KS01-EJ107A Refrigeration and air conditioning refrigeration systems, major components and associated equipment installation

Evidence shall show an understanding of refrigeration and air conditioning refrigeration systems, major components and associated equipment installation, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Refrigeration equipment installation requirements and procedures
 - Standards, codes and requirements applicable to installing refrigeration equipment
 - Environmental and building regulations
 - Major components and associated equipment including condensing units, compressors, condensers, cooling towers, liquid receivers, evaporators, fan coil units, package units, fans and air distribution equipment, pumps
 - Functions, types, operation and applications
 - Installation techniques encompassing: manufacturers specifications and installation instructions; locating and placing major components
 - Accessories installation
 - Connecting piping
 - Maintenance of fire rating integrity.
- b) Cool room and freezer room systems installation requirements and procedures
 - Food spoilage encompassing; Effects of storage conditions, Controlled atmosphere,

- Relative humidity, Evaporator temperature difference, Room design conditions
- Room types and construction encompassing; Pre-fabricated and permanent type walk-in cool rooms and freezer rooms, Construction, Insulation, Vapour barrier, Frost heave, Interior fittings
 - Layouts and installation encompassing; Location of equipment, Equipment site arrangements and building services, Access and obstructions, Power supply and electrical services, Arrangement of piping
 - Components and features encompassing; Refrigerant controls, Evaporators, Solenoid valves, Crankcase pressure regulators, Defrosting method and mullions, Drain facilities and heaters, Pressured relief valves, Door hardware, Lighting and germicidal lamps
 - System and defrost controls encompassing; Operating conditions, Thermostat and pressure controls, Defrost timers and controllers, Overloads and safety control, Electrical power and control circuits
 - Manufacturers specifications and installation instructions
 - Relevant Standards, codes and Regulation requirements
 - Relevant Public Health requirements
- c) Merchandising and display cabinets installation requirements and procedures
- Types and construction encompassing: Deep freeze meat, dairy, and fruit and vegetables, Multi deck display type, Single deck, well type and island cases, Glass door/reach-in merchandiser
 - Components and features encompassing: Condensing units, Refrigerant controls, Evaporators and fans, Defrosting method and mullions, Drain facilities and drain heaters, Air distribution and air-flow, curtains, Cabinet air temperature, velocity and direction, Accessories, Lighting
 - Layouts and installation encompassing: Location of equipment, Equipment site arrangements and building services, Access and obstructions, Power supply and electrical services, Arrangement of piping
 - System and defrost controls encompassing: Operating conditions, Alarm systems, Thermostats and pressure controls, Defrost timers and controllers, Electrical power and control circuits
 - Multiple systems encompassing: Multiple compressors, Multiple evaporators, Heat reclaim systems, Multi-temperature accessories, Controls and sequencing,
 - Manufacturers specifications and installation instructions
 - Relevant Standards, codes and Regulation requirements
 - Relevant Public Health requirements
- d) Residential air conditioning systems installation requirements and procedures
- Types, components, construction, operation and application of residential air conditioners encompassing: Types: window mounted, high wall, floor and ceiling mounted, cassette and ducted, Typical applications for various types of systems, Components, Construction and Operation of the major components within a system. air distribution, Flexible ducting and associated fittings, fans, filters, noise and vibration, Control systems, Operation of a typical system including reverse cycle
 - Procedures for selecting a system for a specific application encompassing; Determining heat load sources using estimating methods and manufacturers data, unit and associated

equipment selection

- Installation of unit and pipework encompassing: Respect for customers premises, Unit location and mounting, Flexible ducting and associated fittings, Fixing, securing and mounting methods, Safe lifting, use of ladders and platforms, Manufacturers installation, Refrigerant piping: layout, installation, insulation, fastening and covering, Condensate drains and pumps
 - Starting up system encompassing: Manufacturers start up instructions - pressure testing, evacuation, opening outdoor unit valves, checking refrigerant charge: pressures, temperature, sweat line and evaporator superheat, adding refrigerant, leak detection, controls - operating and safety, customer familiarisation
 - Relevant Standards, codes and Regulation requirements
- e) Package air conditioning systems installation requirements and procedures
- Air conditioning design conditions encompassing temperature, humidity and ventilation
 - Package air conditioning systems types, construction, components, ancillary equipment, applications and operating conditions
 - Layouts and installation encompassing; Location of equipment, Equipment site arrangements and building services, Access and obstructions, Power supply and electrical services, Arrangement of piping
 - System controls encompassing; Thermostat and pressure controls, timers and controllers, overloads and safety control, electrical power and control circuits
 - Manufacturers specifications and installation instructions
 - Relevant Standards, codes and Regulation requirements
 - Relevant Public Health requirements

KS01-EJ108A Refrigerants and lubricants

Evidence shall show an understanding of refrigerants and lubricants, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Introduction to refrigerants
- Purpose of refrigerant
 - Primary, secondary and expendable refrigerants
 - Ideal properties
 - Pure, azeotropic, zeotropic and blend refrigerants
 - General safety requirements and personal protection equipment
- b) Relevant Acts, Regulations, Codes and Standards
- The ozone layer (function, ozone depleting substances)
 - The ozone protection act and regulation
 - State and federal agencies (Dept of the environment, water, heritage and the arts; Dept of climate change; Australian Refrigeration Council Ltd etc)
 - State and federal licensing requirements

- Refrigerant handling code of practice 2007
 - Relevant Standards
 - Standards philosophy and format
 - How to read and apply a standard
 - Equipment manufactures specifications
- c) Refrigerant properties
- Commonly used types, including CFC, HCFC, HFC, high pressure and natural refrigerants
 - Terms (blend, azeotrope, zeotrope, glide, CFC, HCFC, HFC, HC, bubble point, dew point, critical point, ODP, GWP etc)
 - Typical properties and applications of the current refrigerants used in systems (boiling point, glide, composition (components), comparative latent heat performance etc)
- d) Safe handling of refrigerants
- Refrigerant identification and the numbering system (AS 1677 part 1 sect 3)
 - System refrigerant identification (labeling requirements, Code of Practice)
 - Typical hazards (classification groups - AS 1677 part 1 sect 2 and handling precautions - inhalation, skin contact, cardiac sensitization, decomposition, reaction with moisture etc)
 - Personal safety (MSDS - all common refrigerants plus phosgene, recommended PPE)
 - Cylinders (cylinder terminology (WC, tare etc), transporting safely)
 - Safe Filling (density and water capacity methods)
 - Decanting methods (pumping, temperature differential etc)
 - Recovery cylinders and their safe filling.
 - Disposal of recovered refrigerants (including RRA)
- e) Refrigeration oil
- Types (mineral, POE, AB etc) and their applications
 - Basic properties (miscibility, dielectric strength, viscosity and hygroscopic abilities)
 - Typical issues regarding compatibility (neoprene and POE, POE and mineral etc)
 - Safe handling (MSDS - POE's, Mineral, AB's - Residual acid's in used oils)
 - Applications for the various compressor lubricants used in the trade
- f) Recovery and reclaim procedures
- Refrigerant recovery systems and procedures
 - Vapour
 - Liquid
 - Recovery cylinders
 - Disposing of recovered refrigerants
 - Safety and general issues when recovering refrigerant
- g) Pressure testing
- Pressure testing

- Pressure testing procedures and test pressures per Standards, Codes, Regulations and manufacturers requirements
- Safety and general issues when pressure testing refrigeration systems
- h) Leak detection
 - Leak detector types and applications (electronic, halide, bubble, ultra violet, Sulphur stick, litmus paper etc)
 - Hazards and related safe working practices (working around rotating machinery, open flame, ultra violet light etc)
 - Care and maintenance (delicate electronic equipment, changing sensor tip filters, changing gas cartridges etc)
 - Calibration (auto calibrating , send to a specialist etc)
 - Leak testing methods
- i) Evacuation and dehydration
 - Evacuation and dehydration
 - Deep vacuum methods
 - Triple evacuation
 - Vacuum Measurement
 - Instruments
 - Drop test
 - Vacuum Pumps
 - Types, size and applications
 - Use and connections
 - Care and maintenance
 - Safety and general issues when evacuating refrigeration systems
- j) Refrigerant and oil charging
 - Refrigerant cylinders, storage and safe handling
 - Refrigerant charging methods
 - Vapour
 - Liquid
 - Safety and general issues when charging refrigeration systems including personal protection equipment
 - Refrigerant oil removal and addition tools, procedures and safety
- k) System contamination
 - Contaminants (Non-condensables, moisture, acids, carbon, copper etc)
 - Effects of contamination (Acid, motor burnout, oil contamination, copper plating, seizing, RMD blockage, excessive condensing temps etc)
 - Practices/procedures that cause contamination
 - Methods and components use to remove contamination
 - Filter dryers – liquid, suction, burnout
 - Dry nitrogen
 - Flushing agents

- Evacuation
- l) Basic refrigeration component replacement
 - Risks of working with refrigerants and rotating equipment
 - Refrigerant isolation/pump down/recovery
 - Prevention of system contamination
 - Protection of damage to surrounding equipment/ environment
 - Replace basic components on a refrigeration system, for example filter dryer, sight glass.
 - Pressure testing, evacuation, checking refrigerant charge, refrigerant charging and leak detection
-

KS01-EJ109A Refrigeration and air conditioning installation functionality testing and verification methods

Evidence shall show an understanding of refrigeration and air conditioning installation functionality testing and verification methods, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Refrigeration and air conditioning installations, testing and verification methods
 - Mandatory testing and verification requirements.
 - Optional testing and their appropriate use
 - Testing techniques
 - Visual inspection methods
- b) Electrical safe working practices
 - Hazards associated with low-voltage, extra-low voltage and high-currents
 - Arrangement of power distribution and circuits in an electrical installations
 - Risks and control measures associated an electrical system and equipment that operate at low-voltage and extra-low voltage, and where high-currents are likely.
 - Risks and control measures associated fault finding, maintenance and repair.
 - Isolation and tagging-off procedures.
 - Risks, restrictions and control measures in testing live.
 - Risks and control measures associated with harmful dusts and airborne contaminants.

Note: Sources include thermal insulation, fibrous cement materials and asbestos and other fibre reinforced switchboard materials.

- Safety, selection, use, maintenance and care of test equipment:
 - Safety characteristics of electrical testing devices,
 - Safe use of electrical testing device, and
 - Checks and storage methods for maintaining the safety of testing devices.
- a) Refrigeration and air conditioning safe working practices

- Hazards and risk control measures associated with refrigeration/air conditioning components and systems
 - Harmful effects of refrigerants
 - Control measures for the use, handling and storage of refrigerants
 - Risks associated with modifying refrigeration/air conditioning installations, fault finding, maintenance and repair.
 - Control measures before, while and after working on refrigeration/air conditioning components and systems.
- Safety, selection, use, maintenance and care of test equipment encompassing:
 - Safety characteristics of refrigeration/air conditioning testing/measuring devices,
 - Safe use of testing/measuring device, and
 - Checks and storage methods for maintaining the safety of testing/measuring devices.

KS01-EJ110A Refrigerant piping, accessories and associated controls selection

Evidence shall show an understanding of selection of refrigerant pipe, fittings and accessories, refrigerant flow controls, safety and cycling controls for refrigeration and air conditioning installations based on specifications and manufacturer catalogues, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Drawings, Specifications, Regulations & Codes.
 - Equipment layouts & drawings
 - Site drawings
 - Piping diagrams
 - Wiring diagrams
 - Control diagrams
 - Job specifications
 - Equipment manufacturer's specifications & symbols
 - SAA/NZ standards
 - SAA/NZ standard symbols
 - Regulations & Codes
- b) Piping Arrangement
 - Equipment location
 - Piping arrangements
 - Mounting methods
 - Noise and vibration prevention
 - Pipework mounting and fastening
 - Insulation
 - Pipework installation requirements
- c) Equipment installation requirements

- Standards & Codes
 - Installation techniques
 - System specifications
 - Manufacturer's specifications
- d) Refrigerant Piping & Accessories
- Appropriate piping arrangements.
 - Pipework fittings/accessories & location
 - Pipework installation techniques
- e) Pipe Selection & Sizing
- Sizing charts
 - Correction factors
 - Equivalent lengths
 - Pressure drop
 - Oversized & undersized pipe effects
 - Refrigerant velocity
 - Oil return
 - Effect of system capacity
- f) Refrigerant Flow Controls
- Capillary
 - Thermostatic Expansion Valve
 - Evaporator Pressure Regulator
 - Solenoid valves
 - Control selection
- g) Safety and Cycling Controls
- Pressure controls
 - Temperature controls
 - Humidity controls
 - Control selection
- h) System Capacity Control
- Methods of capacity control
 - Control selection

KS01-EJ111A Refrigeration and air conditioning systems fault diagnosis and repair

Evidence shall show an understanding of refrigeration and air conditioning system fault diagnosis and repair, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Preventative maintenance schedules and procedures.
- b) Normal and abnormal system and component operations including:
- Systems design operating conditions

- Overcharge and undercharge
 - High and low evaporator superheat
 - High and low condensing pressure
 - High and low evaporation pressure
 - High and low liquid sub-cooling
 - Low air/water flow rate through condenser and evaporator
 - Inefficient compressor
 - Open, closed and short circuits in motors and controls
- c) Finding and rectify system faults
- Factors to consider in clarifying the nature of a fault including; initial fault report, confirmation of symptoms of the fault, comparison of symptoms with normal operation
 - Effect to cause reasoning — assumptions of possible causes
 - Methods for testing assumptions including; visual inspection, sectional testing, split-half tests, component isolation
 - Dealing with intermittent faults caused by vibration, shock, changes in temperature and electromagnetic interference.
 - Rectifying control system faults including adjustments, repairs and replacement of components, controls and accessories
- d) Diagnosing and rectifying faults on refrigeration and air conditioning systems including;
- Appliance refrigerated systems
 - Cool room and freezer room systems
 - Merchandising and display cabinets
 - Residential air conditioning systems
 - Package air conditioning systems
 -

KS01-EJ112A Complex refrigeration and air conditioning system fault finding and repair

Evidence shall show an understanding of fault finding and repairing complex refrigeration and air conditioning system, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Fault finding techniques
- Factors to consider in clarifying the nature of a fault encompassing:
 - initial fault report
 - confirmation of symptoms of the fault
 - comparison of symptoms with normal operation
 - Effect to cause reasoning — assumptions of possible causes
 - Methods for testing assumptions encompassing:
 - Visual inspection
 - Sectional testing
 - Split-half tests

- Component isolation
- Dealing with intermittent faults

Note: Typical causes of intermittent faults are vibration, shock, changes in temperature and electromagnetic interference.

b) Refrigeration system analysis

- Pressure Enthalpy definitions
 - high pressure & low pressure refrigerants
 - triple point of new refrigerants
 - glide of trinary blends
 - differential evaporation of refrigerant blends
 - variable refrigerant volume
- Refrigeration cycle
 - expansion process
 - vaporising process
 - compression process
 - condensing process
 - compression ratio
- Enthalpy processes
 - co-efficient of performance
 - effect of suction temperature on cycle efficiency
 - effect of condensing temperature on cycle efficiency
- Actual refrigerating cycles
 - design operating conditions
 - effects of superheating suction vapour
 - superheating without useful cooling
 - superheating that produces useful cooling
 - superheating in suction piping outside the refrigerated space
 - superheating the vapour inside the refrigerated space
 - effects of subcooling the liquid
 - effects liquid - suction heat exchangers
 - effects of pressure losses resulting from friction
- Refrigeration cycle faults
 - symptoms and causes
 - measurements and fault confirmation tests

c) Air conditioning system analysis

- Psychrometric chart
 - properties, definitions and units
 - plotting conditions
 - RA, SA, OA, MA
- Psychrometric processes

- heating
 - cooling only
 - cooling and dehumidification
 - cooling , dehumidification and reheat
 - Design operating conditions
 - indoor and outdoor wet and dry bulb temperatures
 - volume flow rate supply, return and outdoor air
 - Air conditioning system faults
 - symptoms and causes
 - measurements and fault confirmation tests
- d) Power and control system analysis
- power and control circuit diagrams
 - sequence of operation
 - manufacturers diagrams, specifications and instructions
 - power and control circuit faults
 - symptoms and causes
 - measurements and fault confirmation tests
 -

KS01-EJ113A Refrigeration and air conditioning commissioning procedures and requirements

Evidence shall show an understanding of commissioning refrigeration and air conditioning systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Refrigeration systems operation and performance including refrigeration effect; flow rate; specific volume; system capacity; discharge temperature; total heat rejection; heat of compression and refrigerant properties and effects
- b) Compressor operation and performance including:
- Compressor drive methods including belt drives; direct drives; speed vs. pulley size and alignment requirements.
 - Compressor piston displacement; compressor displacement; compression ratio; compressor efficiency
 - Methods of system capacity control including compressor unloading; refrigerant bypass; air flow; water flow; multiple units and compressor speed.
- c) Air conditioning testing/measuring devices applicable to air volume, air velocity, air pressure, air temperature, air relative humidity and sound levels.
- d) System design cooling/heating capacity and conditions from:
- System design specifications and drawings
 - Manufacturers specifications and manuals
- e) Pre-commissioning inspections and checks
- f) Testing, measurements and adjustments of the system
- Major components

- Refrigerant flow controls and accessories
- Safety and cycling controls
- Refrigerant charge
- Air/water flow quantities
- g) System operating conditions and cooling/heating capacity vs system design conditions and cooling/heating capacity
- h) Marking up "as installed" drawings
- i) Commissioning reports
- j) Commissioning refrigeration and air conditioning systems including;
 - Appliance refrigerated systems
 - Cool room and freezer room systems
 - Merchandising and display cabinets
 - Residential air conditioning systems
 - Package air conditioning systems
- k) Retrofitting systems with a replacement refrigerant
 - Systems and refrigerants suitable for retrofitting
 - Retrofitting a refrigerant into a system
 - Procedures for modify an existing system to meet the requirements of the alternative refrigerant encompassing:
 - Evaluating performance of a system prior to being retrofitted.
 - Testing refrigerant oil in accordance with industry standard.
 - Reclaiming and evacuate system.
 - Removing and replacing components.
 - Pressure testing, evacuating and charging.
 - Procedures for commissioning a retrofitted system to the prescribed standard
 - Evaluating key performance factors of a system before and after a retrofit.
 -

KS01-EJ114A Hydronic systems

Evidence shall show an understanding of hydronic systems used for refrigeration and/or air conditioning applications, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods

KS01-EJ115A Beverage dispensers

Evidence shall show an understanding of refrigerated beverage dispensers, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components, and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Pure food act and HACCP
- f) Dispensed beverage product knowledge:

Note: Examples are beer, wine, spirits, soft drinks, and the like

KS01-EJ116A Transport refrigeration systems

Evidence shall show an understanding of transport refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) External power sources

Note: Examples are diesel/petrol engines, electrical, dual power supplies

KS01-EJ117A Ultra-low temperature refrigeration systems

Evidence shall show an understanding of ultra-low temperature refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Suitability of refrigerants for each application
- f)

KS01-EJ118A Post mix refrigeration systems

Evidence shall show an understanding of post mix refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Pure food act and HACCP
- f) Dispensed beverage product knowledge:

Note: Examples are wine, spirits, soft drinks, and the like

KS01-EJ119A Ice making systems

Evidence shall show an understanding of ice making systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) c) Maintenance schedules
- d) d) System faults and testing methods
- e) e) Pure food act and HACCP
- f) f) Dispensed beverage product knowledge
- g)

KS01-EJ120A Industrial refrigeration systems

Evidence shall show an understanding of industrial refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Secondary refrigerants and systems
- f)

KS01-EJ121A Energy management systems for commercial refrigeration

Evidence shall show an understanding of energy management systems for commercial refrigeration, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Functions of a commercial refrigeration E.M.S.
 - General control function
 - Inputs

- Outputs
 - Communications
 - Graphing
 - Supervising
 - Data logging
 - Scheduling
 - Alarms
 - Power consumption
- b) E.M.S. control components
- Identify components
 - Pressure sensors
 - Temperature sensors
 - Time clocks
 - Humidity sensors
 - Liquid level sensors
 - Leak detector sensor
 - State the function and operating parameters of components
 - Pressure sensors
 - Temperature sensors
 - Time clocks
 - Humidity sensors
 - Liquid level sensors
 - Leak detector sensors
- c) Installation requirements and consideration
- Installation of controller(s)
 - Installation of refrigerant leak detector
 - Systems
 - Installation of accessory boards
 - Installation of pressure transducers & wiring
 - Installation of temperature sensors & wiring
 - Control wiring considerations
- d) System design and applications
- Select control components to suit given applications
 - Determine system operating parameters
 - Pressure sensors
 - Temperature sensors
 - Time clocks
 - Humidity sensors
 - Liquid level sensors
 - Leak detector sensors

- Defrost
- Alarm panel
- e) Programming a control system
 - Display terminal and keypad functions
 - Calibration of sensors
 - Changing original settings
 - Program a given set of parameters to suit an application
- f) Component testing and fault finding
 - Trouble shooting
 - Testing of components
 -

KS01-EJ122A Complex HVAC/Refrigeration control system fault finding

Evidence shall show an understanding of complex HVAC/Refrigeration control system fault finding, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Control fundamentals
 - control terminology
 - refrigeration system characteristics
 - HVAC system characteristics
 - control system characteristics
 - control system components
 - control system diagrams and symbols
 - product knowledge
- b) Types of control equipment
 - electrical:
 - classification of circuits
 - two position control
 - floating control
 - sensors
 - controllers
 - flow control devices
 - control systems diagrams
 - electronic:
 - operating principles
 - sensors
 - controllers
 - control system diagrams
- c) Digital Control Systems
 - Computer based control fundamentals

- Definitions
- Principles
- Controller configuration
 - Equipment
 - Zone level controllers
 - System level controllers
- Controller software
 - Operating software
 - Application software
- Controller programming
 - System diagrams
 - Control diagrams
 - Configuration
 - Programming
 - Initialisation
 - EMS, BMS
 - SCADA system
 - Lan, Bacnet
- d) Control systems applications
 - refrigeration
 - air conditioning
 - air handling system controls
 - ventilation
 - heating
 - building airflow system control
 - airflow control
 - singles and multi -zones
 - chiller/boiler and distribution system control (chilled water, boiler, distribution systems)
 -

KS01-EJ123A Complex HVAC system commissioning

Evidence shall show an understanding of complex HVAC system commissioning, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Commissioning fundamentals
 - building specifications/requirements/responsibilities
 - design and as installed drawings
 - building codes
 - local government regulations
 - design conditions

- pre – commissioning checks
 - calibration of instruments
 - commissioning procedures
 - data collection and recording, documentation
 - reporting procedures
- b) Air systems
- factors affecting the design of ductwork systems
 - types of ductwork systems
 - static, velocity and total pressure
 - air testing and balancing
 - air flow
 - pressure
 - temperature
- c) Fans
- types and characteristics
 - fan laws
 - fan and system curves
 - fan testing
- d) Air balancing
- equipment, instruments and procedures
 - leakage testing
- e) Overview of noise in duct systems
- noise sources in duct systems
 - attenuation
 - methods of control
- f) System capacity calculations
- g) Hydronic systems
- hydronic instruments
 - fluid flow
 - pumps: pump curves and system curves
 - pump testing
 - capacity calculations
- h) Plant and equipment
- controls
 - heat exchangers
 - chillers
 - boilers
 - cooling towers

KS01-EJ124A Hydronic system commissioning

Evidence shall show an understanding of hydronic system commissioning, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Commissioning fundamentals
 - building specifications/requirements/responsibilities
 - design and as installed drawings
 - building codes
 - local government regulations
 - design conditions
 - pre – commissioning checks
 - calibration of instruments
 - commissioning procedures
 - data collection and recording, documentation
 - reporting procedures
- b) Hydronic systems operation
 - closed/open systems
 - pump head/lift, static head (high rise building)
 - system friction losses
 - nett positive suction head
 - system curves
- c) Pumps
 - types
 - selection criteria
 - performance characteristics
 - pump curves and system curves
 - pump testing
 - capacity calculations
 - bladder tanks
 - coil characteristics
 - heat exchangers: plate, shell and tube, tube in tube
 - flow measurements: types
 - flow switchers
 - cooling towers: elementary cooling thermodynamics and types
- d) Valves - flow control devices
 - types and applications
 - balancing valves
 - throttling characteristics
 - flow measurements
 - selection and applications

- e) Piping systems
 - balancing and commissioning
 - air venting
 - water treatment
 - vacuum breaking and air breaks
 -

KS01_EJ125A Complex refrigeration systems commissioning

Evidence shall show an understanding of complex refrigeration systems commissioning, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Commissioning fundamentals
 - building specifications/requirements/responsibilities
 - design and as installed drawings
 - building codes
 - local government regulations
 - design conditions
 - pre – commissioning checks
 - calibration of instruments
 - commissioning procedures
 - data collection and recording, documentation
 - reporting procedures
- b) Air Systems (excluding air balancing)
 - instruments
 - air flow
 - pressure
 - temperature
 - fan testing
 - leakage testing
 - system capacity calculations
- c) Hydronic systems
 - hydronic instruments
 - fluid flow
 - pumps: pump curves and system curves
 - pump testing
 - capacity calculations
- d) Refrigeration Systems
 - AS1677
 - Code of practice
 - pressure testing

- evacuation
- charging
- control setting
- commissioning reports
- system performance and capacity

e) Plant and equipment

- controls
- heat exchangers
- chillers
- boilers
- cooling towers
-

KS01-EJ126A Complex HVAC/Refrigeration control system commissioning

Evidence shall show an understanding of complex HVAC/Refrigeration control system commissioning, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

a) Commissioning fundamentals

- building specifications/requirements/responsibilities
- design and as installed drawings
- building codes
- local government regulations
- design conditions
- pre – commissioning checks
- calibration of instruments
- commissioning procedures
- data collection and recording, documentation
- reporting procedures
- Control fundamentals

b) control terminology

- refrigeration system characteristics
- HVAC system characteristics
- control system characteristics
- control system components
- control system diagrams and symbols
- product knowledge

c) Commissioning various types of control equipment

- electrical:
 - sensors
 - controllers

- flow control devices
- control systems diagrams
- electronic:
 - sensors
 - controllers
 - control system diagrams
- Digital Control Systems
 - System diagrams
 - Control diagrams
 - Configuration
 - Programming
 - Initialisation
 - EMS, BMS
 - SCADA system
 - Lan, Bacnet
 -

KS01-EJ127A Thermodynamic parameters of refrigeration and air conditioning systems

Evidence shall show an understanding of engineering mathematics fundamentals and refrigeration science to an extent indicated by the following aspects:

- a) Arithmetic
 - Rational and irrational numbers, surds
 - SI units, conversion using unity brackets
 - Laws of indices (base 10), scientific and engineering notation
 - Estimations, errors and approximations, significant figures
- b) Algebra
 - Substitution
 - +, -, x on simple polynomials. Simple indices
 - Expanding brackets
 - Factorising quadratics. Common factors, difference of two squares
 - Simplifying algebraic fractions
 - Transposition of engineering formulae
 - Solving one variable equations
 - Simple algebraic division.
- c) Geometry
 - Pythagoras Theorem
 - Angles: degrees, radians. Parallel lines cut by a transverse
 - Triangles: sum of angles, properties of equilateral and isosceles triangles
 - Congruent triangles

- Similar triangles: ratio of corresponding sides
 - Sin, cos, tan: ratios of a right angled triangle
 - Sine and cosine rules
 - Circles: circumference, arcs, chords, tangents, circle theorems
 - Area and perimeter mensuration on above figures.
- d) Coordinate geometry
- 2D plane; x - y axes, s - t axes
 - Graph of linear function, $y = ax + b$. Functional notation, $y = f(x)$
 - Straight line given slope and one point or given two points
 - Linear equations: solving algebraically and geometrically
 - Solving 2 linear functions simultaneously, algebraically and geometrically
 - Line segment: length and mid point.
- a) Engineering mechanics
- mass/density
 - weight
 - forces
 - specific gravity
 - equilibrium
 - momentum
 - friction loss
 - velocity and speed
 - energy in all forms
 - mechanical advantage
 - efficiency
 - pressure/stress
- b) Molecular theory
- changes of state
 - sublimation
 - expansion and contraction
 - electron flow
 - state of aggregation
 - internal potential energy
 - phase change diagrams
- c) Thermodynamics
- temperature scales
 - conservation of energy
 - specific heat
 - sensible, latent and super heat
 - properties of steam

- enthalpy
 - heat energy/temperature relationship
 - heat balance on a body
 - heat transfer
 - conductivity
 - calorimetry
 - Peltier effect
 - 1st and 2nd law of thermodynamics
- d) Gas laws and liquids
- pressure
 - Boyles law
 - Charles law
 - Volumetric relationship
 - psychrometrics
 - latent heat of vaporisation
 - relative humidity
 - air conditioning processes
 - dynamic pressure loss
 - velocity and static pressure
 - bourdon tubes
 - density and relative density
 - Archimedes principle
 - Bernoulli's Equation
 - manometers
 - absorption refrigeration
 - centrifugal compression
 - external work of a liquid
 - pressure volume diagrams
 - isothermal and adiabatic processes
 - polytropic processes
 - Dalton's law of partial pressure
- e) Vapour compression
- pressure/enthalpy relationship
 - entropy
 - characteristics of the evaporation, condensation,
 - compression and pressure drop phases
 - co-efficient of performance
 - theoretical/practical cycles
 - characteristics of refrigerants

- theoretical power input
- pressure losses
- heat exchange
- effects of condensing condition changes
- sub-cooling and super-heating

KS01-EJ128A HVAC/R system drawing

Evidence shall show an understanding of air conditioning drawing, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Standards, regulations and codes
- b) Architectural and mechanical drafting conventions encompassing:
 - Fire, hydraulic, electrical layout diagrams,
 - Sketching of pipework circuits and mechanical services,
 - Drawing standards and symbols,
 - Working, detail and assembly drawings,
 - Ductwork layouts and conventions,
 - Pipework layouts and conventions,
- c) Computer aided drawing techniques

KS01-EJ129A Commercial refrigeration and air conditioning heat load estimating

Evidence shall show an understanding of heat load estimating for commercial refrigeration and air conditioning applications to an extent indicated by the following aspects:

- Commercial refrigeration applications
- a) Heat transfer
 - factors affecting heat transfer
 - insulation material characteristics
 - vapour barriers (seals)
 - ambient conditions
 - composite walls (heat flows)
 - types of common insulation
 - thermal conductivity
 - film factors
- b) Cabinet construction and design

- deep freeze case
 - meat case
 - dairy case
 - fruit and vegetable case
 - drink cabinets
- c) Air change load
- room volumes
 - room usage (average, medium, heavy)
 - heat removed from cooling air to refrigerated conditions
 - air curtains
 - temperature differences
 - door opening sizes
 - Tamm's equation
- d) Product load
- sensible heat
 - latent heat
 - heat of respiration
 - storage temperatures
 - unit running times
 - humidity
 - air flows
 - stacking of products
 - freeze, chill, thaw times
- e) Total freezer/cool room loads
- wall load
 - air change load
 - product load
 - miscellaneous
 - total load, safety factor and unit running times
 - floor loads in cool rooms
 - door opening loads (ASHRAE & RADS methods)
 - door opening loads (for trucks)
- f) Process cooling loads
- cooling chemical reactions
 - energy balance methods
 - sensible & latent cooling of gases
 - sensible & latent cooling of water vapour in gas streams
- g) Computer programs

2. Commercial air conditioning applications

- a) Heat flow in buildings
 - conduction
 - convection
 - radiation
 - heat paths
- b) Thermal storage
- c) Different methods of calculations
 - ASHRAE
 - Carrier
 - finite difference
- d) U Values.
- e) Film coefficients.
- f) Solar heat
 - direct
 - diffuse
 - sol air temperature
 - sun position calculations
- g) Design conditions
 - outdoor
 - monthly/daily corrections
 - comfort/critical
 - indoor
 - effective temperature
- h) Thermal comfort.
- i) Space characteristics.
- j) Equipment location.
- k) Zoning
- l) Internal loads
 - lighting
 - equipment
 - people
 - load profiles
 - internal partitions
- m) Fresh air/AS 1668
- n) Calculation of fabric loads
 - walls
 - roofs
 - floors

- o) Windows
 - glass types and factors
 - shade factors
 - internal and external shading
 - shading from adjacent structures
- p) Air quantity calculation
 - psychrometrics
 - by-pass factor
 - coil load
 - VAV air quantities
- q) Piping and other losses.
- r) Refrigeration plant load.
- s) Computer software
 - responsible use

KS01-EJ130A HVAC/R control system fundamentals

Evidence shall show an understanding of HVAC control systems and diagrams, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Control fundamentals
 - control terminology
 - refrigeration system characteristics
 - HVAC system characteristics
 - control system characteristics
 - control system components
 - control system diagrams and symbols
 - product knowledge
- b) Types of control equipment
 - electrical:
 - classification of circuits
 - two position control
 - floating control
 - sensors
 - controllers
 - flow control devices
 - control systems diagrams
 - electronic:
 - operating principles

- sensors
 - controllers
 - control system diagrams
- c) Control systems applications
- refrigeration
 - air conditioning
 - air handling system controls
 - ventilation
 - heating
 - building airflow system control
 - airflow control
 - singles and multi -zones
 - chiller/boiler and distribution system control (chilled water, boiler, distribution systems)
 -

KS01-EJ131A Noise and vibration fundamentals

Evidence shall show an understanding of noise and vibration fundamentals, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Fundamentals of sound
- Properties of sound: Wavelength, amplitude, frequency, period, velocity, sound (intensity, pressure, power), decibels
 - Sound pressure level
 - Sound power level
 - Addition of sound levels
 - Loudness and weighting networks
 - Sound spectrum and octave bands
 - Single value representation of sound spectrum
 - NR curves
 - Sound meters
- b) Fundamentals of vibration
- Terminology: Spring-mass system, spring in series and/or parallel, stiffness, effective stiffness, viscous frictional coefficient, mass, period, frequency (angular, natural, damped, forced), amplitude, static deflection, damping ratio, damping factor, frequency ratio
 - SHM (Simple Harmonic Motion)
 - Damped vibration
 - Forced vibration
 - Maximum amplitude and resonance

- Transmissibility and isolation efficiency
- Vibration isolators
-

KS01-EJ132A Commercial refrigeration systems design and component selection

Evidence shall show an understanding of commercial refrigeration systems design and component selection to an extent indicated by the following aspects:

Refrigeration and food storage technology

- a) Food spoilage and possible causes
 - physical damage
 - animal activity
 - chemical breakdown
 - enzyme activity
 - micro-organisms
 - effects of temperature change
 - effects of humidity change
 - effects of freezing on fresh produce
 - effects of slow freezing time
 - effect of refreezing
- b) Food preservation
 - removing or taking out a reactant
 - removing or inactivating the catalyst
 - reducing temperature
 - changing the reaction system
 - irradiation
- c) Micro-organisms
 - conditions for growth
 - potentially hazardous foods
 - cross contamination
- d) Identification of food spoilage
 - recognition and suggest possible cause
 - physical damage
 - animal activity
 - chemical breakdown
 - enzyme activity
 - micro - organisms
- e) Types of heat processing techniques
 - heat processing using steam and water

- blanching
 - pasteurisation
 - sterilisation
 - evaporation
 - heat processing using hot air
 - dehydration
 - baking and roasting
- f) Types of chilling processing techniques
- chilling and controlled atmosphere storage
 - freezing
 - freeze drying and freeze concentration
 - modified atmosphere combined with low temperature cryovac.
- g) Relevant Standards, Codes, Regulations and industry practices
- Standards and Codes
 - Regulations
 - Equipment manufactures specifications and practices
2. Refrigeration system components and piping
- a) Relevant Standards, Codes Regulations and industry practices
- AS1677, detailed understanding
 - AS 3666, overview
 - ozone protection regulations
 - IIR Ammonia Data Book
 - ANSI/IIR standards
 - ANSI/ASHRAE Mechanical Refrigeration and IIR
 - bulletins and standards
 - Equipment manufactures specifications and practices
- b) Calculation of capacity in heat exchangers
- $Q = UA (LMTD)$
 - $Q = mc\Delta t$
 - $Q = m \Delta h$
- c) Evaporators
- commercial types and applications
 - coil bypass factor
 - effects of evaporator TD on space humidity
 - effects of air circulation on product conditions
 - selection criteria and selection tables
- d) Condensers
- commercial types and applications
 - effects of ambient conditions

- condenser control
- heat rejection factor
- condenser TD
- selection criteria and selection tables

e) Compressors

- types and applications
- capacity
- displacement
- volume flow rate
- theoretical capacity
- total volumetric efficiency
- effect of operating conditions, including suction
- pressure drop and superheating
- actual capacity
- power
- theoretical requirement
- effects of operating conditions
- actual requirements
- post defrost loads
- pull down torque requirements, high, medium
- and low back pressure compressors
- selection tables, motor selection

f) Liquid expansion devices

- types, operation and applications
- effects from sub-cooling
- distributor types, operation and applications
- selection tables
- System load balance point encompassing:
- graphical representation
- Line sizing an design
- velocity tables
- pressure drop in lines and fittings
- oil migration stabilisation
- refrigerant velocity
- effect of varying system capacity
- oil traps
- risers
- double risers
- liquid migration

- design for parallel components and multiplex systems
- g) Automatic controls
 - fin spacing, suction temp to evaporator suction
 - hot-gas bypass valves
 - electronic control of valves PLC control
 - refrigerant regulating valves
 - solenoid valves
 - condenser pressure regulating valves
 - evaporator pressure regulating valves
 - crankcase pressure regulating valves
 - cycling controls
 - pressure-stats
 - thermostats,
 - defrost controls
 - monitoring and alarm controls
 - refrigeration automation systems
 - control strategies
 - control modes

KS01-EJ133A Industrial refrigeration systems design and component selection

Evidence shall show an understanding of industrial refrigeration systems design fundamentals, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Relevant Standards, Regulations and industry practices
 - AS1677, detailed understanding
 - AS 3666, overview
 - ozone protection regulations
 - IIR Ammonia Data Book
 - ANSI/IIR standards
 - ANSI/ASHRAE Mechanical Refrigeration & IIR bulletins and standards (list will be provided by Rama)
 - Equipment manufacturers specifications and practices
- b) Operating characteristics
 - pH charts
 - refrigerating effect, relate back to air and fluid coolers
 - heat of compression, relate back to screw, rotary and reciprocating compressors
 - heat rejected high side of the system, relate back to air cooled, evaporative, and water cooled condensers

- variable liquid refrigeration systems & liquid overfeed systems
 - required mass flow rate of refrigerant and volume flow rate at various points in system
 - theoretical compressor power
 - required condenser capacity
- c) Major system components
- refrigerants, including R717 and R22
 - secondary refrigerants
 - component lubricant refrigerant compatibility
 - evaporators
 - condensers, cooling towers
 - compressors
 - expansion valves
 - interconnecting piping and
 - isolating valves
 - pilot operated valves
 - defrost system components for air, water, recycled water, hot gas, electric methods
 - refrigerant accumulators and liquid pumps

KS01-EJ134A HVAC system design and component selection

Evidence shall show an understanding of HVAC systems design and component selection, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

Refrigeration system components and piping

- a) Relevant Standards, Codes Regulations and industry practices
- AS1677, detailed understanding
 - AS 3666, overview
 - ozone protection regulations
 - ANSI/IIAR standards
 - ANSI/ASHRAE Mechanical Refrigeration and IIAR
 - bulletins and standards
 - Equipment manufacturers specifications and practices
- b) Calculation of capacity in heat exchangers
- $Q = UA (LMTD)$
 - $Q = mc\Delta t$
 - $Q = m \Delta h$
- c) Evaporators
- commercial types and applications

- coil bypass factor
 - effects of evaporator TD on space humidity
 - effects of air circulation on product conditions
 - selection criteria and selection tables
- d) Condensers
- commercial types and applications
 - effects of ambient conditions
 - condenser control
 - heat rejection factor
 - condenser TD
 - selection criteria and selection tables
- e) Compressors
- types and applications
 - capacity
 - displacement
 - volume flow rate
 - theoretical capacity
 - total volumetric efficiency
 - effect of operating conditions, including suction
 - pressure drop and superheating
 - actual capacity
 - power
 - theoretical requirement
 - effects of operating conditions
 - actual requirements
 - post defrost loads
 - pull down torque requirements, high, medium
 - and low back pressure compressors
 - selection tables, motor selection
- f) Liquid expansion devices
- types, operation and applications
 - effects from sub-cooling
 - distributor types, operation and applications
 - selection tables
 - System load balance point encompassing:
 - graphical representation
 - Line sizing an design
 - velocity tables
 - pressure drop in lines and fittings
 - oil migration stabilisation

- refrigerant velocity
- effect of varying system capacity
- oil traps
- risers
- double risers
- liquid migration
- design for parallel components and multiplex systems

g) Automatic controls

- fin spacing, suction temp to evaporator suction
- hot-gas bypass valves
- electronic control of valves PLC control
- refrigerant regulating valves
- solenoid valves
- condenser pressure regulating valves
- evaporator pressure regulating valves
- crankcase pressure regulating valves
- cycling controls
- pressure-stats
- thermostats,
- defrost controls
- monitoring and alarm controls
- refrigeration automation systems
- control strategies
- control modes

2. Commercial air conditioning systems design

a) Design parameters for single-storey buildings (e.g. offices, restaurants, hotels, bars)

- Customer and objective
- Customer concept of environment desired
- Economics
- Client brief

b) Relevant design criteria

- Building purpose, location, orientation and shape
- External environment ambient conditions
- Internal load diversity
- Thermal capacity behaviour
- Thermal load (full and partial)

c) Zoning and building usage

- Space and building

- Occupancies, single purpose, multi-purpose
- d) System selection criteria
 - Economics
 - Environment
 - Control requirements
 - Existing structures
 - New structures
 - System components
 - Space for equipment and system
 - Selection of appropriate system, equipment, ductwork and components
- e) Systems and applications
 - Design features, engineering and selection procedures for direct expansion air conditioning systems:
 - RAC's, split systems, package units
 - Free blow and ducted fan coil units
 - Cooling, heat pump and electric heating

KS01-EJ135A Refrigeration, heating, ventilation and, air conditioning control system design

Evidence shall show an understanding of designing refrigeration/HVAC control systems to meet refrigeration/HVAC system operating requirements through the integration of electrical, electronic, pneumatic and digital controls, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Control systems
 - control terminology
 - control system characteristics
 - control system diagrams and symbols
- b) Types of control equipment
 - Electrical (covered in KS01-EJ130A.1)
 - classification of circuits
 - two position control
 - floating control
 - sensors
 - controllers
 - flow control devices
 - control systems diagrams
 - Electronic (covered in KS01-EJ130A.1)
 - operating principles

- sensors
 - controllers
 - control system diagrams
 - Pneumatic:
 - Control fundamentals
 - Pneumatic control terminology
 - Definitions
 - Control basics
 - Air supply
 - Pilot bleed system
 - Signal amplifier
 - Sensing elements
 - Relays and switches
 - Air supply system
 - Air drying methods
 - Pressure regulating valves
 - Pressure reducing valves
 - System controllers
 - Thermostats
 - Sensors
 - Actuators
 - Dampers
 - System control configuration
 - Sequence control
 - Limit control
 - Changeover control
 - Compensated control
 - Recycling control
 - Pneumatic – electric control
 - Control systems
- c) Digital Control Systems
- Computer based control fundamentals
 - Definitions
 - Principles
 - Controller configuration
 - Equipment
 - Zone level controllers
 - System level controllers
 - Controller software
 - Operating software

- Application software
- Controller programming
 - System diagrams
 - Control diagrams
 - Configuration
 - Programming
 - Initialisation
 - EMS, BMS
 - SCADA system
 - Lan, Bacnet
- d) Applications
 - Refrigeration systems
 - HVAC systems
 - air handling system controls
 - ventilation
 - heating
 - building airflow system control
 - airflow control
 - single and multi –zones
 - chiller boiler and distribution system
 - Logic analysis
 - Energy management
 - Asset management
 - Life cycle
 - Supervisory
 - introduction building management
 - remote building control interface and modem
 -

KS01-EJ136A Energy management fundamentals

Evidence shall show an understanding of energy management fundamentals, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Typical energy sources and characteristics
 - supply authorities
 - standard units of measurement
 - electricity
 - steam
 - hot water
 - high temperature hot water

- town gas
 - LP Gas
 - solar
 - waste heat
 - petrol
 - diesel
- b) Energy Usage
- office lighting
 - air conditioning systems
 - refrigeration systems
 - security systems
 - computer systems
 - standby/emergency systems
 - lifts and escalators
- c) Energy auditing process
- energy costs and tariffs
 - energy consumption
 - predicting future costs
 - plotting consumption trends
 - historical data
 - collecting information using surveys
 - comparisons of actual to recorded usage
 - energy balance
 - instrumentation
 - building management systems
 - estimating savings potential
- d) System operation for energy efficiency
- types of systems
 - efficiency in building structures
 - operation of a vehicle fleet
 - proportion total energy consumption against individual systems
 - passive building design
 - preventative maintenance procedures
 - monitoring building management systems
 - operation of major and minor plant
 - inappropriate energy management procedures
 - building plant control systems
 - Australian standards/local authority requirements
 - case studies
- e) Implementing energy management procedures for a building

- recording base year data
- climatic conditions for locality
- establishing energy costs and tariffs
- building and systems surveys
- payback period
- survey analysis
- energy conservation procedures
- informing stockholders
- recommendations and documentation
- implementation issues
- monitoring, evaluation and follow up
-

KS02-EJ136A Building management systems

Evidence shall show an understanding of building management systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Functions of a BMS
 - autonomous Functions
 - input
 - output
 - general I/O
 - installation management items
 - energy management
 - risk management
 - information processing
 - objectives
 - building running costs
 - smoke control as per AS 1668 part 1
- b) BMS hardware
 - system architecture
 - communication devices
 - substations
 - PC's
 - interfaces with other systems
- c) Input and output functions
 - digital inputs/outputs
 - digital output with status feedback
 - analogue input/output
 - sensors

- alarms
- d) Energy management
 - night cycle
 - optimum stop/start
 - time and event programs
 - night purge
 - outside air percentage control
 - enthalpy control
 - power demand control
 - duty cycle
 - presence detection
 - lighting control
- e) Information processing functions
 - computer systems
 - central system management
 - programs
 - system configuration and security
 - operator - machine interface
 - data points
- f) Risk and maintenance management
 - system files
 - fire, intruder control
 - access control
 -

KS01-EJ137A Indoor air quality

Evidence shall show an understanding of evaluating and reporting of a building's indoor air quality, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Indoor air quality factors
 - interactive nature of pollutants
 - comfort criteria
 - source of odours
 - pathway from source to occupants
 - occupant activities
 - impact on productivity
- b) Causes of IAQ problems
 - moisture
 - mould and mildew
 - bacterial growths

- asbestos and other particulate
- volatile chemicals produced in the building
- chemical products
- c) HVAC systems
 - types of HVAC systems
 - system components
 - duct cleaning
 - system commissioning
 - operation of system
 - damper adjustment
- d) Measurements
 - common parameters to measure
 - measurement devices available
 - instrument calibration
 - analysing and interpreting results
 - laboratory tests
 - standards
 - evaluation and reporting of IAQ
- e) Resolving IAQ problems
 - conducting IAQ investigations
 - the walk-through
 - building history
 - HVAC system information
 - occupant interviews
 - troubleshooting
- f) IAQ management
 - building IAQ profile
 - location of potential IAQ problems
 - procedures to control IAQ
 - communication
 - response to complaints
 - equipment preventive maintenance
 - chemical inventory
 -

KS01-EJ138A Noise and vibration in refrigeration and air conditioning systems

Evidence shall show an understanding of noise and vibration in refrigeration and air conditioning systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Fundamentals of sound

- frequency
 - decibels
 - octave bands
 - direct sound
 - velocity
 - sound pressure level
 - sound power level
 - sound meters
- b) Noise and people
- physical measurement of sound
 - weighting networks
 - NR curves
 - noise damage to hearing
 - evaluate daily noise exposures
 - peak noise levels
 - attenuation for hearing protectors
 - excess noise levels permissible
 - noise abatement acts
 - advanced noise and vibration control
- c) Sound in confined and unconfined spaces
- Inverse square laws
 - Direct and reflective sound
 - Define reverberation time
 - Sabine's formula
 - Absorption coefficients of surfaces
 - Types of absorbers and their operation
 - Insulation performances of partitions
- d) Identify and analyse problems
- one-dimensional sound waves
 - standing waves
 - energy in a sound wave
 - sources
 - effects of air turbulence
 - transmitters
 - amplifiers
 - absorptivity
 - reflectivity
 - room characteristics
 - acoustic design in buildings
 - fan and air noise transmission in ducts

- e) Methods of control
 - natural attenuation
 - sound absorbing materials, placement
 - duct lining
 - lined plenums
 - lined duct splitters
 - duct attenuators
 - white noise
 - vibration isolators
- f) Acoustic specifications
 - attenuator ratings
- g) Sound insulation
 - Plant room breakout
 - Controlling plant room noise
- h) Duct borne noise
 - Sound power spectra for fans
 - Noise attenuation in ducts and fittings
 - Reducing fan noise transmission
 - Regeneration noise
 - Sources of regenerated noise
 - Use tables to estimate regenerative noises
 - Breakout situations
 - Fan noise breakout
 - List methods of controlling breakout
- i) Controlling the cost
 - Economical use of attenuation
- j) Vibration
 - SHM (Simple Harmonic Motion)
 - Period
 - Frequency
 - Amplitude
 - Estimate frequencies for fans, pumps and refrigeration plant
 - Estimate transmission of vibration
 - Vibration control for building structures
 - Use transmissibility graphs to select springs, vibration eliminators and pads
 - Types of isolation materials and mounting devices
 - Select isolation and mounting devices
 - Inertia blocks
- k) Relevant standards, regulation and codes
- l) Noise and vibration analysis computer software packages

m)

KS01-EJ139A Specification development

Evidence shall show an understanding of specification writing, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Purpose and nature of specification
- b) Performance based specifications
- c) Prescriptive specifications
- d) Acceptable evidence of compliance
- e) Additional service required with the supply of equipment
- f) Dealing with suppliers and manufacturer's
- g) Documenting specification.

KS02-EJ139A Computer aided drafting

Evidence shall show an understanding of computer aided drafting, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Specific procedures
 - Creating symbols for library files
 - Program specific commands
 - Speed enhancement
 - Configuring the digitising tablet
- b) Methodology for creating layers
 - Name
 - Colour
 - Linetype
- c) Methodology for drawing variables
 - Limits
 - Grid
 - Snap
 - Dimensions
 - Text
 - Units
- d) ISO drawing sheets
- e) Advanced drawings
- f) Multiple three dimensional views
 - Setting up environment on screen
 - Top view

- Front and side views
- Three dimensional views
- g) Movement through space
 - Draw on any created views
 - Relocate coordinate system as necessary
- h) Creation of views
 - Creation of three dimensional geometric shapes
 - Creation of three dimensional complex view by:
 - Manipulation of drawing planes
 - Location of geometric shapes
- i) Editing
 - Use of function to facilitate modification of geometric shapes in completion of a three dimensional view
- j) Display of three dimensional view
 - Wire Line
 - Solid Face
 - Isometric
 - Perspective
 - Orthographic
- k) Saving
 - Use of assembly drawing file for plotting

KS01-EJ141A Complex commercial refrigeration system design

Evidence shall show an understanding of complex commercial refrigeration system design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Commercial refrigeration system types
 - medium and low temperature applications
 - operating conditions
 - system operating and service requirements
 - refrigerant types
 - components
 - multiple evaporator systems
 - multiple temperature systems
 - multiple compressor (rack) systems
 - two stage compressors
 - multiplex systems
 - defrost requirements and methods

- electric defrost systems
- hot gas defrost systems
- cool gas defrost systems
- b) Manufacturer's data
 - rating tables
 - selection tables
 - catalogues.
- c) Operating characteristics
 - Effects of temperature glide with blended refrigerants,
 - Ph Charts,
 - Refrigerating Effect,
 - Heat of compression,
 - Heat Rejected on High Side of the System,
 - required mass flow rate of refrigerant,
 - Volume flow rate at various points in system,
 - Theoretical compressor power,
 - required condenser capacity.
- d) Review refrigerant flow controls
 - refrigerant regulating valves
 - solenoid valves
 - expansion valves
 - pressure regulating valves
- e) Review automatic systems controls
 - cycling controls
 - pressure-stats
 - thermo-stats
 - defrost controls
 - monitoring and alarm controls
 - energy management systems
 - refrigeration automation system
 - control strategies
 - control modes
- f) System design
 - Required cooling capacity per day
 - Running time and required system cooling capacity
 - System capacity control for peak and low load
 - Refrigeration system diagrams
 - Refrigerant, equipment, major component, controls, piping and accessory selection
 -

KS01-EJ142A Complex industrial refrigeration system design

Evidence shall show an understanding of complex industrial refrigeration system design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Standards
 - AS1677
 - ANSI/IIAR Standards
 - ANSI/ASHRAE Standards
 - IIAR Bulletins
- b) Moderate and low temperature industrial refrigeration systems
 - revise direct, flooded and pumped liquid recirculation systems
 - evaporators
 - multi-staged compression
 - direct staging
 - cascade staging
 - compound compressors
 - de-superheaters, liquid injection
 - direct expansion intercoolers
 - open and closed intercoolers
 - basic designs of accumulators/intercooler vessels
 - oil cooling methods
 - oil stabilisation, return and oil recovery in flooded systems
- c) Multiple evaporators and multiple compressors
 - parallel evaporators
 - multiple temperature systems
 - evaporator pressure regulators
 - temperature control methods
 - parallel compressors
 - pipework layout
 - methods of establishing pressure drop in dry and wet suction lines
- d) Indirect refrigeration systems
 - classification according to AS1677
 - applications
 - evaporators
 - heat exchangers, types, construction, selection
 - secondary refrigerants
 - brines
 - antifreeze solutions
- e) Flooded systems
 - applications

- equipment
 - accumulators
 - level controls
 - liquid recirculation pumps
 - liquid pressure relief valve
- f) Cryogenic systems
- applications and equipment
 - system components
 - refrigerants
 - design safety
 - economics
 - cascade systems
- g) Basic control sequences
- maintaining evaporator conditions
 - staging and suction pressure control
 - maintaining condenser conditions
 - control of intermediate pressure, methods of industrial refrigeration compressor capacity control
- h) System design
- Required cooling capacity per day
 - Running time and required system cooling capacity
 - System capacity control for peak and low load
 - Refrigeration system diagrams
 - Refrigerant, equipment, major component, controls, piping and accessory selection
 -

KS01-EJ143A Complex HVAC system design

Evidence shall show an understanding of complex air conditioning system design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) HVAC load estimating of multiple zone and multi-storey buildings
- System design parameters
 - human comfort
 - system requirements in accordance with AS1668
 - heat transfer calculations for complex structures and building components
 - heat and radiation transfer calculations through complex glass structures including various internal and external shading devices
 - indoor air quality
 - olfs and decipols
 - Complex shading
 - solar data, azimuth and altitude angles

- shading from adjacent structures
 - Computer software
 - heat load estimating
 - building thermal performance analysis and simulation software
- b) Advanced Psychrometrics
- Complex psychrometric processes
 - revise sensible cooling and heating and evaporative (adiabatic) cooling
 - cooling and dehumidification
 - cooling and dehumidification with high latent load
 - cooling and dehumidification all out door air
 - cooling and dehumidification all out door air with dehumidified air requirements less than supply air
 - cooling with evaporative humidification
 - cooling with near isothermal humidification
 - spray process to include cooling and dehumidification, cooling and humidification with heated spray water, heating and humidification.
 - partial load processes
 - reheat
 - bypass of, RA only and mix of RA & OA
 - variable air volume
 - variable coil effective surface temperature
 - split coil, horizontal, vertical and intertwined.
 - System performance
 - saturation efficiency of sprayers
 - system capacity calculated from air quantity and enthalpy change
 - Required plant capacity and airflow rates
 - effects of coil bypass factor and ADP
 - calculation of dehumidified air quantity, using both TSH and ERSH methods.
 - Recap on psychrometrics formulae and charts
 - properties of air
 - gas constants
 - derivation of air constants
 - combined gas laws
 - Dalton's law of partial pressures
 - Carrier's equation
 - psychrometric property tables
 - psychrometric charts
 - air mixing equations
 - air quantity equations
 - indirect evaporative coolers

- analysis of cooling coil selection and performance
 - psychrometric analysis of:
 - air conditioning in tropics
 - all outdoor air
 - LCV/HWF systems
 - psychrometric analysis using equations and tables
- c) Air conditioning system design
- Design parameters for multi-storey building
 - customer and objective
 - customer concept of environment desired
 - economic
 - client brief
 - Relevant design criteria
 - building purpose, location, orientation and shape
 - external environment ambient conditions
 - internal load diversity
 - thermal capacity behaviour
 - thermal load (full and partial)
 - Zoning and building usage
 - space and building
 - occupancies, single purpose, multi-purpose
 - System selection criteria
 - economics
 - environment
 - control requirements
 - existing structures
 - new structures
 - system components
 - space for equipment and system
 - selection of appropriate system
 - System and applications
 - design features, engineering procedures and controls for:
 - direct expansion - self contained room/zone, heat pump, multi-zone fan-coils, central station
 - all water - room fan-coil
 - all-air - constant volume variable temperature, face and bypass, reheat, constant temp variable volume, constant volume induction, dual-duct, dual-conduit
 - air water - induction unit, primary air fan- coil
 - HVAC energy conservation techniques
 - heat recovery systems

- night cycle
- optimum stop/start
- purge cycles
- chiller/boiler/cooling tower sequencing
- economy cycles (based on temperature or enthalpy)
- supply air reset
- supply water reset
- condenser water temperature reset
- power demand control
- load limiting
- load shedding
- set point relaxation
- ventilation cycles
- plant - fixed OA to economy, boiler to electric reheat, constant volume to VAV etc.
- cost-benefit (payback)
-

KS01-EJ144A Exhaust systems design

Evidence shall show an understanding of exhaust systems design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Relevant codes and regulations
 - health and safety
 - noise
 - smoke
 - fire
 - hazard identification
- b) System types
 - applications
 - application flow charts
 - system requirements
 - hazard identification
 - effluent types and removal
 - relationship with smoke spill systems
 - supply air dilution applications
 - natural ventilation applications
 - fan assisted exhaust applications
 - replenishment of exhaust air
 - system components
- c) Duct design

- static, velocity, total pressure
 - pressure drop
 - fouling
 - transitions
 - elbows
 - fan position and mounting
 - noise and noise attenuation
 - requirements for access and maintenance
 - system integrity
- d) Fan and motor selection
- applications
 - suitable fan types
 - motor rating and suitability
 - balancing the fan duct system
 - flame proofing
- e) Filters and filter selection
- types and applications
 - capture velocity
- a) Outlet design and location
- prevailing winds
 - position relative to air intakes
 - weather and bird proofing
- b) Cycling/operation control
- applications
 - code/regulation requirements
 - monitoring of contaminants
 - contaminant detection
 - sensors
 - variable speed fans
 - flame proofing of control equipment
 -

KS01-EJ145A HVAC/R hydronic system design

Evidence shall show an understanding of HVAC/R hydronic system design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Hydronic system design fundamentals
- Principles of fluid flow
 - properties of fluids
 - flow of ideal fluids

- fluid flow equipment
 - Bernoulli Theorem
 - fluid flow in pipes
 - Pressure loss and static head - calculation
 - flow throughout system
 - pressure throughout system
 - friction losses
 - pressure loss charts for: copper, steel, UPVC
 - dynamic losses
 - fitting pressure losses
 - fitting interaction
 - total losses
 - calculating system (static and dynamic) head
 - Pump performance and selection
 - pump classification and types
 - pump performance terminology, discharge, head, power, efficiency, speed, net positive suction head required
 - pump performance curves
 - pump laws
 - system head and 'K' factor
 - balance points
 - energy considerations
 - pump cavitation
 - calculation of net positive suction head available
 - Series and parallel operation
 - Pipe sizing
 - maximum friction rate
 - erosion and equipment life
 - industry standards
 - recommended system water velocities
 - economic balance - first cost and operating cost
- b) Hot water systems
- boilers
 - coils
 - expansion tanks
 - pumps, characteristics curves
 - control valves, types, flow diagrams,
 - air purge points
 - water treatment
 - pipe anchors and expansion joints

c) Chilled water systems

- Chillers
- Coils
- expansion tanks
- pumps, characteristics curves
- control valves, types, flow diagrams,
- air purge points
- water treatment
- pipe anchors and expansion joints

d) HVAC/R hydronic systems

- Systems operation
 - closed/open systems
 - pump head/lift, static head (high rise building)
 - system friction losses
 - nett positive suction head
 - system curves
- Pumps
 - types
 - selection criteria
 - performance characteristics
 - bladder tanks
 - coil characteristics
 - heat exchangers: plate, shell and tube, tube in tube
 - flow measurements: types
 - flow switchers
 - builders: types and performance characteristics
 - cooling towers: elementary cooling thermodynamics and types
- Valves - flow control devices
 - types and applications
 - throttling characteristics
 - flow measurements
 - selection and applications
- Hydronic system configuration and design
 - piping configurations
 - single pipe closed circuit
 - two pipe closed circuit
 - direct return
 - three pipe closed circuit with reversed return
 - three way diverting valves
 - risers and headers

- component location
- evaluation of piping configurations
- capital cost
- owning and operating costs
- noise vibration
- maintenance
- future expansion
- commissioning and balancing
- operating characteristics
- cavitation
- System pipe sizes
- pipe dynamic and friction losses for different materials
- fitting pressure losses for different materials
- thermal heat losses
- bare, insulated and underground pipes
-

KS01-EJ146A Complex HVAC/R control system design

Evidence shall show an understanding of complex HVAC/R control system design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Advanced HVAC/R control system design
- Control diagrams
 - Australian Standard and nonstandard symbols as used in a variety of typical HVAC/R control diagrams.
 - electric/electronic control diagrams
 - electrical installation documents
 - pneumatic diagrams
 - DDC diagrams
 - controls/electrical power circuit interface
 - nomographs
 - extraction of specific information relating to the operation and control of plant from a variety of typical HVAC/R control diagrams.
 - development of control diagrams to required standards given specific system operating parameters.
 - Control design requirements
 - standard and statutory requirements
 - economy of operation (energy management)
 - the desired or most appropriate system operating logic for a specified HVAC/R system.
 - appropriate mode of control for a specified HVAC/R system.

- control system type selection for specific applications with due regard to plant size, application, operating environment, available control power supply options, economy and computability to existing or proposed plant and control system.
 - components required to assemble and operate the control system of a specified HVAC/R system.
- b) HVAC/R system energy conservation methods
- HVAC system control
 - night cycle
 - optimum stop/start
 - purge cycles
 - chiller/boiler/cooling tower sequencing
 - economy cycles (based on temperature or enthalpy).
 - supply air reset
 - condenser water temperature reset
 - electrical load control
 - power demand control
 - load limiting
 - load shedding
 - set point relaxation
 - ventilation cycles
- c) Building Management Systems
- Functions of a BMS:
 - autonomous Functions
 - input
 - output
 - general I/O
 - installation management items
 - energy management
 - risk management
 - information processing
 - objectives
 - building running costs
 - smoke control as per AS 1668 part 1
 - BMS hardware:
 - system architecture
 - communication devices
 - substations
 - PC's
 - interfaces with other systems
 - Input and output functions:

- digital - inputs/outputs
- digital output with status feedback
- analogue input/output
- sensors
- alarms
-

KS01-EJ147A HVAC/R energy audits

Evidence shall show an understanding of HVAC/R energy auditing, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Identification of major energy consuming plant
 - review of HVAC/R system components
- b) Methods of energy conservation
 - review of energy conserving strategies
 - house keeping
 - time schedules
 - good maintenance practices
 - filters, fans, appropriate set points, dead bands etc.
 - HVAC system control
 - night cycle
 - optimum stop/start
 - purge cycles
 - chiller/boiler/cooling tower sequencing
 - economy cycles (based on temperature or enthalpy).
 - supply air reset
 - condenser water temperature reset
 - electrical load control
 - power demand control
 - load limiting
 - load shedding
 - set point relaxation
 - ventilation cycles
- c) Tests and data collection procedures
 - use of BMS for data collection (trending)
 - use of data recorders (loggers)
 - monitoring of building operations generally
- d) Analyse results from test data
 - compare against standards (BOMA)
 - review current practices against ideal

- total consumption vs. peak load
- electricity tariffs and implications
- e) Methods of reducing energy usage
 - plant retrofits
 - controls - application of strategies
 - plant - fixed OA to economy, boiler to electric reheat, and constant volume to VAV etc. cost/benefit (payback).
 -

KS01-EJ148A HVAC/R control system audits

Evidence shall show an understanding of HVAC/R control system audits, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) review of HVAC/R system components
- b) performance requirements of particular control applications from available system specifications, design briefs etc
- c) descriptions of operation
- d) measurements, recordings, etc. of system performance, as required to confirm plant control compliance with desired conditions.
- e) comparison of system specifications, control strategies, design briefs, and recorded test results with current HVAC/R energy management principles to establish the economy of operation of HVAC/R plant.
- f) preparation a detailed report outlining the results of investigation and stating suggested control system adjustments, alterations and modifications to improve the performance of the plant.
- g)

KS01-EJ149A Heat exchanger design

Evidence shall show an understanding of heat exchanger design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Advanced thermodynamics
 - Heat transfer
 - Modes of heat transfer
 - Conduction through a flat plate, series flat plates, thick and thin wall pipe, composite pipes (e.g. lagged pipes and drums)
 - Convection at a flat surface or tube
 - Radiation from a flat surface or tube for black or grey bodies
 - Combined conduction and convection through single or multiple flat plates or thin wall tubes
 - Combined convection and radiation
 - Combined conduction, convection and radiation such as fluid in a tank (convection to wall), through wall and/or insulation

- (conduction) to outside air (convection and radiation)
- Heat exchangers - parallel, counter flow and cross flow
- Refrigeration/heat pump
 - Basic principles and terminology
 - Vapour compression cycle
 - Performance criteria
 - Types of refrigerant - designation, properties advantages and disadvantages
 - Refrigerant properties using the p-h diagram
 - Ideal vapour compression cycle on the p-h diagram
 - Energy balance and heat transfers in compressor, evaporator and condenser
 - Actual vapour compression cycle and variations from the ideal
 - pressure loss in lines and non-ideal compression
 - Superheating and subcooling with or without suction/liquid heat exchanger
 - Carnot principle applied to refrigerator and heat pump
 - Principles of evaporative refrigeration, absorption refrigeration, air cycle refrigeration and thermo-electric refrigeration
- b) Heater exchanger design
 - Concepts
 - Design parameters and limitations
 - Construction material and components
 - Testing requirements
 -

KS01-EJ150A New and alternative technology sources

Evidence shall show an understanding of the sources of new and alternative technology development and processes for their adoption, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Sources of information on alternative or new technologies
 - Industry organisations
 - Industry technical journals
 - Government and private research papers/literature
 - Manufacturers' bulletins
- b) Comparison of technical data from different manufacturers
- c) Evaluating performance benefits and limitations of new and developed technologies for given applications, encompassing:
 - Capital cost benefits
 - Operations efficiency
 - Risk hazardous and issues related to environmental and health and safety
 - Functionality
- d) Processes to facilitate adoption

Note: Research; analyses; reporting; recommending; and the like, utilising a range of techniques, processes and technologies

KS01-EJ151A Small electrical appliances and hand power tools

Evidence shall show an understanding of small electrical appliances and hand power tools, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects

- a) Types, applications, operating principles and characteristics
- b) Motors and drive mechanisms
- c) Control and over current protection methods and devices
- d) Typical hand power tool faults encompassing:
 - Motor faults
 - Power supply faults

Note. Examples include open circuit or tripped circuit in cord connected tools and battery charging and discharging problems in battery operated tools.

- Control faults
- Mechanical faults
-

KS01-EJ153A Refrigeration and air conditioning motors and associated controls

Evidence shall show an understanding of refrigeration and air conditioning motors and associated controls, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Three phase induction motors
 - Revise the principles of electromagnetism
 - Phase sequence
 - Three phase induction motor action
 - Induction motor construction
 - stator construction
 - rotor construction
 - Speed and slip
 - Line and phase voltages
 - Terminal block markings
 - Motor nameplate details
 - Motor rating
 - Star and Delta connections
 - Electrical isolation
 - Electrical testing and fault finding
 - Rotation reversal
 - Maintenance requirements

b) Three phase motor starters

- Types of three phase induction motor starters
 - Direct-on-line motor starters
 - characteristics, applications and limitations
 - line and control voltages
 - connection, testing and fault finding
 - Other motor starters – characteristics, applications and limitations
 - Star-delta
 - Auto-transformer
 - Part winding
 - Solid State (soft start)

c) Three phase motor protection devices

- Motor protection
- Motor protection devices
 - star point overloads
- Types of protection devices
 - fuses and circuit breakers
 - thermal overload
 - magnetic overload
 - under voltage and overvoltage relays
 - electronic motor protection
 - Isolation devices
 - Timers
 - Environmental protection
 - Fault finding in three phase motor installations
 - Motor circuit faults

d) Split phase, single phase motors and starters

- Split phase single phase motors
- Development of starting torque in split phase induction motors
- Winding characteristics
- Construction details
- Starting
 - centrifugal switch
 - current coil relay
 - solid state relay
- Characteristics of a split phase motor
 - advantages
 - disadvantage
 - application
 - rating

- speed
 - reversal
 - Testing and fault finding
- e) Capacitor and shaded pole, single phase motor and starters
- Capacitor start motors
 - Characteristics
 - Switching mechanism
 - Applications
 - Motor reversal
 - Capacitor start/capacitor run motors
 - Characteristics
 - Switching mechanism
 - Applications
 - Motor reversal
 - Permanently split capacitor motors
 - Characteristics
 - Applications
 - Motor reversal
 - Capacitors
 - Shaded pole induction motors
 - Advantages
 - Disadvantages
 - Reversal
 - Applications
 - Motor faults and fault finding
 - Capacitor start types
 - Shaded pole motor type
- f) Series universal, single phase motors
- Basic motor principles
 - Commutation
 - Electromagnet field system
 - Reversal
 - Supply types, a.c. /d.c.
 - Construction
 - Characteristics
 - Applications
 - Reversal
 - Faults
 - Synchronous motor
- g) Single phase motor protection devices

- Motor protection
 - Environmental
 - Overheating
 - Thermal overload relay
 - Thermal disc overload
 - Internal overload
 - Protection against open circuit, under voltage and automatic restarting
 - Testing and fault finding
- h) Single phase motor speed control devices
- Speed control methods
 - Pole changing method
 - Voltage control method
 - Inverter
 -

KS01-EJ154A Appliance control systems and devices

Evidence shall show an understanding of control systems and devices used in domestic appliances, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Control systems and components encompassing:
 - appliance controls,
 - electrical/electronic controls,
- b) Control terminology
- c) Types of control
- d) Appliance characteristics and control parameters
- e) System responses to parameter changes
- f) Appliance integrated communications components and their function.
- g) Appliance diagnostic tools
- Types, construction, operation and application of electrical, electronic and mechanical diagnostic tools
- Note. Examples are appliance manufacturer specific diagnostic tools, binary code via LED display; Test instruments such as multimeters, clamp meters, insulation resistance meters, power analysers and high voltage testers; data loggers, microwave leak detectors, gas (hydrocarbon) detectors and sound meters
 - Installation requirements, adjustments and safety encompassing:
 - Manufacturers' instructions and data
 - Installation safety
 - Effects and risks of electrical current and mechanical movement
 - Protection against indirect contact
 - Computer and paper based diagnostic tools encompassing:
 - Appliance manufacturers programs

- Note. Examples are binary code via LED display, remote fault diagnosis via phone access and remote fault diagnosis via Internet
- Text books and manufacturers data
- Service, fault finding and repair encompassing:
 - Manufacturers' data
 - Safety checks
 - Operating sequence
 - Typical symptoms
 - Fault identification using diagnostic tools
 - Confirmation of fault
 - Repairs limitations
-

KS01-EJ155A Appliance refrigeration system

Evidence shall show an understanding of appliance refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

1. Domestic appliance principles

a) Major appliances encompassing:

Note: Examples of major appliances are washing machines, clothes dryers, dishwashers, refrigerators, freezers, air conditioners, electrical and gas cookers and heaters

- Installation codes, statutory requirements and regulations
 - Manufacturer and company installation requirements and warranty implications
 - Site preparation and accessibility.
 - Fixing and procedures and methods for connecting services.
- ##### **b) Operation principles of major domestic appliances that use electrical, gas and/or water services and/or incorporate refrigeration encompassing:**
- Purpose and operational options.
 - Functions of major components.
- ##### **c) Operational testing and set up procedures encompassing:**
- Pre-start checking.
 - Safety controls checking.
 - Operating cycle testing and control adjustments

2. Capillary systems

- ##### **a) Requirements of Domestic Refrigeration Code of Practice.**
- ##### **b) Function, types, construction, characteristics and applications encompassing:**
- system unloading
 - calculating system operating pressures
 - critical length

- critical charge
 - c) Faults leading to repair/replacement of a capillary tubes
 - d) Selection of replacement capillary tubes.
 - e) Procedures for commissioning and servicing a capillary tube system.
3. Appliance refrigeration systems
- a) Types, applications, construction, components and operating characteristics
 - b) Typical component wear or defects
 - c) Typical faults
 - d) Component repair/replacement methods
 - e) Manufacturers' parts catalogues and service reports
4. Retrofitting domestic refrigeration systems
- a) Reasons for retrofitting
 - Montreal Protocol
 - Kyoto Summit
 - Global warming
 - AS Codes of Practice
 - Acts and Regulations
 - b) System Analysis
 - Equipment identification
 - Systems options
 - c) Refrigerant selection
 - Safety considerations
 - ANSI / ASHRAE Standard 34
 - AIRAH Refrigerant Selection Guide
 - Transitional and drop in-refrigerants
 - Medium and long term refrigerants
 - Refrigerant selection considerations
 - Domestic refrigeration system performance testing
 - Refrigerant recovery, recycling or reclaim
 - Lubricant selection considerations
 - d) Retrofit procedure:
 - Refrigerant recovery
 - Flushing procedures
 - Retrofit procedure for CFC/HCFC to blended refrigerants
 - Oil and drier replacement
 - Evacuation
 - Refrigerant charging

- System labelling
-

KS01-EJ156A Clothes washing machines and dryers

Evidence shall show an understanding of clothes washing machines and dryers, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics
- b) Installation
 - Installation codes, statutory requirements and regulations
 - Manufacturer and company installation requirements and warranty implications
 - Site preparation and accessibility.
 - Fixing and procedures and methods for connecting services.
- c) Operational testing and set up procedures encompassing:
 - Pre-start checking.
 - Safety controls checking.
 - Operating cycle testing and control adjustments
- d) Typical component wear or defects
- e) Typical faults
- f) Component repair/replacement methods
- g) Manufacturers' parts catalogues and service reports

KS01-EJ157A Electric heating appliances

Evidence shall show an understanding of electrical heating appliances, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Heating principles and applications
Note. Principles include resistance, induction and microwave.
- b) Types of heating appliances, their operating principles and characteristics
Types include ovens, cook tops, space heaters, but excludes microwave ovens
- c) Heating circuits and controls
- d) Typical faults
- e) Faulty components repair/replacement methods
- f) Manufacturers' parts catalogues and service reports
- g)

KS01-EJ158A Dishwasher machines

Evidence shall show an understanding of dish washer machines, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics
- b) Typical component wear or defects
- c) Typical faults
- d) Faulty component repair/replacement methods
- e) Manufacturers' parts catalogues and service reports
- f)

KS01-EJ159A Gas heating appliances

Evidence shall show an understanding of gas heating appliances, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics
- b) Types include ovens, cook tops, space heaters
- c) Typical component wear or defects
- d) Typical faults
- e) Component repair/replacement methods
- f) Manufacturers' parts catalogues and service reports
- g)

KS01-EJ161A Appliance, testing and compliance verification methods

Evidence shall show an understanding of appliance testing and compliance verification, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Mandatory testing and verification requirements.
- b) Appliance efficiency
- c) Testing techniques
- d) Visual inspection methods
- e)

KS01-EJ162A Appliance Refrigerants and lubricants

Evidence shall show an understanding of refrigerants and lubricants used in self contained appliances, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Introduction to refrigerants
 - Purpose of refrigerant
 - Ideal properties
 - Pure, azeotropic, zeotropic and blend refrigerants
 - General safety requirements and personal protection equipment
- b) Relevant Acts, Regulations, Codes and Standards

- The ozone layer (function, ozone depleting substances)
 - The ozone protection act and regulation
 - State and federal agencies (Dept of the environment, water, heritage and the arts; Dept of climate change; Australian Refrigeration Council Ltd etc)
 - State and federal licensing requirements
 - Refrigerant handling code of practice
 - Relevant Standards
 - Standards philosophy and format
 - How to read and apply a standard
 - Equipment manufactures specifications
- c) Refrigerant properties
- Commonly used types used in appliances, including CFC, HCFC, HFC, high pressure and natural refrigerants
 - Terms (blend, azeotrope, zeotrope, glide, CFC, HCFC, HFC, HC, bubble point, dew point, critical point, ODP, GWP etc)
 - Typical properties and applications of the current refrigerants used in appliances (boiling point, glide, composition (components), comparative latent heat performance etc)
- d) Safe handling of refrigerants
- Refrigerant identification and the numbering system (AS 1677 part 1 sect 3)
 - System refrigerant identification (labeling requirements, Code of Practice)
 - Typical hazards (classification groups - AS 1677 part 1 sect 2 and handling precautions - inhalation, skin contact, cardiac sensitization, decomposition, reaction with moisture etc)
 - Personal safety (MSDS - all common refrigerants plus phosgene, recommended PPE)
 - Cylinders (cylinder terminology (WC, tare etc), transporting safely)
 - Safe Filling (density and water capacity methods)
 - Decanting methods (pumping, temperature differential etc)
 - Recovery cylinders and their safe filling.
 - Disposal of recovered refrigerants (including RRA)
- e) Refrigeration oil
- Types (mineral, POE, AB etc) used in appliances and their applications
 - Basic properties (miscibility, dielectric strength, viscosity and hygroscopic abilities)
 - Typical issues regarding compatibility (neoprene and POE, POE and mineral etc)
 - Safe handling (MSDS - POE's, Mineral, AB's - Residual acid's in used oils)
 - Applications for the various compressor lubricants used in the trade
- f) Recovery and reclaim procedures
- Refrigerant recovery systems and procedures
 - Vapour
 - Liquid
 - Recovery cylinders

- Disposing of recovered refrigerants
- Safety and general issues when recovering refrigerant
- g) Pressure testing
 - Pressure testing
 - Pressure testing procedures and test pressures per Standards, Codes, Regulations and manufacturers requirements
 - Safety and general issues when pressure testing refrigeration systems
- h) Leak detection
 - Leak detector types and applications (electronic, halide, bubble, ultra violet, etc)
 - Hazards and related safe working practices (working around rotating machinery, open flames, ultra violet light etc)
 - Care and maintenance (delicate electronic equipment, changing sensor tip filters, changing gas cartridges etc)
 - Calibration (auto calibrating, send to a specialist etc)
 - Leak testing methods
- i) Evacuation and dehydration
 - Evacuation and dehydration
 - Deep vacuum methods
 - Triple evacuation
 - Vacuum Measurement
 - Instruments
 - Drop test
 - Vacuum Pumps
 - Types, size and applications
 - Use and connections
 - Care and maintenance
 - Safety and general issues when evacuating refrigeration systems
- j) Refrigerant and oil charging
 - Refrigerant cylinders, storage and safe handling
 - Refrigerant charging methods
 - Vapour
 - Liquid
 - Safety and general issues when charging refrigeration systems including personal protection equipment
 - Refrigerant oil removal and addition tools, procedures and safety
- k) System contamination
 - Contaminants (Non-condensables, moisture, acids, carbon, copper etc)
 - Effects of contamination (Acid, motor burnout, oil contamination, copper plating, seizing, RMD blockage, excessive condensing temps etc)
 - Practices/procedures that cause contamination
 - Methods and components use to remove contamination

- Filter dryers – liquid, suction, burnout
 - Dry nitrogen
 - Flushing agents
 - Evacuation
- l) Basic refrigeration component replacement
- Risks of working with refrigerants and rotating equipment
 - Refrigerant recovery
 - Prevention of system contamination
 - Protection of damage to surrounding equipment/ environment
 - Replace basic components on a refrigeration system, for example filter dryer.
 - Pressure testing, evacuation, checking refrigerant charge, refrigerant charging and leak detection
 -

KS01-EJ164A HVAC air and hydronic systems

Evidence shall show an understanding of heating, ventilation and air conditioning (HVAC) air and hydronic systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

1. Air Systems

- a) Air distribution principles
- air diffuser selection
 - factors affecting the design of ductwork systems
 - types of ductwork systems
 - static, velocity and total pressure
 - laminar and turbulent flow
 - moody diagram
 - parameters that control cost
- b) Pressure loss
- friction and dynamic
 - Colebrook - White formula
 - in ducts, friction charts
 - in fittings, loss co-efficient
 - fitting selection criteria
 - diffuser pressure loss
- c) System sizing
- velocity method
 - equal friction method
 - static regain method
 - balanced pressure drop method

- circular to rectangular equivalent
- standard duct sizes and gauges
- balancing
- d) Heat and leakage losses
 - heat gain/loss calculation
 - bare vs. insulated
 - leakage
- e) Overview of noise in duct systems
 - noise sources in duct systems
 - attenuation
 - impact on design
 - methods of control
- f) Fans
 - types and characteristics
 - fan laws
 - system effect
 - fan selection
 - fan and system curves
- g) Air systems
 - dual and single duct constant volume
 - variable volume
 - induction units
 - multi-zone
 - diversity factors

-

2. Hydronic Systems

- a) Systems operation
 - closed/open systems
 - pump head/lift, static head (high rise building)
 - system friction losses
 - nett positive suction head
 - system curves
- b) Pumps
 - types
 - selection criteria
 - performance characteristics
 - bladder tanks
 - coil characteristics
 - heat exchangers: plate, shell and tube, tube in tube

- flow measurements: types
 - flow switchers
 - builders: types and performance characteristics
 - cooling towers: elementary cooling thermodynamics and types
- c) Valves - flow control devices
- types and applications
 - throttling characteristics
 - flow measurements
 - selection and applications
- d) Piping systems
- balancing and commissioning
 - air venting
 - water treatment
 - vacuum breaking and air breaks

KS01-EJ165A Thermodynamics and fluid fundamentals

Evidence shall show an understanding of refrigeration engineering mathematics, thermodynamics and fluid fundamentals, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

1. Refrigeration engineering mathematics fundamentals

- a) Matrices
- The operations: addition (subtraction), scalar multiplication, matrix multiplication up to 3x3 matrices.
 - Identity matrix, inverse matrix
 - Elementary algebraic manipulation of matrices
 - Solve up to three equations (linear) in three unknowns using inverse matrices and determinants.
- b) Quadratic Functions
- Graphs of quadratic functions represented by parabolas and significance of the leading coefficient
 - Zeros represented graphically
 - Solve quadratic equations by factoring and quadratic formula
 - Solve simultaneously linear and quadratic equations algebraically and geometrically.
 - Engineering Mathematics- B
- c) Exponential and Logarithmic Functions
- Laws of indices
 - Graph of $f(x) = kab^x$, emphasising $a = 10, e$

- Definition of the logarithm to any base
 - Graph of $f(x) = k \log_a bx$, emphasising $a = 10, e$
 - Solve exponential and simple log equations using indices, logs, calculator, graphically
 - Change of log base, emphasising 10 and e
 - Growth and decay
- d) Trigonometric Functions
- The ratios: sin, cos, tan, cosec, sec, cot
 - Degrees, radians
 - Graphs of $k f(ax + b)$ where $f(x) = \sin x, \cos x, \tan x$, and significance of k, a, b , for example $V = V_m \sin(\omega t + \phi)$
 - Trigonometric identities
 - Solve trigonometric equations
-
- ## 2. Thermodynamics fundamentals
- a) Energy and humanity
- Need for energy and relationship between energy usage and standard of living
 - Energy conversion - typical processes and efficiencies
 - Sources of energy
 - Solar energy - direct heating, photosynthesis, solar cells, power tower, hydrogen for solar energy, ocean thermal energy collector, solar ponds, wind and wave energy, hydro-electric power
 - Geothermal energy
 - Tidal energy
 - Nuclear energy - fission and fusion, burner and breeder reactors
 - Stored fuel reserves
 - Fuel conservation - reduction in wastage, recycling, greater usage efficiency and use of waste heat
 - Thermodynamics
- b) Basic Concepts
- Nature of matter - atoms, molecules, inter-molecular forces, molecular motion, states of matter
 - Mass and conservation of mass principle
 - Volume, density, specific volume, relative density
 - Force, weight, pressure (atmospheric, gauge and absolute)
 - Temperature (Celsius and Kelvin)
 - Systems and black box analysis
 - Reciprocating piston and cylinder mechanism – pressure ratio and compression ratio
- c) Energy
- Definition and principles

- Potential energy
 - Kinetic energy
 - Work (linear and rotational), constant and variable force, relationship to pressure and volume change
 - Power (linear and rotational)
 - Sensible heat - specific heat capacity (constant pressure and constant volume)
 - Latent heat
 - Chemical energy - energy content of a fuel
 - Internal energy
 - Energy transfer in closed and open systems
 - Definition of a closed system
 - Calorimetry as an example of a closed system (with or without phase change)
 - Thermodynamics 1
 - Non-flow energy equation - typical applications such as stirring with simultaneous heating or cooling
 - Definition of an open system
 - Mass and volume flow rate and continuity equation
 - Steady flow energy equation (negligible change in kinetic or potential energy) leading to the concept of enthalpy - typical applications such as turbines, compressors, boilers and heat exchangers.
- d) Gases
- Definition of a perfect or ideal gas in terms of the molecular model
 - General gas equation
 - Characteristic gas equation (equation of state)
 - Constant pressure process
 - Constant volume process
 - Isothermal process
 - Polytropic process
 - Adiabatic process
- e) Heat engines
- Definition of a heat engine
 - Essentials of a heat engine - heat source, heat sink, working substance, mechanical power output, working cycle
 - Energy balance for a heat engine (as a black box) and efficiency
 - Maximum possible efficiency (Carnot efficiency)
 - Types of heat engines according to working substance, heat source, mechanical arrangement and working cycle
 - Typical practical cycles - Stirling, Otto, Diesel, dual, two stroke (spark and compression ignition). Joule cycle.
 - Thermodynamics 1
- f) Heat engine performance

- Measurement of torque and power output - rope brake, shoe brake, hydraulic dynamometer, electric dynamometer
- Heat supply rate, efficiency, specific fuel consumption
- Measurement of indicated power - mechanical indicator, electric/electronic indicator, Morse test
- Friction power, mechanical efficiency, indicated thermal efficiency
- Volumetric efficiency
- Energy balance
- Performance curves - variable load constant speed, variable speed constant throttle setting.

3. Fluid mechanics fundamentals

a) Basic properties of fluids

- Description of a fluid and the difference between solids and fluids, liquids and gases, hydraulics and pneumatics
- Chemical properties, reaction with metals, corrosiveness, flammability, toxicity, pollution and environmental effects
- Dissolves gases and particles in liquids (slurries)
- Foaming of liquids. Basic properties and units - mass, volume, density, specific volume, relative density, force and weight, pressure (absolute, atmospheric and gauge), temperature (Celsius and Kelvin), viscosity, surface tension
- Vapour pressure of a liquid - saturation vapour pressure
- Temperature and pressure effects on the basic properties
- Ideal/perfect gases and liquids
- Gas laws for ideal gases
- Fluid Mechanics 1

b) Components

- Pipes, channels, tubes and ducts (rigid and flexible)
- Valves - gate, globe, non-return/foot, needle, ball, plug cock, diaphragm, pressure regulating/reducing, safety
- valves
- Filters and strainers for gases and liquids
- Gauges and instruments - pressure and temperature gauges, liquid level gauges, thermometers, thermocouples, manometers, piezometers
- Pipe fittings - elbows/bends, enlargement/contractions, coupler/unions, tees
- Tanks and vessels - storage tanks, pressure vessels, header and surge tanks, weirs/dams/reservoirs
- Nozzles/spray heads
- Flow measurement instruments - venturi and orifice meters, pitot tube, rotameter, anemometer (fan/hot wire)
- Pumps/compressors, motors/turbines

- Actuators - linear (cylinders) and rotary
 - Selection of equipment and instruments considering properties and compatibility
- c) Fluid statics
- Pressure at a point, direction of pressure on a surface
 - Pressure variation with depth in a liquid
 - Pascal's Principle
 - Manometer/piezometer calculations (vertical and inclined)
 - Forces due to fluid pressure on vertical, horizontal and inclined surfaces
 - Centre of pressure
 - Archimedes Principle - buoyancy, flotation, apparent weight and centre of buoyancy
 - Fluid flow
 - Steady and unsteady flow, streamlines and eddies
 - Velocity - average or mean and local
 - Mass and volume flow rate
 - Conservation of mass leading to the Continuity Equation for fluid flow
 - Modification of the Continuity Equation for volume flow of liquids or gases with small changes in density
 - Bernoulli Equation for ideal fluids, meaning of pressure, velocity and potential head. Total head
 - Causes of head loss and modification of the Bernoulli Equation to include a head loss term for real fluids
- d) Fluid power
- Definition and units for work, torque and power
 - Relationship between force, velocity and power and torque, angular velocity and power
 - Work done by a gas expanding at constant pressure
 - Relationship between fluid power, mass flow rate and head
 - Relationship between fluid power, volume flow rate and pressure
 - Efficiency of a pump or turbine
 - Modification of the Bernoulli Equation to include a pump or turbine in the fluid circuit as well as a head loss term
- e) Forces developed by flowing fluids
- Impulse-momentum equation for fluid flow
 - Force developed by a jet striking a stationary plate - perpendicular, inclined or curved
 - Force developed by a jet striking a moving plate or blade
 - Force developed by a jet striking a series of moving plates or blades - power developed and efficiency

KS01-EJ166A Dairy refrigeration systems

Evidence shall show an understanding of dairy refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

a) System characteristics, design features, applications, construction, components and typical layout arrangements.

- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Pure food act and HACCP
- f) Dispensed beverage product knowledge
-

KS01-EJ167A Central plant air conditioning

Evidence shall show an understanding of central plant air conditioning systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) System characteristics, design features, applications, construction, components and typical layout arrangements.
- b) Operating and control principles
- c) Maintenance schedules
- d) System faults and testing methods
- e) Secondary systems and refrigerants
-

KS01-EJ168A Microbial control

Evidence shall show an understanding of microbial control, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

a) Legislation and regulatory requirements for microbial control

b) Types of air and water systems that require control of harmful microbes.

c) Harmful microbes and they effects if left uncontrolled

d) Methods of controlling harmful microbes, including regular cleaning/decontamination of effected plant, sample testing and approved treatment.

e) Safe handling and application of treatment materials.

f) Maintenance

- Principles and function
- Systems and terminology
- Data acquisition
 - plant history cards/files
 - inspection techniques
 - predictive maintenance

- Maintenance plans
- Recording methods
-

KS01-EJ170A Refrigeration and air conditioning systems controls

Evidence shall show an understanding of refrigeration and air conditioning systems safety and cycling controls, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Power and control terminology, symbols and diagrams/drawings
- b) Control systems and components
- c) Refrigeration and air conditioning system electrical/electronic controls
 - Types, applications, operation, installation/replacement, setting adjustment and testing
 - Refrigerant pressure sensing controls including low and high pressure, oil pressure controls and defrost pressure controls
 - Temperature, humidity, air/water flow and defrost controls
 - Electrical controls, including timers, relays (starting and control), contactors, three phase motor starters
- d) Refrigeration and air conditioning direct digital controls
 - Types, applications, operation, installation/replacement, setting adjustment and testing
- e) Refrigeration and air conditioning pneumatic controls
 - Types, applications, operation, installation/replacement, setting adjustment and testing
- f) Refrigeration and air conditioning process characteristics and control parameters
- g) System responses to parameter changes
- h) Finding and rectify control system faults
 - Factors to consider in clarifying the nature of a fault including; initial fault report, confirmation of symptoms of the fault, comparison of symptoms with normal operation
 - Effect to cause reasoning — assumptions of possible causes
 - Methods for testing assumptions including; visual inspection, sectional testing, split-half tests, component isolation
 - Dealing with intermittent faults caused by vibration, shock, changes in temperature and electromagnetic interference.
 - Rectifying control system faults including control adjustment, repair and replacement
 -

KS01-EJ171A Refrigerated beverage vending cabinets

Evidence shall show an understanding of refrigerated beverage vending cabinets, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Types, construction and operation of refrigerated drink vending cabinets encompassing:
 - Coin operated mechanism on the refrigerated vending cabinet.
 - Electro-mechanical mechanism on the coin operated vending cabinet.

- Electronic mechanism on the coin operated vending cabinet.
- b) Specialised components and features required for the operation of a coin operated refrigerated vending cabinet encompassing:
 - Electrical / electronic control circuitry.
 - Air distribution and air flow curtains.
 - Lighting arrangements.
- c) Installation requirements for a refrigerated coin operated vending cabinet encompassing:
 - Location requirements
 - Access requirements and avoidance obstruction
 - Power supply and electrical service requirements
- d) System operating conditions for a coin operated refrigerated vending cabinet.
- e) Commissioning, service and maintenance procedures of a refrigerated coin operated vending cabinet encompassing:
 - Electrical / electronic control devices checks and adjustments.
 - Air flow checks and adjustments.
 - Mechanical checks and adjustments
 - Typical faults
 -

KS01-EJ172A Split system basic operating principles, refrigerants and lubricants

Evidence shall show an understanding of refrigerants and lubricants used in split air conditioning and heat pump systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated

- a) The Residential Air Conditioning and Heat Pump Industry and Licensing Requirements
 - Brief overview and history of the Australian residential air conditioning/heat pump industry
 - Typical applications and equipment
 - Overview of the State and federal agencies (environment and heritage, greenhouse office, ARC, OFT etc)
 - State and federal licensing requirements
 - The ozone protection act
 - The ozone layer (function, ozone depleting substances)
 - Overview of the Australia and New Zealand refrigerant handling code of practice 2007, Part 2, Systems other than Self-contained low charge systems
- b) Heat
 - Matter (atoms, molecules, energy and its different forms)
 - Heat energy (definition, unit of measurement)
 - Enthalpy (definition, unit of measurement)
 - Heat flow (hot to cold)
 - Heat transfer
 - methods (conduction, convection, radiation)

- requirements
- effects
- c) Temperature and Relative Humidity
 - Temperature
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Conversion to/from absolute values
 - Temperature difference/change (t_d , Δt , unit of measurement)
 - Relative humidity
- d) Sensible and Latent Heat
 - Definition of specific heat capacity, latent heat and sensible heat (including units of measurement)
 - Types of latent heat
 - Heat calculations
- e) Pressure
 - Pressure
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Vacuum scales (Pascals, microns)
 - Conversion to/from absolute values
 - The basic Gas Laws – Boyles, Charles and Daltons (excl combined or general gas law)
 - Pressure gauge types and applications (pressure, compound, vacuum, manometer, magnehelic, barometer)
 - Hazards and related safe working practices (dangerous system pressures)
 - Care and maintenance (ingress of oil and contaminants (dirt), avoiding needle bounce (especially HP) etc)
 - Calibration (atmospheric pressure, send to a specialist etc)
 - Appropriate and safe methods of use
 - Typical locations
- f) Refrigerant conditions
 - Saturation temperature
 - Saturated liquid / saturated vapour
 - Superheated vapour
 - Sub-cooled liquid
 - Pressure temperature relationships
 - P/T charts
 - Enthalpy
- g) The Vapour Compression Cycle
 - Major system components
 - High and low pressure sides
 - Basic system operation
- h) Thermometers and relative humidity devices

- Thermometer types and applications (digital, stem, dial, max/min, non-contact, data loggers)
 - Relative Humidity measurement devices and applications (dry bulb/wet bulb, sling, digital)
 - Hazards and related safe working practices (working near rotating machinery - fans, pulleys, belts etc)
 - Care and maintenance (bending stems, overheating, removing batteries after use, uncoiling capillary)
 - Calibration (boiling water, iced water, send to a specialist etc)
 - Appropriate and safe methods of use
 - Typical locations on a system
 - Fitting temperature and relative humidity instruments
- i) Leak Detectors
- Detector types and applications (electronic, halide, bubble, ultra violet)
 - Hazards and related safe working practices (working around rotating machinery, open flame, ultra violet light etc)
 - Care and maintenance (delicate electronic equipment, changing sensor tip filters, changing gas cartridges etc)
 - Calibration (auto calibrating , send to a specialist etc)
 - Leak detection procedures
- j) Service Gauges
- Manifold Gauges
 - Types (dial gauges or electronic, manifolds with additional vacuum and charging ports & sight glasses)
 - Typical uses for service gauges (high & low side pressure readings, charging, evacuating)
 - Care and maintenance (oil and contaminants (dirt) in hoses, avoiding needle bounce, changing hose seals)
 - Calibration (hoses open to atmosphere, adjusting screw etc)
 - Hose shut-off valves and adaptors (access control valves, kwik couplers, etc)
 - System Access Fittings
 - Types (Schrader, service valve, post valve, quick couplers etc)
 - Typical applications for each
 - Hazards and related safe working practices (oil or liquid spray, keeping clean, leaks etc)
 - Care and maintenance (gland nuts loosened/tightened, seal caps fitted, regulations on piercing valves)
 - Using Service Gauges
 - Service gauge manifold hose fitting
 - Purging
 - Pressure readings
 - Service gauge manifold hose removal

- Pressure to temperature conversion
- k) Properties of Split Heat Pump Refrigerants
 - Types (R22, R407C, R410a, R12 (old units) Hydrocarbons)
 - Terms (blend, azeotrope, zeotrope, glide, CFC, HCFC, HFC, HC, bubble point, dew point, critical point, ODP, GWP etc)
 - Typical properties of the current refrigerants used in split systems (boiling point, glide, composition (components), comparative latent heat performance etc)
- l) Properties of Split Heat Pump Refrigerant Oils
 - Types (mineral, POE, AB) and their applications
 - Basic properties (miscibility, dielectric strength and viscosity)
 - Typical issues regarding compatibility (neoprene and POE, POE and mineral etc)
 - Safe handling (MSDS - POE's, Mineral, AB's - Residual acid's in used oil)
- m) Procedures for Working with Refrigerants
 - Contaminants (Non-condensables, moisture, carbon, copper etc), effects of contamination (Acid, motor burnout, oil contamination, seizing, RMD blockage etc) and methods of contamination prevention
 - Reclaiming/recovering refrigerants (using recovery pumps)
 - Recovery cylinders (suitable types, markings and precautions – Code of Practice)
 - Disposing of recovered refrigerants (Code of Practice)
 - Pressure testing systems (suitable gases (nitrogen), test pressure etc)
 - Purging pipework (illegal in Australia)
 - Evacuation of newly installed split systems (vacuum pumps, correct use, 'drop testing')
 - Charging refrigerant into a newly installed split system (pre-charged, charging cylinders, electronic scales)
 - Detecting refrigerant leaks (electronic, bubbles, halide for R22)
 - De-commissioning a split system (recovering refrigerant, isolating in outdoor unit)
 - The practice of retrofitting (overview)
 - Working with high pressure refrigerants (R410A) and Hydrocarbons (special precautions, tools etc)
 -

KS01-EJ173A Microwave ovens

Evidence shall show an understanding of microwave ovens, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Microwave cooking basics encompassing:
 - Properties of microwaves
 - Biological effects of microwaves
 - Fundamental microwave oven operations
- b) Microwave oven performance encompassing:
 - Radiation leakage
 - Power output measurement

- Oven leakage safety system
- Magnetron tests and measurements
- Interlocks
- Thermal cut outs and thermostats
- Stirrer cooling and turntable systems
- c) Power control systems encompassing:
 - Hazards of microwaves and associated high voltages
 - High/low power selection
 - Duty cycle control systems
 - Basic circuit diagrams
 - New microwave oven technology such as inverter microwave ovens
- d) Auto-cook facilities encompassing:
 - Temperature control cooking systems
 - Humidity sensor cooking systems
 - Infrared sensor cooking systems
 - Convection microwave oven systems
- e) Service, fault finding and repair encompassing:
 - Manufacturers' data
 - Safety checks
 - Operating sequence
 - Typical fault symptoms
 - Test equipment
 - Fault identification
 - Fault location using test equipment and service manuals
 - Repairs techniques
 -

KS01-EJ174A Safe working practices for hydrocarbon refrigerants

Evidence shall show an understanding of safe working practices and relevant Standards, Codes and Regulations for hydrocarbon refrigerants to an extent indicated by the following aspects:

- a) Environmental issues
 - Ultraviolet light and the Ozone Layer
 - The Greenhouse Effect and Global Warming
 - Refrigerant categories and basic compositions
 - Environmental issues for each category
- b) Hydrocarbon Types and applications
 - Introduction to hydrocarbons as a refrigerant
 - Types
 - Applications

- Properties
- Compatibility
- c) Acts, Regulations and Standards
 - OH&S Overview
 - Purpose of Acts, Regulations, Codes of Practice, Standards & guidelines
 - Duty of care
 - Applicable acts, standards and codes
 - Record keeping requirements
 - Toxicity and flammability groupings
- d) Emergency Procedures & Incident Management
 - Workcover
 - Hazard Control and Risk Assessment
 - Typical emergency response plans
- e) First Aid
 - Personal protective equipment
 - Hydrocarbon exposure
 - Asphyxiation and revival techniques
- f) MSDS and HAZCHEM codes
 - Types and layout
 - Reading MSD sheets
 - HAZCHEM codes
- g) Cylinders and Storage
 - Ignition sources
 - Storage requirements for hydrocarbons
 - Typical plant room layouts and requirements
 - Maintenance procedures
 - Cylinder and system labelling
 - Disposal of hydrocarbon refrigerants and lubricating oils
 -

KS01-EJ175A Self contained Hydrocarbon refrigeration and air conditioning systems

Evidence shall show an understanding of servicing and repair techniques, applying safe working practices and relevant Standards, Codes and Regulations for Hydrocarbon refrigeration systems to an extent indicated by the following aspects:

- a) Hydrocarbon refrigeration systems
 - Basic operation system types, applications and design operating conditions
 - Domestic refrigerators
 - Self contained refrigeration cabinets
 - Self contained air conditioners
 - Single head split air conditioners

- Heat pump water heaters
- b) Operating conditions for hydrocarbon refrigeration systems
 - Compressors
 - Functions of the compressor
 - Types, construction and their applications
 - Lubrication and lubricators
 - Lubrication methods
 - Safe handling of lubricants
 - Selection of Lubricants
 - Adding and removing oil from Hydrocarbon systems
 - Evaporators / Cooling Units
 - Types, construction and applications
 - Evaporator defrost methods and controls
 - Operation and maintenance
 - Refrigerant Flow Devices
 - Types, construction and applications
 - Operation and maintenance
 - Ancillary Components
 - Leak detectors
 - Safety controls
 - Operation and maintenance
- c) Applicable Standards and Codes
 - Hazards associated with Hydrocarbons
 - AS/NZS 1677
 - AS/NZS 1571
 - IIAR Bulletins
 - ANSI/ASHRAE Standards
 - International Standards EN378
- d) System access tools
 - Schraeder valves
 - Piercing valves
 - Process tube adaptors
 - Gauge manifold sets
 - Maintenance
- e) Access procedures
 - Ignition sources
 - Ventilation
 - Gauge manifold hoses
 - System operating values

- f) Refrigerant removal/recovery and flushing
 - Bleed to atmosphere
 - Recovery to a cylinder
 - Burning
 - Flush with inert gas
- g) Tube joining methods
 - Lok-ring
 - Flare joints
 - Silver brazed joints
 - Flux
- h) Compressor lubricants
 - Types
 - Properties
 - Replacing
 - Disposing
- i) Pressure testing
 - Requirements
 - Recommended pressures
- j) Evacuation
 - Vacuum pumps
 - Vacuum measuring devices
 - Maintenance
 - Recommended depth of vacuum
 - Procedure
- k) Charging
 - Precautions
 - Liquid or vapour charging
 - Suitable methods
 - Disposing of contaminated refrigerant and oil
- l) Leak detection
 - Methods
 - Procedure
 - Maintenance

KS01-EJ176A Installation and commissioning techniques for Hydrocarbon refrigeration Systems

Evidence shall show an understanding of installation and commissioning techniques for hydrocarbon refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Special features for hydrocarbon system
 - Compatibility Issues
 - Major components
 - Materials/substances
 - Metering devices
 - Regulating valves
 - Electrical controls
 - Tools
 - Refrigerant leakage
 - Enclosures
- b) Codes, regulations and standards
 - EN378
 - AS 1677.1
 - ANZ Refrigerant Handling Code of Practice 2007- Part 1
- c) Site Arrangements
 - Building services
 - Piping requirements for hydrocarbons
 - Suitable Equipment locations
- d) Site Safety
 - Hazards
 - Checklist
 - Report
- e) System diagrams
 - Mechanical layouts
 - Electrical circuits
- f) Installation
 - Assembly
 - Pressure Testing
 - Evacuation
 - Charging
 - Leak Detecting
- g) Commissioning
 - Pressure Temperature relationships for hydrocarbon refrigerants
 - Evaporator Td's for hydrocarbon systems
 - Condenser Td's for hydrocarbon systems
 - Cycling control settings

- Safety control settings
- Regulator settings
- Refrigerant metering device settings

KS01-EJ177A Hydrocarbon refrigeration systems design

Evidence shall show an understanding Hydrocarbon refrigeration systems, components and piping design requirements, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Technical standards, regulations and codes for hydrocarbon refrigeration systems
 - Standard philosophy and format
 - Standards, regulations and codes that apply to Hydrocarbon refrigeration systems
 - Equipment manufacturers specifications
- b) Hydrocarbon refrigeration system design requirements
 - Applications of hydrocarbon refrigeration systems
 - Domestic refrigerators
 - Commercial refrigeration
 - Thermodynamic properties of HC
 - HC phase diagram
 - HC properties tables and chart
 - HC Refrigeration cycle
 - P-h diagram representation
 - Expansion, evaporation, compression and condensation processes
 - Performance analysis of HC refrigeration systems
 - Refrigerating effect
 - Heat of rejection
 - Heat of compression
 - Coefficient of performance
 - Effects of suction superheating on cycle efficiency
 - Effects of liquid sub-cooling on cycle efficiency
 - Actual HC refrigeration cycles
 - Superheating inside and outside the refrigerated space
 - Liquid-suction heat exchangers
 - Pressure drop in piping due to friction and dynamic losses
- c) Hydrocarbon refrigeration system components and piping
 - Design preliminaries
 - System operating parameters
 - Project specifications
 - Equipment selection criteria

- Selection tables, charts and catalogues
- Materials used with HC refrigerants
- Heat exchanger selection
 - Selection of evaporators
 - Selection of condensers
- Compressor selection
- Liquid expansion devices selection
- System load balance point
- Refrigeration line design and sizing
- Automatic controls
- Safety
 - MSDS of HC refrigerants
-

KS01-EJ178A Safe working practices with Ammonia refrigerant

Evidence shall show an understanding of safe working practices and relevant Standards, Codes and Regulations for Ammonia refrigerant an extent indicated by the following aspects:

- a) Introduction to Ammonia Refrigerant
 - Properties of Ammonia
 - Occupational Health and Safety Legislation
 - Physical Effects of Ammonia
 - Flammability of Ammonia
- b) Australia Standards
 - AS/NZS 1667.1:1998 Refrigerating Systems Refrigerant Classification
 - AS/NZS 1667.2:1998 Refrigerating Systems Safety Requirements for Fixed Applications
 - AS/NZS 2022: 2003 Anhydrous Ammonia – Storage and Handling
- c) Safety
 - Hazards in a refrigeration plant
 - Hazards of Ammonia
 - Dealing with emergencies
 - Personal Protection Equipment
 - Draining oil procedure
 - Ammonia decanting procedure
 - Ammonia charging procedure
 - Ammonia pump down procedure
 - Ammonia purging procedure
 - Confined spaces
 - First aid for Ammonia
 - Chemical Safety

- Material Safety Data Sheets (MSDS)
- d) Safety Management and Risk Management
 - Operating Procedures
 - Preventative Maintenance Programs
 - Risk Assessment
 - Risk Management Plan
 - Training
 - Safety Audits
 - Record keeping
 - Permits
 - Incident investigation and reporting
 - Duty of care
 -

KS01-EJ179A Servicing and repair techniques for Ammonia refrigeration systems

Evidence shall show an understanding of the Ammonia refrigeration systems, their operating conditions, and servicing and repair techniques, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Ammonia Refrigeration Systems
 - Vapour Compression Systems
 - Revision of Vapour Compression Cycle
 - Properties of Ammonia
 - Safe Handling of Ammonia
 - Types of Ammonia Systems
 - Direct Expansion Systems
 - Flooded Systems
 - Liquid Recirculation Systems
 - Multi Staged Systems
 - Single Staged Systems
 - Multi Staged Systems
 - Cascade Systems
- b) Operating conditions of Ammonia Refrigeration Systems
 - Compressors
 - Function of the compressor
 - Types, construction and their applications
 - Capacity control of compressors
 - Factors affecting performance
 - Economiser operation
 - Types of oil separators
 - Methods of oil cooling
 - Operation and maintenance
 - Lubrication and lubricants
 - Lubrication methods
 - Safe handling of lubricants
 - Selection of lubricants
 - Oil / Ammonia separation
 - Adding and removing oil from Ammonia systems
 - Methods of oil recovery
 - Evaporators / Cooling Units
 - Types of evaporators (air / fluid cooling)
 - Direct contact freezing
 - Secondary refrigerants
 - Evaporator defrost methods and controls
 - Operation and maintenance

- Condensers and high pressure receivers
 - Evaporative condensers
 - Water cooled condensers
 - Air cooled condensers
 - High pressure receivers
 - Operation and maintenance
 - Low Pressure Receivers
 - Suction accumulators
 - Intercoolers
 - Liquid refrigerant pumps
 - Liquid level controls
 - Operation and maintenance
 - Purging
 - Non condensable gases
 - Manual; purging of Ammonia systems
 - Automatic refrigerated purgers
 - Operation and maintenance
 - Refrigerant Flow Devices
 - Expansion valves
 - Automatic liquid feed control devices
 - Pressure regulating devices
 - Operation and maintenance
 - Methods of oil recovery
 - Ancillary Components
 - Strainers, isolating valves
 - Liquid level indicators
 - Pressure relief valves
 - Ammonia leak detectors
 - Safety controls
 - Operation and maintenance
- c) Servicing and repairs

- Servicing Procedures
- Leak detection methods
- Adding refrigerant
- Removing refrigerant
-

KS01-EJ180A Installation and commissioning techniques for Ammonia refrigeration systems

Evidence shall show an understanding of installation and commissioning techniques for ammonia refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Interpret Drawings
 - Refrigeration Piping Schematic Diagrams
 - Refrigeration Layout Diagrams
 - Electrical Control Diagrams
 - PLC Control Diagrams
- b) Project Management
 - Work Breakdown Structures
 - Network Diagrams / Gantt Charts
 - Costing
 - Dealing with Conflict
 - Delegation
- c) Refrigerant Piping
 - Pipe Sizing Principles
 - Material Compatibility
 - Installation Principles
 - Welding
 - Hydraulic Shock
 - Relief Valves
 - Pressure Testing/Evacuation
- d) Insulation and Vapour Barrier
 - Insulation Materials
 - Vapour barriers
- e) Coolroom and Freezer Construction
 - Construction Materials
 - Construction Methods
 - Underfloor heating
 - Defrost Methods
 - Commissioning Procedures
- f) Refrigeration Control System Testing and Adjustment

- Refrigerant Level Controls
 - Refrigerant Pressure Controls
 - Temperature Controls
 - Flow Controls
 - Defrost methods and controls
 - Central PLC System
- g) Testing and Commissioning
- Compressors
 - Evaporative condensers
 - Water cooled condensers
 - Air cooled condensers
 - High pressure receivers
 - Evaporators (air / fluid cooling)
 - Direct contact freezing
 - Secondary refrigerants
 - Start up and Shut Down Procedures
- h) Report on the install and commissioning of Ammonia refrigeration systems
- Operating conditions are recorded
 - Documentation marked up "As Installed"

KS01-EJ181A Ammonia refrigeration system design

Evidence shall show an understanding of Ammonia refrigeration systems, components and piping design requirements, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Technical Standards, Codes and Regulations
- Environmental and safety considerations in the use and disposal of ammonia refrigerant
 - Toxicity of ammonia, the effects on human health and the legislative limitations imposed on ammonia refrigerant as a result
 - Flammability of ammonia, concentration, LEL
 - Environmental effects
 - Safe disposal
 - MSDS samples
 - Registration requirements for transport and on-site use
 - Relationship between ammonia system refrigerant charge and Dangerous Goods Storage regulations
 - Engine ventilation requirements and determination of ventilation rates
 - Scrubbers for elimination of the harmful effects of ammonia

b) Ammonia refrigeration system design requirements

- Applications of refrigerant ammonia (NH₃) in industrial refrigeration
 - Introduction to industrial ammonia refrigeration applications and systems
 - Applications in Industrial Refrigeration: Cool and cold storage, food processing, beverage manufacturing plants, fertilizer plants, second compression stage of CO₂ systems
 - Application in environment control and air conditioning: Large scale reticulated water/secondary refrigerant systems
 - Advantages and disadvantages of ammonia refrigerant compared with other natural and synthetic refrigerants
- Properties, application and limitations of ammonia refrigerant
 - General classification of ammonia refrigerant according to AS 1677 Refrigerating Systems
 - Common contaminants in ammonia refrigeration systems, water, oil, non-condensable and the effects of same on cycle efficiency and system wear
 - Refrigeration machine oils soluble in ammonia, oil type, applications, reactions with water
 - Thermal and transport properties of ammonia in comparison with other natural and synthetic refrigerants including the behaviour in a vapour compression cycle
- Application concepts and principles
 - Single stage vapour compression cycles with dry expansion refrigerant feed
 - Single and dual stage vapour compression cycles with liquid overfeed
 - Single stage vapour compression cycles with screw compressors and liquid overfeed
 - Cascade NH₃/CO₂ systems with dry expansion and liquid overfeed
 - Single and dual stage vapour compression cycles with gravity flooded refrigerant feed
 - Single and dual stage vapour compression cycles with NH₃ used as a volatile secondary refrigerant
 - Dual stage vapour compression cycles with multiple (>2) saturation temperature levels
 - Automatic defrost principles including off-cycle air defrost, ambient air defrost, hot gas defrost, electric defrost and water defrost
 - Selection and sizing of ammonia pumps for liquid overfeed systems
 - Selection and sizing of high pressure and low pressure vessels
 - Refrigerant pipe sizing using Ammonia refrigerant
 - Selection of suitable refrigerant oil

c) Ammonia refrigeration system components and piping

- Corrosion and Material selection
 - Materials compatibility table
 - Thermal and other properties of materials in use
 - Pipe material and jointing methods/materials

- Compressors
- Pumps, impellers and seals
- Isolation and control valves
- Heat exchangers
- Pipe and insulation materials, pipe stresses and pipe suspension methods
 - Mild steel pipe
 - Stainless steel pipe
 - Sharpy tested pipe
 - Post-installation insulation (in situ foaming, formed insulation, closed cell flexible insulation)
 - Pre-insulated pipe material
 - Vapour barrier – importance and maintenance
- Heat exchangers
 - Finned air coolers or evaporators - induced draught, forced draught, stainless steel/aluminium, mild steel galvanized, all aluminium, stainless steel/AlMg3, all stainless steel; description of what materials are used where and for what reason; various refrigerant feed methods including advantages/disadvantages i.e. top feed, bottom feed, vertical up flow/down flow of air; fin spacing, fin thickness; impact of geometry on fluid pressure drops
 - Condensers – evaporative, air cooled, air cooled adiabatically assisted, water cooled shell and tube, water cooled plate/plate, water cooled plate and shell, cascade shell and tube, cascade plate/plate, cascade plate and shell; material selection for condensers, importance of discharge temperature for condenser design
 - Cooling towers
 - Intercoolers and economizers of the closed type, sizing of liquid subcooling coils and tube bundles
 - Liquid coolers or evaporators – plate/plate, plate/shell, shell and tube; material selections, refrigerant feed methods, oil management
 - Screw compressor oil coolers – plate/plate type, shell and tube type, water cooled, refrigerant cooled, surface enhancement options
 - Heat recovery – shell and tube de-superheaters, plate/plate de-superheaters, heat recovery condensers of various types
- System control and monitoring
 - Compressor capacity control – pressure and temperature signals
 - Room temperature and humidity control – understanding the principle of cooling and re-heating air streams to control absolute moisture contents
 - Control of condensers – optimization of overall plant C.O.P.
 - Floating condensing pressures
 - Control of fluid temperatures within the system – oil, secondary refrigerants, subcooling
 - Control of flows – thermostatic expansion valves, low pressure floats, high pressure floats, motorized valves, electronic expansion valves, hand regulating valves, oil return systems between compressor oil separators and compressors

- Pressure controllers - evaporating pressure controllers, thermostatic controllers, hot gas bypass valves, crankcase pressure regulators, overflow valves, NH3 pump pressure control, flow controllers, defrost pressure controllers
- Defrost control
- PLC control systems
- SCADA systems
- Water treatment and desiccant dehumidifiers
 - Condenser water treatment – purpose and legislative requirement
 - Treatment of secondary refrigerant loops including monitoring
 - Desiccant dehumidifiers and their role in infiltration minimization, defrost control and energy savings
- Equipment Selection
 - Use computer software and manufacturers data to select major components of an Ammonia refrigeration plant
-

KS01-EJ182A Service and repair secondary refrigeration systems

Evidence shall show an understanding the secondary refrigeration systems, components, maintenance service and repair, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Secondary refrigeration systems
- Introduction to secondary refrigeration systems
 - Safety
 - Basic operation
 - Typical applications
 - Safety in handling Secondary Refrigerants
 - Types of secondary Refrigerants
 - Need for anti bacterial and corrosion inhibitor use
 - Use of PPE (Personal Protective Equipment)
 - Major components location, purpose and operation
 - Safety
 - Major components Operation
 - Pipe work and insulation
 - Pumps
 - Cooling coils
 - Low temperature defrost systems
 - Heat recovery coils
 - Control system, pressure temperature, and safety
 - Control, balance and operational valves
- b) Service and repair secondary refrigeration systems
- Carry out repairs to secondary refrigerant systems.

- Safety
 - Appropriate personnel contacted before isolation repairs to pumps
 - Additions required to maintain chemical integrity of refrigerant
 - Repairs to cooling coils/ freezing coils
 - Repair system leaks
 - Repair pipework or insulation
 - Repair / replace defective control valves
 - Repair / replace defective control system component
 - Refrigerant disposal EPA requirements
 - Complete report on repair activities
 - Tools and equipment for repair work
 - Applicable Standards and Codes
- c) Maintenance procedures for secondary refrigeration systems
- Maintenance requirements of secondary refrigeration systems.
 - Safety
 - Operation of primary cooling source
 - Tool and equipment
 - Operation of pumps
 - Chemical integrity of refrigerant
 - Cooling coils/ freezing coils operation
 - Leak detection additives
 - Leak test system
 - Pipework and insulation check
 - Control valve test
 - Control system check
 - Complete report on maintenance activities
 - Tools and equipment for maintenance work
 - Applicable Standards and Codes
 -

KS01-EJ183A Secondary refrigeration system design

Evidence shall show an understanding of secondary refrigeration system, components and piping design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Technical standards, regulations and codes for secondary refrigeration systems
- Environmental and safety considerations in the use and disposal of secondary refrigerants
 - Toxicity and food compatibility
 - Flammability
 - Environmental effects
 - Safe disposal

- MSDS samples
- Registration requirements for transport and on-site use
- b) Secondary refrigeration systems design requirements
 - Applications of secondary refrigeration systems in refrigeration
 - Introduction into Secondary Refrigeration
 - Applications in Industrial Refrigeration: Cold storage, food processing, climatic test chamber
 - Application in Commercial Refrigeration: Supermarkets, Small commercial systems
 - Advantages and disadvantages of secondary refrigerants over the direct use of primary refrigerants
 - Properties, application and limitations of available secondary refrigerants
 - General classification of secondary refrigerant types – single phase, volatile, phase change
 - General types of single phase secondary refrigerants available: Glycols, Alcohols, Brines, Hydrocarbons, Silicone oils, Water
 - Common types of volatile and phase change secondary refrigerants available: CO₂, Ice slurries
 - Thermal and transport properties of most widely used single phase secondary refrigerants (MEG, PG, Ethyl Alcohol, CaCl₂, Potassium brines)
 - Pump selection for viscous fluids
 - Application concepts and principles
 - Main and loop circuits, use of variable speed pumps and overflow valves
 - Buffer and storage tanks, benefits and disadvantages
 - Loop temperature control and loop pump selection
 - Control valve options: Regulating and on/off, 2-way and 3-way, mixing and diverting
 - Expansion and contraction of components, compensation for pipe expansion, effect of pipe pre-insulation
 - Expansion and contraction of secondary refrigerant, use of membrane expansion tanks versus open expansion tank
 - Air purging
- c) Secondary refrigeration system components and piping
 - Corrosion and Material selection
 - Materials compatibility table
 - Thermal and other properties of materials in use
 - Pipe material and jointing methods/materials
 - Pumps, impellers and seals
 - Isolation and control valves
 - Heat exchangers
 - Pipe and insulation materials

- Metal pipe
- Plastic pipe
- Post-installation insulation (in situ foaming, formed insulation, closed cell flexible insulation)
- Pre-insulated pipe material
- Vapour barrier – importance and maintenance
- Heat exchangers
 - Plate heat exchangers, brazed, welded, semi-welded, gasketed. Design considerations in conjunction with primary refrigerant, flooded, direct expansion, pump circulated primary refrigerant
 - Shell & tube and Plate & shell heat exchangers
 - Fan coil units
- System control
 - Primary pump speed and staging control
 - Maintenance of minimum flow and control valve pressure head
 - Overflow valves
 - Secondary loop temperature control
 - Room humidity and temperature control with fan-coil units
-

KS01-EJ184A Safe working practices with Carbon Dioxide refrigerant

Evidence shall show an understanding of safe working practices with carbon dioxide refrigerant and relevant Standards, Codes and Regulations an extent indicated by the following aspects:

- a) Introduction to Carbon Dioxide refrigerant
 - Refrigerants and CFC/HFC phase out
 - Introduction to Carbon Dioxide – CO₂
 - Benefits of using Carbon Dioxide as a Refrigerant (R744)
- b) Introduction to HAZCHEM Codes and Material Safety Data Sheets (MSDS)
 - Classification of Dangerous Goods
 - HAZCHEM CODE
 - Refrigerant 2RE Hazchem Codes
 - UN (United Nations) Number
 - Material Safety Data Sheets (MSDS)
 - Personal Protection Equipment (PPE)
- c) Carbon Dioxide Plant Safety
 - Carbon Dioxide CO₂ R744 Detectors
 - Appropriate Type
 - Care ,Maintenance and Installation
 - Cylinder Regulators CO₂

- All currently available regulators provide vapour feed only
- Pressure readings (bottle and line)
- Refrigerant Cylinders CO₂
- Refrigerant conditions
 - Hazards and related safe working practices (dangerous system pressures)
 - Pressure to temperature conversion (Saturated P/T is only between 430 kPa and 4399kPa)
- Carbon Dioxide Relief Valves AS1894-1997
- d) Emergency Management
 - Planning for emergencies
 - The emergency plan
 - Risk Assessment
- e) First Aid for CO₂ Exposure
 - Type of exposure
 - Acute
 - Chronic
 - Swallowed
 - Eye
 - Skin
 - Inhaled
 - Carbon Dioxide CO₂ R744 is a narcotic and an asphyxiant in large concentrations in air. Concentrations above 10% in air may lead to death very quickly.
 - First Aid Facilities
 - Ensure plenty of drinking water
 - Safety shower
 - Eye wash station eye wash bottle available
 - Oxygen for resuscitation
 - Always seek urgent medical attention when an incident occurs with Carbon Dioxide CO₂ R744 refrigerant.
 - DRABC – steps or procedures that must be carried out if a first aid person or emergency personnel come across a person who is unconscious
 - SCBA – Self contained breathing apparatus. Compressed air comes in bottles strapped to the user's body. Note all personnel who may be required to use SCBA type equipment require specialised training
- f) Applicable Standards and Codes
 - Hazards associated with Carbon Dioxide (MSDS)
 - AS1894 – 1997
 - New South Wales OH&S Act 2000 No40
 - Storage and handling of workplace Dangerous Goods National Code of Practice (NOHSC:2017 – 2001)
 - Dangerous Goods Act

- AS1940-2004 The storage and handling of flammable and combustible liquids
- AS/NZS 1677
- AS/NZS 1571
- IIAR Bulletins
- ANSI/ASHRAE Standards
- IOR Safety code for Refrigerating Systems utilising Carbon Dioxide

KS01-EJ185A Servicing and repair techniques for Carbon Dioxide refrigeration systems

Evidence shall show an understanding of carbon dioxide refrigeration systems, operation, components, service and repair techniques, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Carbon Dioxide Refrigeration Systems
 - Introduction to Carbon Dioxide refrigeration System
 - Benefits of using Carbon Dioxide as a Refrigerant
 - Thermophysical Properties
 - Introduction to Liquid recirculation /Cascade system employing Carbon Dioxide refrigerant at Sub-Critical condition.
 - Systems and Major components
 - Basic operation
 - Typical applications
- b) Operating conditions of carbon dioxide Refrigeration Systems
 - CO₂ Refrigeration Compressors and lubricants
 - Types, construction and their applications (reciprocating, screw,)
 - Types of compatible compressor oil (POE), (PAO)
 - Safe handling of lubricants for CO₂ applications (MSDS - POE's, PAO)
 - System components, construction and operation
 - CO₂ Low temperature evaporators design features
 - Medium Temperature Liquid re-circulation evaporators
 - Hand expansion valves (medium temp.)
 - Electronic expansion valves (low temp)
 - Cryogenic pressure relief devices
 - Plate heat exchangers
 - Liquid –Suction heat exchangers
 - Liquid CO₂ Refrigerant Pumps
 - "Q" Min and "Q" Max valves
 - Interconnecting piping
 - Refrigerant receiver
 - Isolation valves

- Applicable Standards and Codes
 - Hazards associated with Carbon Dioxide (MSDS)
 - AS/NZS 1677
 - AS/NZS 1571
 - IIAR Bulletins
 - ANSI/ASHRAE Standards
 - IOR Safety code for Refrigerating Systems utilising Carbon Dioxide
- c) Servicing and repair techniques for carbon dioxide refrigeration systems
 - Service Gauges
 - Appropriate Type
 - Care and Maintenance of Gauges and hoses
 - Service procedures
 - Charging CO₂ into a system in both vapour and liquid form
 - Discharging CO₂ from a system safely
 - Pressure testing
 - System and component isolation
 - Leak detection methods for CO₂
 - Cylinder Regulators CO₂
 - All currently available regulators provide vapour feed only
 - Pressure readings (bottle and line)
 - Refrigerant Cylinders CO₂
 - Refrigerant conditions
 - Hazards and related safe working practices (dangerous system pressures)
 - Pressure to temperature conversion (Saturated P/T is only between 430 kPa and 4399kPa)
 - System standing pressure as a result of power loss.
 - Moisture problems with CO₂ systems
 -

KS01-EJ186A Installation and commissioning procedures for Carbon Dioxide refrigeration systems

Evidence shall show an understanding of installation and commissioning procedures for sub-critical carbon dioxide refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Materials and Installation procedures
 - Material selection
 - Copper pipe standards
 - Pipe connections
 - Pipe supports hangers and connections

- Arrangement of isolation valves
- Location of relief valves
- b) Commissioning
 - Pressure testing
 - Evacuation and dehydration
 - Charging refrigerant and lubricant
 - System testing and adjustment
 - Documentation

KS01-EJ187A Carbon Dioxide refrigeration system design requirements

Evidence shall show an understanding of Carbon Dioxide refrigeration systems, components and piping design requirements, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Technical Standards, Regulations and Codes for carbon dioxide refrigeration systems
 - Standard philosophy and format
 - Standards, regulations and codes that apply to CO₂ refrigeration systems
 - Equipment manufactures specifications
- b) Carbon Dioxide refrigeration system design requirements
 - Possible areas of applications of CO₂ refrigeration systems
 - Mobile air conditioner
 - Heat pump water heater
 - Commercial refrigeration
 - Thermodynamic properties of CO₂
 - CO₂ phase diagram
 - CO₂ properties tables and chart
 - Conventional refrigeration cycle versus CO₂ refrigeration cycle
 - T-s and p-h diagram representations
 - Isentropic efficiency
 - Volumetric efficiency
 - Types of CO₂ refrigeration system configurations
 - Sub-critical operation
 - Trans-critical operation
 - Cascade systems
 - Performance analysis of CO₂ refrigeration systems
 - Sub-critical cycle
 - Trans-critical cycle
 - Cascade systems

c) Carbon Dioxide refrigeration system components and piping

- Design preliminaries
 - System operating parameters
 - Project specifications
 - Equipment selection criteria
 - Selection tables, charts and catalogues
- Heat exchanger selection
 - Selection of evaporators
 - Selection of condensers
 - Selection of coolers
- Compressor selection
- Liquid expansion devices selection
- System load balance point
- Refrigeration line design and sizing
- Automatic controls
- Safety devices
-

KS01-EJ188A Trans-Critical Carbon Dioxide refrigeration and heat pump systems

Evidence shall show an understanding of servicing and repair techniques for Trans-critical Carbon Dioxide refrigeration and Heat Pump Systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Introduction to Carbon Dioxide refrigeration and heat pump systems encompassing -
 - Benefits of using Carbon Dioxide as a Refrigerant
 - Thermophysical Properties
- b) Access procedures Introduction to self contained systems employing Carbon Dioxide refrigerant at Trans-Critical condition.
 - Systems and major components
 - Basic Operation
 - Typical applications
 - 1. Domestic refrigerators and freezers
 - 2. Refrigerated cabinets
 - 3. Heat pump water heaters
- c) Servicing tools, equipment and procedures
 - Service Gauges
 - Appropriate Type
 - Care and Maintenance of Gauges and hoses
 - Service procedures
 - Charging CO₂ into a system in both vapour and liquid form
 - Discharging CO₂ from a system safely
 - Pressure testing

- System and component isolation
- Leak detection methods for CO2
- Cylinder Regulators CO2
 - All currently available regulators provide vapour feed only
 - Pressure readings (bottle and line)
- Refrigerant Cylinders CO2
- Refrigerant conditions
 - Hazards and related safe working practices (dangerous system pressures)
 - Pressure to temperature conversion (Saturated P/T is only between 430 kPa and 4399kPa)
- System standing pressure as a result of power loss.
- Moisture problems with CO2 systems
- d) CO2 refrigeration compressors and lubricants
 - Types, construction and their applications
 - Types of compatible compressor oil (POE), (PAO)
 - Safe handling of lubricants for CO2 applications (MSDS - POE's, PAO)
- e) System components, construction and operation
 - CO2 evaporators design features
 - CO2 sub-cooler design features
 - Refrigerant flow controls
 - 1. Capillary tubes and accumulator
 - 2. Electronic expansion valves
 - Pressure relief devices
 - Liquid –Suction heat exchangers
- f) Applicable Standards and Codes
 - Hazards associated with Carbon Dioxide (MSDS)
 - AS/NZS 1677
 - AS/NZS 1571
 - IIAR Bulletins
 - ANSI/ASHRAE Standards
 - IOR Safety code for Refrigerating Systems utilising Carbon Dioxide

EK01-EJ189A Room air conditioners

Evidence shall show an understanding of self contained room air conditioners, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Types, applications, construction, components and operating characteristics
- b) Typical component wear or defects
- c) Typical faults

- d) Component repair/replacement methods
- e) Manufacturers' parts catalogues and service reports
- f)

KS01-EJ190A Basic commercial refrigeration system equipment, components and accessories selection

- Evidence shall show an understanding of basic commercial refrigeration system components and piping selection, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:
 - a) Calculation of capacity in heat exchangers:
 - $Q = UA \text{ (LMTD)}$
 - $Q = mc\Delta t$
 - $Q = m \Delta h$
 - b) Evaporators
 - commercial types and applications
 - coil bypass factor
 - effects of evaporator TD on space humidity
 - effects of air circulation on product conditions
 - selection criteria and selection tables
 - c) Condensers
 - commercial types and applications
 - effects of ambient conditions
 - condenser control
 - heat rejection factor
 - condenser TD
 - selection criteria and selection tables
 - d) Compressors
 - types and applications
 - capacity
 - displacement
 - volume flow rate
 - theoretical capacity
 - total volumetric efficiency
 - effect of operating conditions, including suction pressure drop and superheating
 - actual capacity
 - power
 - theoretical requirement
 - effects of operating conditions
 - actual requirements
 - post defrost loads
 - pull down torque requirements, high, medium and low back pressure compressors

- selection tables, motor selection
- e) Refrigerant flow controls
 - types, operation and applications
 - effects from sub-cooling
 - distributor types, operation and applications
 - selection tables
- f) System load balance point
 - graphical representation
- g) Line sizing and design
 - quick selection tables
 - velocity tables
 - pressure drop in lines and fittings
 - oil migration stabilisation
 - refrigerant velocity
 - effect of varying system capacity
 - oil traps
 - risers
 - liquid migration
- h) Automatic controls
 - fin spacing, suction temp to evaporator suction
 - hot-gas bypass valves
 - electronic control of valves PLC control
 - refrigerant regulating valves
 - solenoid valves
 - condenser pressure regulating valves
 - evaporator pressure regulating valves
 - crankcase pressure regulating valves
 - cycling controls
 - pressure-stats
 - thermostats,
 - defrost controls
 - monitoring and alarm controls
 - refrigeration automation systems
 - control strategies
 - control modes
 -

KS01-EJ191A Air conditioning system equipment and component selection

Evidence shall show an understanding of air conditioning system equipment, components and piping selection, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Residential Air Conditioning Unitary Equipment
 - Construction, operation, application and selection of:
 - room air conditioners
 - split systems – wall hang, cassettes and ducted
 - small package units
 - cooling only and reverse cycle
- b) Line sizing and design
 - quick selection tables
 - velocity tables
 - pressure drop in lines and fittings
 - oil migration stabilisation
 - effect of varying system capacity
 - oil traps
 - liquid migration
- c) Control Systems
 - Construction, operation, application and selection of:
 - cycling and safety controls
 - pressure-stats
 - thermostats,
 - de-ice controls
 - air conditioning automation systems
 - control strategies
- d) Air Distribution
 - Principles
 - factors affecting the design of ductwork systems
 - flexible ductwork systems
 - static, velocity and total pressure
 - Pressure loss
 - friction and dynamic
 - in ducts, friction charts
 - in fittings, loss co-efficients
 - diffuser pressure loss
 - System sizing
 - standard duct sizes and gauges
 - duct selection
 - fitting selection
 - air diffuser selection
 - balancing
 -

KS01-EJ192A HVAC/R Psychometrics

Evidence shall show an understanding of applied psychometrics, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Fundamentals and terms
 - sensible heat factor (conditioned space and grand total)
 - quantity of air
 - effective surface temperature
 - bypass factor
- b) Coil characteristics
 - processes
 - sensible cooling
 - cooling, dehumidification
 - sensible heating
- c) Spray processes
 - saturation efficiency
 - processes
 - adiabatic/evaporative cooling
 - cooling & humidification
 - sensible cooling
 - cooling and/or humidification
 - chemical dehumidification process: dehumidification & heating
 - cooling tower characteristics: humidification & cooling
 - indirect evaporative cooling process
- d) System analysis
 - partial load
 - reheat control
 - bypass control
 - volume control
 - dump back systems
 - low velocity coils
- e) Psychrometric formulae and charts
 - properties of air
 - gas constants
 - derivation of air constants
 - combined gas laws
 - Dalton's law of partial pressures
 - Carrier's equation
 - psychrometric property tables
 - air mixing equations

- air quantity equations
-

KS01-EJ193A HVAC/R System Thermodynamics

Evidence shall show an understanding of introduction to refrigeration and air conditioning systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

Refrigeration systems

- a) Major components, type and functions:
 - evaporators
 - compressors
 - expansion devices
 - ancillary components
 - refrigerants
- b) System operation and performance:
 - thermodynamic properties of refrigerants
 - pressure enthalpy charts
 - the refrigerant cycle
 - the refrigerant cycle represented on pH charts
 - introduction to refrigerating effect, heat of compression, heat rejected on high side, co-efficient of performance, liquid sub-cooling suction superheating
 - effects on performance of changing operating pressures, liquid sub-cooling, suction superheating
- c) Application of refrigeration:
 - introduction to industrial refrigeration, specific system component types and refrigerants applied.
 - scope of commercial refrigeration, specific system component types and refrigerants applied
- d) Refrigerated enclosures and cabinets:
 - merchandising and display cabinets:
 - deep freeze meat
 - dairy
 - fruit and vegetable
 - multi-deck display
 - single deck
 - well type
 - island cases
 - glass door
 - reach door

- reach in merchandisers
- defrosting methods
- cold rooms and freezer rooms
- types and construction
- insulation
- vapour barrier
- frost heave
- interior fittings
- location of equipment
- defrosting methods
- cold tracking
- trace heating
- storage conditions
- temperature
- relative humidity
- air velocity
- air patterns
- load limits

Air conditioning systems

- a) Occupational health requirements:
 - WH&S requirements
 - BCA requirements
 - AS1668 parts 1 & 2
 - AS3666
 - noise and vibration
 - air quality
 - sick building syndrome
- b) Operating requirements:
 - ventilation
 - air distribution
 - terminal velocity
 - temperature
 - relative humidity
 - air quality
 - noise
 - basic psychrometrics
- c) Operating modes
 - ventilation
 - evaporative cooling

- ventilation and cooling
 - ventilation and heating
 - dehumidification
 - dehumidification
 - dehumidification and reheat
 - humidification
- d) Operating terminology/characteristics:
- throw, drop
 - primary and secondary air
 - coanda effect
- e) HVAC system components and functions:
- fans
 - ducting
 - registers
 - dampers
 - filters
 - cooling coils
 - heating coils
 - induction units
 - fan coil units
 - terminal units
 - humidifiers, pumps and sprayers
 - hydronic systems and components
- f) Applications and construction of air conditioning systems:
- applications
 - residential, commercial, low and high rise, industrial ventilation and air conditioning
 - packaged plant
 - RACs, split systems (wall and floor console, ceiling fan coil), wall fascia, roof top, reverse cycle option central station plant
 - all air systems, constant volume variable temperature, constant temperature variable volume, air/water systems
 - all water system, multi-zoning, thermal storage systems
 - basic air conditioning system diagrams
 - duct layout
 - hydronic layout
 - unit/conditioner drawings
- g) HVAC control systems:
- basic principles
 - terminology

- symbols and diagrams
- basic applications

KS01-EJ194A Low voltage refrigeration circuits

Evidence shall show an understanding of low voltage d.c. and a.c single and multiple path applied to refrigeration systems, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Resistance Measurement
 - Typical field instruments and applications
 - Insulation resistance tester
 - IR Tester parts and functions
 - Continuity testing
 - Insulation resistance testing
 - IR Tester voltage ranges
 - AS/NZS 3000 wiring rules
 - Calibration of IR Testers
 - Storage of IR Testers
 - Using of testers for continuity and insulation resistance measurement
 - Calculation of resistance from measured results
- b) Factors affecting resistance
 - Factors
 - Resistivity
 - Change in length
 - Change in cross sectional area (csa)
 - Change in temperature
 - PTC and NTC
 - Influence on practical circuits
 - Measurement of resistance
- c) Voltage and current measurement
 - Hazards
 - Characteristics of instruments
 - Reading scales
 - Voltmeters
 - Characteristics
 - Types
 - Operation
 - Connection
 - Loading effect

- Advantages and disadvantages
- Selection
- Ammeters
 - Characteristics
 - Types, series-ammeter and tong-ammeter
 - Operation
 - Connection
 - Advantages and disadvantages
 - Selection
- d) Direct Current parallel circuits
 - Parallel circuits
 - Parallel circuit components
 - Applications of parallel circuits
 - Characteristics
 - Calculation of parallel circuit parameters
 - Circuit connections
 - Measurements of R, V, I in parallel circuits
 - Determine V, I, R, P
- e) Direct Current series / parallel circuits
 - Series/Parallel circuits
 - Series/Parallel circuit components
 - Applications of series/parallel circuits
 - Characteristics
 - Bridge network
 - Calculation of series/parallel circuit parameters
 - Connection of series/parallel circuits
 - Measurements of R, V, I in series/parallel circuits
 - Determine V, I, R, P
- f) Capacitors and Capacitance
 - Capacitor construction
 - Dielectric material
 - Types of capacitors
 - Circuit symbols
 - Capacitor terms
 - Units
 - Factors affecting capacitance
 - Capacitor charge
 - RC d.c series circuit
 - Time constants
 - Connection of capacitors

g) Capacitors in Series and Parallel

- Capacitor hazards
- Safe handling of capacitors
- Dangers of discharging capacitors
- Series connections
- Parallel connections
- Measuring / testing of capacitors
- Capacitor faults
- Applications of capacitors
- Calculation of total capacitance
- Series and parallel connections
- Testing capacitors for serviceability

h) Electromagnetic induction

- Faraday's law
- Applications
- Inductance

i) Single phase alternating current

- Generation of a sinusoidal waveform
- Sinusoidal waveform characteristics
- Measuring and calculating values of a sinusoidal waveform
- Generation of single phase alternating current
- Voltage and current in resistive, inductive and capacitive circuits
- Ohms Law and Impedance
- Power
 - power in a single phase circuit
 - power factor and phase angle
 - methods used to measure single phase power, energy and power factor
 - single phase power measurement
 - effects of low power factor
 - power factor improvement requirements
 - power factor improvement methods
 - wiring rules and regulations

j) Magnetic devices

- Relays
- Contactors
- Solenoids
- Transformers
- Single & double wound.
- Volts vs. Turns ratio.
- Losses:

- VA in vs. VA out.
 - Control transformers
 - Power and motor starting transformers.
 - Safety.
 - Magnetic sensing devices
- k) Three phase alternating current
- Advantage of three phase system
 - Generation of three phase
 - Relationship between generated voltages
 - Phase sequence
 - Three phase star-connections
 - Star connections
 - Line and phase voltages and currents
 - Three phase four wire systems
 - function of the neutral conductor
 - Three phase delta-connections
 - Delta connections
 - Line and phase voltages and currents
- l) Circuit protection and isolation
- Harmful effects of:
 - direct contact
 - indirect contact
 - thermal effects
 - over current
 - faults
 - mechanical movement
 - Earthing
 - earthing terms
 - minimum earthing conductor size
 - MEM system
 - AS/NZS 3000 requirements
 - Circuit protection devices
 - purpose, types, operating principles, characteristics and applications, including rewirable fuses, HRC fuses, circuit breakers, residual current devices and overvoltage and under voltage protection devices.
 - circuit protection and load protection
 - AS/NZS 3000 requirements (including sanger tags, & switch locking)
 - discrimination of circuit protection devices.
 - Isolation devices
 - requirements for provision of isolation

- need for protection against mechanical movement
- AS/NZS 3000 requirements

KS01-EJ195A Basic operating conditions of vapour compression systems - appliances

Evidence shall show an understanding of basic operating conditions of vapour compression systems used in refrigerated appliances, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- a) Domestic refrigeration industry
 - The history of the domestic refrigeration industry
 - Applications, classifications and equipment used
- b) Introduction to the Vapour Compression System
 - Basic Operation
 - Major Components
- c) Heat
 - Matter (atoms, molecules, energy and its different forms)
 - Heat energy (definition, unit of measurement)
 - Enthalpy (definition, unit of measurement)
 - Heat flow (hot to cold)
 - Heat transfer
 - methods (conduction, convection, radiation)
 - requirements
 - effects
- d) Temperature and relative humidity
 - Temperature
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Conversion to/from absolute values
 - Temperature difference/change (td, Δt , unit of measurement)
 - Relative humidity
 - Thermometer types and applications (digital, stem, dial, max/min, non-contact, data loggers)
 - Relative Humidity measurement devices and applications (dry bulb/wet bulb, sling, digital)
 - Hazards and related safe working practices (working near rotating machinery - fans, etc)
 - Care and maintenance (bending stems, overheating, removing batteries after use, uncoiling capillary)

- Calibration (boiling water, iced water, send to a specialist etc)
 - Appropriate and safe methods of use
 - Typical locations on a system
 - Fitting temperature and relative humidity instruments
- e) Sensible and Latent Heat
- Definition of specific heat capacity, latent heat and sensible heat (including units of measurement)
 - Types of latent heat
 - Heat calculations
- f) Pressure
- Pressure
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Vacuum scales (Pascals, microns)
 - Conversion to/from absolute values
 - The basic Gas Laws – Boyles, Charles and Daltons (excl combined or general gas law)
 - Pressure gauge types and applications (pressure, compound, vacuum, manometer, magnehelic, barometer)
 - Hazards and related safe working practices (dangerous system pressures)
 - Care and maintenance (ingress of oil and contaminants (dirt), avoiding needle bounce (esp. HP) etc)
 - Calibration (atmospheric pressure, send to a specialist etc)
 - Appropriate and safe methods of use
 - Typical locations
- g) Refrigerant conditions
- Saturation temperature
 - Saturated liquid / saturated vapour
 - Superheated vapour
 - Sub-cooled liquid
 - Pressure temperature relationships
 - P/T charts
 - Enthalpy
- h) The vapour compression cycle
- Primary system components
 - High and low pressure sides
 - Basic system operation
- i) Working safely with refrigeration vapour compression systems
- Risk management principles and processes
 - Hazards and risk control measures associated with:
 - refrigeration vapour compression systems and components
 - refrigerants

- measuring and testing equipment
- j) Leak detectors
- Detector types and applications (electronic, halide, bubble, ultra violet)
 - Hazards and related safe working practices (working around rotating machinery, open flame, ultra violet light etc)
 - Care and maintenance (delicate electronic equipment, changing sensor tip filters, changing gas cartridges etc)
 - Calibration (auto calibrating , send to a specialist etc)
 - Leak detection procedures
- k) Service gauges
- Service Gauges
 - Types (dial gauges or electronic, manifolds with additional vacuum and charging ports & sight glasses)
 - Typical uses for service gauges (high & low side pressure readings, charging, evacuating)
 - Care and maintenance (oil and contaminants (dirt) in hoses, avoiding needle bounce, changing hose seals)
 - Calibration (hoses open to atmosphere, adjusting screw etc)
 - Hose shut-off valves and adaptors (access control valves, kwik couplers, Hansen lines etc)
 - System Access Fittings
 - Types (Schrader, piercing, etc)
 - Typical applications for each
 - Hazards and related safe working practices (oil or liquid spray, keeping clean, leaks etc)
 - Care and maintenance (gland nuts loosened/tightened, seal caps fitted, regulations on piercing valves)
 - Using Service Gauges
 - Service gauge manifold hose fitting
 - Purging
 - Pressure readings
 - Service gauge manifold hose removal
 - Pressure to temperature conversion
- l) Refrigeration Compressors
- Function of the compressor
 - Compressor style (hermetic)
 - Types, construction and their applications (reciprocating, rotary, scroll)
 - Basic types of compressor oil (Mineral, Polyolester (POE), Alkyl Benzene, Polyalkylene Glycols (PAG)) (brief overview)
 - Methods of lubrication (splash, forced)
 - Safe handling (MSDS - POE's, PAG's, Mineral, AB's - Residual acid's in used oil)

- m) Condensers and related components
 - Function of the condenser
 - Types, construction and their applications (static, forced draught)
- n) Evaporators and related components
 - Function of the evaporator
 - Evaporator styles (direct expansion)
 - Types, construction and their applications (static, forced draught)
 - Refrigerant/air flow paths (forced/induced draft, parallel/counter flow)
- o) Common Refrigerant Metering Devices
 - Function of a refrigerant metering device
 - Overview of common types and their applications (capillary tube and restrictor)
- p) Basic Operating Conditions
 - Ambient conditions
 - Common climate values (highest max temp, lowest min temp, mean daily temp, mean highest/lowest)
 - Typical climates for various common localities
 - Evaporator Td
 - Effect of changes in Evap. Td and typical industry reference values for forced draught and static coils
 - Condenser Td
 - Effect of changes in Cond. Td and typical industry reference values for forced draught and static coils
 - Typical storage conditions (temp & RH)
 - Typical high and low side system operating values (pressures and temperatures allowing 1K equivalent PD)

Draft Knowledge and Skills Clause

KS01-EJ196A Ammonia refrigeration system operation

Evidence shall show an understanding of refrigeration principles, Ammonia refrigeration systems, their operating conditions, and starting up and shut down procedures, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

- T1 Introduction to the Vapour Compression System
 - Basic Operation
 - Major Components
- T2 Heat
 - Heat energy (definition, unit of measurement)
 - Enthalpy (definition, unit of measurement)

- Heat flow (hot to cold)
- Heat transfer
 - methods (conduction, convection, radiation)
 - requirements
 - effects

T3 temperature and relative humidity

- Temperature
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Conversion to/from absolute values
 - Temperature difference/change (td, Δt , unit of measurement)
- Relative humidity
- Thermometer types and applications (digital, stem, dial, max/min, non-contact, data loggers)
- Relative Humidity measurement devices and applications (dry bulb/wet bulb, sling, digital)
- Hazards and related safe working practices (working near rotating machinery - fans, pulleys, belts etc)
- Care and maintenance (bending stems, overheating, removing batteries after use, uncoiling capillary)
- Calibration (boiling water, iced water, send to a specialist etc)
- Appropriate and safe methods of use
- Typical locations on a system
- Fitting temperature and relative humidity instruments

T4 Sensible and Latent Heat

- Definition of latent heat and sensible heat (including units of measurement)
- Types of latent heat

T5 Pressure

- Pressure
 - Scale types (imperial, metric, absolute) and their units of measurement
 - Vacuum scales (Pascals, microns)
 - Conversion to/from absolute values
- The basic Gas Laws – Boyles, Charles and Daltons (excl combined or general gas law)
- Pressure gauge types and applications (pressure, compound, vacuum, manometer, magnehelic, barometer)
 - Hazards and related safe working practices (dangerous system pressures)
 - Care and maintenance (ingress of oil and contaminants (dirt), avoiding needle bounce (esp. HP) etc)
 - Calibration (atmospheric pressure, send to a specialist etc)
 - Appropriate and safe methods of use
 - Typical locations

T6 Refrigerant conditions

- Saturation temperature
- Saturated liquid / saturated vapour
- Superheated vapour
- Sub-cooled liquid
- Pressure temperature relationships
- P/T charts
- Enthalpy

T7 The vapour compression cycle

- Primary system components
- High and low pressure sides
- Basic system operation

T8 Working safely with refrigeration vapour compression systems

- Risk management principles and processes
- Hazards and risk control measures associated with:
 - refrigeration vapour compression systems and components
 - refrigerants
 - measuring and testing equipment

T9 Ammonia Refrigeration Systems

- Vapour Compression Systems
 - Revision of Vapour Compression Cycle
 - Properties of Ammonia
 - Safe Handling of Ammonia
- Types of Ammonia Systems
 - Direct Expansion Systems
 - Flooded Systems
 - Liquid Recirculation Systems
- Multi Staged Systems
 - Single Staged Systems
 - Multi Staged Systems
 - Cascade Systems

T10 Operating conditions of Ammonia Refrigeration Systems

- Compressors
 - Function of the compressor
 - Types, construction and their applications
 - Capacity control of compressors
 - Factors affecting performance
 - Economiser operation

- Types of oil separators
- Methods of oil cooling
- Operation and maintenance
- Lubrication and lubricants
 - Lubrication methods
 - Safe handling of lubricants
 - Selection of lubricants
 - Oil / Ammonia separation
 - Adding and removing oil from Ammonia systems
 - Methods of oil recovery
- Evaporators / Cooling Units
 - Types of evaporators (air / fluid cooling)
 - Direct contact freezing
 - Secondary refrigerants
 - Evaporator defrost methods and controls
 - Operation and maintenance
- Condensers and high pressure receivers
 - Evaporative condensers
 - Water cooled condensers
 - Air cooled condensers
 - High pressure receivers
 - Operation and maintenance
- Low Pressure Receivers
 - Suction accumulators
 - Intercoolers
 - Liquid refrigerant pumps
 - Liquid level controls
 - Operation and maintenance
- Purging
 - Non condensable gases
 - Manual; purging of Ammonia systems
 - Automatic refrigerated purgers
 - Operation and maintenance
- Refrigerant Flow Devices
 - Expansion valves
 - Automatic liquid feed control devices
 - Pressure regulating devices
 - Operation and maintenance
 - Methods of oil recovery
- Ancillary Components

- Strainers, isolating valves
 - Liquid level indicators
 - Pressure relief valves
 - Ammonia leak detectors
 - Safety controls
 - Operation and maintenance
- T11 System start up and shut down procedures
- T12 Emergency procedures
- T13 Maintenance and servicing procedures
- Leak Testing
 - Leak detector types and applications
 - Hazards and related safe working practices
 - Care and maintenance
 - Leak detection procedures
 - Charging refrigerant into system
 - Routine maintenance procedures
 - Draining and adding oil
 - Charging system
 - Purging condensable gases
 - Leak testing
 - Checking drives, bearings, couplings, pulleys, V-belts etc.
 - Fault finding
 - Identify faults that affect the safe operation of the plant
 - Controlling and addresses faults
 - Limiting the affect of the fault on the safe operation of the fault
 - Organising correction action to repair the fault

2 Discipline K - Renewable and Sustainable

Discipline K – Renewable and Sustainable

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

2 Discipline L - Imported units - EKAS for this discipline are yet to be classified.

Discipline L – Imported units

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

2 Discipline M – Hazardous

Discipline M – Hazardous

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

2 Discipline N – Rail

Discipline N – Rail

KS01-EN021A Rail signalling cable repair

Evidence shall show an understanding of repairing rail signalling cables to an extent indicated by the following aspects:

- T1 Types of cable used for rail signalling encompassing:
 - signalling power cables and multi core signalling control cables
- T2 Types of cable joining kits used to repair damaged signal cables encompassing:
 - heat shrink and water proof jointing kits. (e.g. epoxy mould)
- T3 Procedures for identifying corresponding ends of broken cable cores encompassing:
 - cable isolation methods and testing deenergised cable cores
- T4 Methods of joining broken cable core conductors and reinstating insulation encompassing:
 - use of hand tools to remove insulation and applying crimp lugs, selection of inline joiner lugs, and selection of appropriate jointing materials and kits
- T5 Conductor continuity and core insulation and earth testing procedures and acceptable results encompassing:
 - testing to confirm deenergised cores; continuity of repaired cores, earth resistance of repaired cores and insulation between repaired cores; industry standard acceptable cable test results; and recording of test results
- T6 Special termination tools and their use encompassing:
 - use of insulation removal tools inline crimping tools, conducting tool tests, checking calibration date and recording tests

2 Discipline P - Restricted

Discipline P – Restricted

KS01-EP012A Electrical Safety Principles

Evidence shall show an understanding of electrical safety principles to an extent indicated by the following aspects

T1 The basic electrical circuit

- elements of a simple electric circuit (supply, control switch, protection device and load).
- definition, the symbol and the abbreviation of the unit for electromotive force, potential difference, current, resistance
- types of electrical load
- need for devices to afford electrical protection and the mechanisms used in protection devices including resetting
- symbols for the components of a basic electrical circuit
- connection of the circuit from the schematic diagram
- a.c supply (both single and three phase) and d.c. supply
- correct connection and use of voltmeters and ammeters, including the selection of correct range in terms of magnitude and whether the supply is a.c. or d.c.
- need for isolating, testing and tagging electrical circuits
- isolation, testing and tagging accessories in a simulated environment
- connecting a simple electrical circuit including supply, control switch and load.
- measuring voltage and current within a simple circuit

T2 Relationships in an electrical circuit

- relationship between Voltage, Current and Resistance
- connection of meters to determine resistance from voltmeter and ammeter readings using a variation of the Ohm's Law relationship
- predicting changes in circuit parameters for altered values of voltage, current and resistance
- definition of 'power' in electrical terms (for d.c. or resistive a.c. circuits)
- using circuit readings determine power using the appropriate equations, symbols and unit abbreviations including the use of multiples and sub multiples

T3 Electrical diagrams

- symbols used for fuse, circuit breaker, isolator, normally open contacts, normally closed contacts, coil, energy meter, a.c. motor, transformer.
- using a 'block diagram' as means of developing concepts and understanding
- producing a block diagram of a simple circuit
- function of single line diagrams including their application in three phase systems
- definition of a 'circuit' or 'schematic' diagrams
- wiring diagrams
- connecting a simple circuit using a schematic diagram noting the wide degree of variety in the way the conductors may be run
- producing the wiring diagram of the connections used in following the schematic diagram

- connecting a simple circuit following a wiring diagram
- producing a schematic diagram from the wiring diagram

T4 Test equipment – selection and care

- fault currents and the implications of incorrectly connecting a meter to a high fault current source
- category ratings of multimeters in terms of their breaking capacity (fault current interruption) and identification of the appropriate category of instrument for typical domestic work and for typical commercial work.
- regulatory requirements in regard to the maintenance and testing of test instrumentation.
- steps and procedures for the safe use, care and storage of electrical instruments.
- selecting test equipment for given situations.

T5 Test equipment - Voltage measurement

- voltage measurement -meters connected in parallel
- operation of series test lamps
- construction of a set of series test lamps with emphasis on safety requirements
- using a set of series test lamps
- operation of neon test pencils and test screwdrivers with emphasis on the limitations of their safe use
- operation and limitations of voltage probes including their limitations
- using an analog multimeter for voltage measurement ensuring the following - setting zero, correct scale; ac or dc, polarity and magnitude, avoiding parallax error and estimating between division readings
- using a digital multimeter for voltage measurement ensuring the following - correct range and no active conductors are connected to any meter earth

T6 Test equipment - Resistance measurement

- voltmeter-ammeter method of resistance measurement
- measuring resistance in a simple circuit using the voltmeter-ammeter method with emphasis on the correct choice of long or short shunt
- measuring resistance in a simple circuit using an analog multimeter ensuring the following - setting zero, selecting correct range, estimating of between division readings
- measuring resistance using a digital multimeter
- insulation resistance, and list the required minimum values for insulation resistance for low voltage wiring and low voltage equipment (insulation resistance between active and earth the value for appliances incorporating heating elements)
- insulation resistance needs to be measured at higher than supply voltage and list the voltages to be used

- conducting insulation resistance tests using a hand held tester after checking for zero and meter calibration
- continuity and what a continuity tester does
- checking the polarity of a three core extension cord using a continuity tester

T7 Test equipment - Current measurement

- advantage(s) of the clip-on method of current measurement
- measuring current in a simple circuit using a multimeter on the correct current range and explain why a series connection must be used
- measuring current using a clip-on (tong tester) taking each circuit conductor in turn.

KS02-EP012A Disconnect and Reconnect Composite Appliances

Evidence shall show an understanding of disconnect and reconnect composite appliances to an extent indicated by the following aspects

T1 Cable connections

- construction of typical power cables.
- principle of operation of the following types of terminals stud, screw, tunnel, faston and soldered
- cable preparation and terminating methods appropriate to each type of terminal, including any special requirements which apply
- terminating cables using all of the above terminal types employing the correct preparation and the relevant terminating tools including the correct size soldering equipment

T2 Protection for Safety

- dangers associated with earth-faults.
- protection of persons against electric shock from earth-faults.
- maintaining a low earth-fault current path resistance.
- components in an earth-fault current path.
- testing the resistance of a fault-current path.
- regulatory issues/requirements/limitations in regards to working live

T3 Safety testing preparation and procedures

- faulty earth-fault current paths
- using safe working practices when carrying out fault finding work.
- Identification of earthing system components.
- unsatisfactory resistance of a fault-current path.
- actions to rectify unsatisfactory resistance of an earth-fault current path or insulation.

T4 Isolating supplies

- regulatory requirements in regards to working de-energised, and ensuring and maintaining isolation
- reasons for advising all personnel likely to be affected:
- preventing others wanting to remake supply
- reason for isolation and approximate time of outage to allow planning of alternate activities
- identification the type and arrangement of circuits supplying equipment that is to be disconnected
- availability of supply is tested at an appliance about to be disconnected
- locating isolation device/s e.g. lockable adjacent isolating switch or fuse/circuit breaker at a distribution board usually identified at the appliance
- determining the method of isolation to be used; which available device
- isolating a supply at a fuse, the fuse wedge is removed only after the appliance is turned off and why the empty wedge is replaced once the fusible link has been removed
- tests to determine if an appliance/equipment is turned off when isolating at a fuse/circuit breaker
- use of and reason for danger tags at the point of isolation
- reason for the following steps: testing on a known live supply, testing for isolation, retesting on a known live supply after confirming isolation

T5 Disconnecting an composite appliances - ELV

- identification of the type and arrangement of circuits supplying composite appliances that is to be disconnected from a ELV single phase and/or multiphase supply of voltages up to 50 V a.c. or 120 V d.c.
- procedures that ensure the safe isolation of the supply to composite appliances which is to be disconnected.
- disconnecting isolated composite appliances from fixed wiring with minimal damage to wiring system. after ensuring no visible faults or damage, and the recording of conductor connection sequence
- termination practices in regard to disconnected wiring

T6 Reconnecting an composite appliances - ELV

- importance of checking the new composite appliances nameplate details against those of the appliance being replaced
- need for high insulation resistance and the need to test insulation of 400 volt composite appliances at 1000 volts and identify the minimum acceptable value of insulation resistance between active and earth generally and the value for appliances incorporating heating elements.

- testing procedures: testing on a known live supply, testing for isolation and retesting on a known live supply after confirming isolation
- need to disconnect circuit cables before undertaking insulation resistance testing
- compliance testing the fixed composite appliances: insulation resistance test and continuity test
- need to ensure the following steps are taken when terminating cables: stranded conductors are twisted tightly together, appropriate lugs are used rather than simple loops under a nut e.g. soldered lugs or Ross Courtney, Stanco or other solderless variety, shake proof washers are used, cables are not left under physical stress, cables are protected when passing through metal openings, conductors are doubled in tunnel connectors

T7 Disconnecting an composite appliances - LV

- identification of the type and arrangement of circuits supplying composite appliances that is to be disconnected from a single phase and/or multiphase supply of voltages up to 1000 V a.c. or 1500 V d.c.
- procedures that ensure the safe isolation of the supply to composite appliances which is to be disconnected
- disconnection of isolated composite appliances from fixed wiring with minimal damage to wiring system after ensuring no visible faults or damage, and the recording of conductor connection sequence
- termination practices in regard to disconnected wiring

T8 Reconnecting an composite appliances – LV

- importance of checking the new composite appliances nameplate details against those of the composite appliances being replaced
- need to visually inspect and test the composite appliance electrical characteristics using suitable test equipment to ensure composite appliance is safe to connect in regard to sufficiently high insulation resistance, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating, and arrangements for protection against dangers of mechanical movement are undamaged and in place
- compliance testing of the fixed composite appliance, ie insulation resistance and continuity
- testing the disconnected composite appliance for faults (open circuits, partial open circuits, short circuits, partial short circuits and earth faults), and recognise any unsatisfactory test results obtained
- procedures for composite appliances with unsatisfactory results - unsuitability for reconnection
- identification of the type and arrangement of circuits supplying composite appliances that is to be reconnected to a single phase and/or multiphase supply of voltages up to 1000 V a.c. or 1500 V d.c.
- procedures ensuring isolation of supply

- process to establish the integrity of the circuit to which the disconnected composite appliance is to be connected, including:
- testing the resistance between the protective earthing conductor and neutral conductor as applicable is sufficiently low ie not greater than 2 ohms
- insulation resistance of the active conductors is greater than 1 megohm
- engaging appropriately qualified person to rectify any noncompliance
- appropriate cable termination practices
- reconnection of composite appliances to fixed wiring with minimal damage to wiring system
- continuity between exposed conductive parts of the composite appliances and the main earth or metal switchboard enclosure
- restoring supply after ensuring correct connections, and all safety requirements have been met
- testing the supply at composite appliances
- restoring all mechanical protection eg terminal covers
- checking operation of reconnected composite appliance

T9 Produce documentation and reports

- need to produce status reports and documents to locate and identify isolation mechanisms for a wide range of circuits and associated loads.
- production of reports and documents to use a suitable procedure to safely disconnect a component from a single phase supply and/or multiphase supply.
- content required in reports and documents used to safely determine the suitability of a component for reconnection to supply.
- producing reports and documents for the safe reconnection/commissioning of a component to the supply.

T10 Enterprise reporting and recording system

- purpose and extent of maintaining work activities records in an enterprise
- types of records for maintaining work activities in an enterprise
- methods for recording and maintaining work records
- work records for regulation requirements
- producing enterprise records and documents for the safe reconnection/commissioning of a component to the supply.

KS01-EP017A Fault find – electrical composite equipment

Evidence shall show an understanding of fault finding electrical composite equipment to an extent indicated by the following aspects

T1 Safe fault finding encompassing:

- using safe working practices when carrying out fault finding
- identification of common types of electrical faults (open circuit, short circuit, partial open circuit and partial short circuit)
- symptoms of common faults (human body senses – hearing, smell, sight and touch, electrical measurement – resistance, current and voltage)
- using appropriate test equipment to locate common faults

T2 Single phase composite equipment encompassing:

- composite equipment
- types of single and three phase composite equipment
- basic principles of operation of typical composite equipment
- identification of basic types of single/three phase composite equipment
- interpretation of ratings from nameplates for comparison with any replacement
- principles of operation of control equipment and protection devices associated with a range of single/three phase composite equipment
- common faults that occur in single phase composite equipment and the indicators of such faults
- techniques to ensure the electrical isolation and the maintenance of electrical isolation of single/three phase composite equipment when conducting fault finding on it
- regulatory requirements/obligations in regard to any "live" testing that may be unavoidable
- fault finding procedures
- visual checking techniques on a range of single/three phase composite equipment
- using test instrumentation, safely conduct procedures to identify faults in a range of single/three phase composite equipment
- rectification all identified faults ensuring appropriate consultation/approval before implementing contingencies
- testing required to ensure repaired equipment is safe for connection to supply
- checking repaired equipment for safe and correct operation

T3 Produce documentation and reports encompassing:

- need to produce status reports and documents to locate and identify isolation mechanisms for a wide range of circuits and associated loads
- production of reports and documents to use a suitable procedure to safely locate and rectify faults in electrical low voltage composite equipment following prescribed procedures
- content required in reports and documents used to safely locate and rectify faults in electrical low voltage composite equipment following prescribed procedures
- producing reports and documents for the safe location and rectification of faults in electrical low voltage composite equipment following prescribed procedures

T4 Enterprise reporting and recording systems encompassing:

- state the purpose and extent of maintaining work activities records in an enterprise
- types of records for maintaining work activities in an enterprise
- methods for recording and maintaining work records
- work records required by regulation requirements
- producing enterprise records and documents for the safe location and rectification of faults in electrical low voltage composite equipment following prescribed procedures

KS01-EP024A Flexible cords and plugs to 230 V

Evidence shall show an understanding of flexible cords and plugs to 230 V to an extent indicated by the following aspects

T1 Safety encompassing:

- OH&S and electrical safety requirements
- requirements of AS/NZS 4836:2001 Safe working practices on low voltage installations

T2 The basic electrical circuit encompassing:

- simple electric circuit (supply, control device and load)
- symbol, units of measurement and the abbreviation for electromotive force, potential difference, current and resistance.
- drawing of a basic electrical circuit using correct symbols
- using multiples and submultiples for voltage, current and resistance values
- a.c and d.c supplies
- single phase electrical loads
- electrical circuit protection devices

T3 Relationships in an electrical circuit encompassing:

- relationship between voltage, current and resistance (Ohm's law)
- changes in circuit parameters for altered values of voltage, current and resistance
- electrical power in relationship to d.c. or resistive a.c. circuits

T4 Test Equipment - resistance measurement encompassing:

- types of electrical test equipment used for resistance measurement (analogue and digital multimeters, insulation resistance testers and continuity testers)

- selection of appropriate electrical test instrument for continuity and insulation resistance measurement
- using analogue and digital multimeters for resistance measurement (ensuring zero setting, correct scale selection, avoidance of parallax error and estimation of between division readings for analogue multimeters)
- continuity tests and using a continuity tester to check the polarity of a three core extension cord
- insulation resistance tests and minimum values for insulation resistance for low voltage equipment
- reasons for insulation resistance testing is conducted at higher than supply voltage (AS/NZS3000 requirements)
- using insulation resistance hand held tester
- care and storage of electrical instruments
- regulatory requirements in regard to the maintenance and testing of test instrumentation for resistance measurement.

T5 Selection of flexible cords and plugs to suit given applications encompassing:

- types , structures and applications of common cores (parallel two core unsheathed ('figure 8') cords, light duty sheathed, ordinary duty sheathed, heavy duty sheathed and textile braided)
- determining the current rating of a range of commonly used flexible cords
- service duty
- purpose of colour coding and the recommended single phase colour code and the conventional code used in the most common alternative colours
- selection of appropriate flexible cords for a range of single phase appliances in regard to application, load, and service duty
- identification of correct plug and socket polarities for the range of commonly used 230 volt plug socket combinations
- factors affecting the choice of plugs and sockets including IP rating
- selection of the correct plug and socket combinations for a range of applications including use in damp areas

T6 Connecting flexible cords and plugs to appliances encompassing:

- design features of plugs and sockets which protect the conductor terminations from undue force when disconnecting a cord - tortuous path
- cord preparation - not to mark/damage the inner core when stripping the sheath for termination, double the end of the conductor to be terminated
- purpose of earthing
- structure of double insulated appliances, symbol, reasons they should not be earthed, and maintenance of the integrity of the double insulation

- preparation of the surfaces at an earthing connection before and after completion of the termination including terminations exposed to corrosion, and those for which no specific earthing terminal is provided
- fitting a range of various plugs and sockets with attention to requirements, colour code, polarity, and correct termination of conductors with the sheath well into the body, and the cord grip anchored
- terminate cords to several appliances utilising the appropriate cord type and rating

T7 Testing encompassing:

- importance of conducting both visual and electrical tests to ensure leads are safe and appropriate for connection to supply in regard to physical condition, sufficiently high insulation resistance, continuity, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating, and arrangements for protection against dangers of mechanical movement as relevant are undamaged and in place
- check polarity of plug, and for any abnormal or obvious damage or fault
- minimum acceptable value of insulation resistance between active neutral and earth
- conduct insulation resistance and continuity tests prior to, and after, connecting cords and plugs to appliances
- fault finding attached cords and plugs, and cord extension leads

T8 Producing documentation and reports encompassing:

- nature and content of, and the need to produce, status reports and documents
- Producing status reports and documents

KS01-EP025A Flexible cords/cables and plugs to 1000 V

Evidence shall show an understanding of flexible cords/cables and plugs to 1000 V to an extent indicated by the following aspects

T1 Safety encompassing:

- OH&S and electrical safety requirements
- requirements of AS/NZS 4836:2001 Safe working practices on low voltage installations

T2 Selection of flexible cords/cables and plugs to suit given applications encompassing:

- multiphase systems
- structure of plug pin configuration
- applications of commonly used flexible cords/cables and plugs for connection to 1000 Va.c. or 1500 Vd.c. supply
- determining the current rating of a range of commonly used flexible cords/cables and plugs for connection to 1000 Va.c. or 1500 Vd.c. supply

- determining the number of cores /pins required for given situations
- multiphase colour code and the conventional code used in the most common cords/cables
- selecting flexible cords/cables for given multiphase loads to 1000 V and service duty.
- selecting multiphase plugs to 1000 V for a given load and IP rating.
- selecting the correct plug and socket combinations for a range of applications including use in damp areas

T3 Connect flexible cords/cables and plugs to multiphase equipment encompassing:

- design features of plugs and sockets which protect the conductor terminations from undue force when disconnecting a cord - tortuous path
- cord preparation - not to mark/damage the inner core when stripping the sheath for termination, double the end of the conductor to be terminated
- preparation of the surfaces at an earthing connection before and after completion of the termination including terminations exposed to corrosion, and those for which no specific earthing terminal is provided
- prepare flexible cords/cables for connection
- single insulated metal framed equipment is earthed in accordance with requirements or the integrity of double insulated equipment is maintained
- fitting a range of various multiphase flexible cords/cables, plugs, and sockets with attention to tortuous path requirements, colour code, polarity, and correct termination of conductors with the sheath well into the body, and the cord grip anchored

T4 Determine that a flexible cord/cable and plug is safe and is connected correctly encompassing:

- importance of conducting both visual and electrical tests to ensure leads are safe and appropriate for connection to supply in regard to physical condition, sufficiently high insulation resistance, continuity, arrangements for protection against indirect contact are undamaged and in place, appropriate IP rating, and arrangements for protection against dangers of mechanical movement as relevant are undamaged and in place
- check polarity of plug, and for any abnormal or obvious damage or fault
- minimum acceptable value of insulation resistance between actives, neutral and earth
- conduct insulation resistance and continuity tests prior to, and after, connecting cords/cables and plugs to appliances
- fault finding attached multiphase flexible cords/cables and plugs, and multiphase cord extension leads

T5 Producing documentation and reports encompassing:

- nature and content of, and the need to produce, status reports and documents
- producing status reports and documents
-

2 Discipline R - Research

Discipline R – Research

EKAS for this discipline are yet to be classified. Please refer to the EKAS statements in the relevant unit for the appropriate EKAS code.

Appendix 1 - Unit to Essential Knowledge and Associated Skills Relationship

2.2 Electrotechnology Training Package Essential Knowledge and Associated Skills (EKAS) - Appendices

Appendix 1 - Unit to Essential Knowledge and Associated Skills Relationship

Appendix 2 - Essential Knowledge and Associated Skills to Unit Relationship

The following section of the Electrotechnology Training Package is the Essential Knowledge and Associated Skills includes two appendices covering:

- Appendix 1 - Competency Standard Units to Essential Knowledge and Associated Skills Relationship
- Appendix 2 - Essential Knowledge and Associated Skills to Competency Standard Units Relationship

This information is provided to assist users in developing holistic training support materials for respective qualifications and/or competency standard units.

Appendix 1 - Unit to Essential Knowledge and Associated Skills Relationship

A - Assembly Units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEA001B Assemble electronic apparatus	2.11.11.2 Surface mount soldering techniques
	2.18.1 Occupational Health and Safety principles
UEENEEA002B Select electronic	2.9.1.1 Electronic component basics

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
components	2.18.1 Occupational Health and Safety principles
UEENEEA003B Set-up and check electronic component placement machines	2.11.16 Electronic component place equipment
UEENEEA004B Rework electronic sub assemblies	2.2.6 Enterprise quality management system, basics
	2.11.11.3 Printed circuit board repair techniques
UEENEEA005B Conduct functional and quality tests on assembled electronic apparatus	2.11.18 Electronic assembly functional and quality testing
UEENEEA006B Apply lead-free soldering techniques	2.2.6 Enterprise quality management system, basics
	2.11.11.4 Lead-free soldering technology
	2.18.1 Occupational Health and Safety principles
UEENEEA007A to A009A Reserved	Reserved
UEENEEA010B Assemble, mount and connect switchgear and controlgear	2.6.6.2 Alternating current rotating machines
	2.6.24.1 Switchgear/controlgear
	2.18.2 Electrical Safe working practices
UEENEEA011A Reserved	Reserved
UEENEEA012B Make up and assemble bus bars	2.1.5.2 Bus bar techniques
	2.18.2 Electrical Safe working practices
UEENEEA013B Assemble and	2.1.5.1 Power cable and conductor terminations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
wire control panels	2.3.1 Electrical control devices
	2.3.2 Control circuit fundamentals
	2.6.8.2 Single & three-phase transformers
	2.6.24.2 Control panel wiring
	2.7.4.1 Electrical installations, protection methods and devices
	2.18.2 Electrical Safe working practices

B - Broadcast Units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEB001B Operate and maintain an amateur radio communication station	2.10.32 Amateur radio communication principles, practices, and technical overview
	2.18.1 Occupational Health and Safety principles

C - Common and commercial Units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills
UEENEEC001B Maintain documentation	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.20 Computer use basics

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills
	2.18.1 Occupational Health and Safety principles
UEENEEC002B Source and purchase material/parts for installation or service jobs	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.7 Enterprise purchasing system
	2.2.20 Computer use basics
	2.18.1 Occupational Health and Safety principles
UEENEEC003B Provide quotations for installation or service jobs	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.5 Enterprise customer relations protocols
	2.2.8 Enterprise costing methods
	2.2.10 Job costing techniques
	2.18.1 Occupational Health and Safety principles
UEENEEC004B Prepare specifications for the supply of materials and equipment for electrotechnology projects	2.2.11.2 Specification development
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEC005B Estimate electrotechnology projects	2.2.11.1 Estimating techniques
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEC006B Prepare tender submissions for electrotechnology	2.2.12 Tendering requirements

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills
projects	
UEENEEC007B Manage contract variations	2.2.11.1 Estimating techniques
	2.2.14 Contracts, format, responsibilities and obligations
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEC008B Receive and store materials and equipment for electrotechnology work	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.9 Enterprise stock control methods
	2.2.20 Computer use basics
	2.18.1 Occupational Health and Safety principles
UEENEEC009B Provide quotations for inspection and compliance audit services	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.5 Enterprise customer relations protocols
	2.2.8 Enterprise costing methods
	2.2.10 Job costing techniques
	2.18.1 Occupational Health and Safety principles
UEENEEC010B Deliver a service to customers	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.4 Problem solving techniques
	2.2.5 Enterprise customer relations protocols
	2.2.6 Enterprise quality management system,

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills
	basics
	2.2.13 User instruction techniques
	2.18.1 Occupational Health and Safety principles
UEENEEC011A	Reserved
UEENEEC012B Direct technical and non-technical enquiries to appropriate personnel	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.5 Enterprise customer relations protocols
	2.2.6 Enterprise quality management system, basics
	2.2.22 Enterprise work/business coverage
	2.18.1 Occupational Health and Safety principles
UEENEEC013B Participate in business equipment work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC014B Participate in computer equipment work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC015B Participate in electronic installations work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills
UEENEEC016B Participate in voice and data communications work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC017B Participate in appliance servicing work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC018B Participate in electrical machine repair work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC019B Participate in switchgear and controlgearwork and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC020B Participate in electrical work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC021B Participate in	2.2.45 Responsibilities under a competency

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills
electronics and communications work and competency development activities	development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC022B Participate in fire protection control work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC023B Participate in gaming electronic work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC024B Participate in instrumentation and control work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC025B Participate in refrigeration and air conditioning work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC026B Participate in security equipment work and	2.2.45 Responsibilities under a competency development plan

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills
competency development activities	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC027B Participate in rail communications and networks work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC028B Participate in hazardous areas work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures
UEENEEC029B Participate in explosion-protected equipment overhaul work and competency development activities	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
	2.2.48 Enterprise work activities policies and procedures

D - Computerised systems units

Competency Standard Units (CSUs)	Essential knowledge and associated skills
UEENEEC001B Use basic	2.2.20 Computer use basics

Competency Standard Units (CSUs)	Essential knowledge and associated skills
computer applications relevant to a workplace	2.18.1 Occupational Health and Safety principles
UEENEED002B Assemble, set-up and test personal computers	2.4.11 Personal computers, hardware structure
	2.4.12.1 Computer hardware sub-assemblies
	2.4.14 Personal computer operating systems, basics
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEED003B Evaluate and modify programs written in object oriented code	2.4.43.1 Object oriented programming basics
UEENEED004B Use engineering applications software	2.4.16 Personal computers, engineering applications software basic
	2.18.1 Occupational Health and Safety principles
UEENEED005B Enter and verify operating instruction in microprocessor equipped devices	2.3.7 Smart device basics
	2.18.1 Occupational Health and Safety principles
UEENEED006A	Reserved
UEENEED007B Develop, enter and verify programs for programmable logic controllers using ladder instruction set	2.3.8 Programmable controller basics
	2.3.9 PLC programming basics
	2.3.10.1 PLC programming
	2.7.13 Electrical installations, programmable logic controller requirements
	2.18.1 Occupational Health and Safety principles
UEENEED008B Develop, enter and verify programs in Supervisory Control and Data Acquisition systems	2.3.14 Supervisory control and data acquisition systems programming
UEENEED009B Develop, enter	2.3.10.2 PLC high level programming

Competency Standard Units (CSUs)	Essential knowledge and associated skills
and verify programs for industrial control systems using high level instructions	
UEENEED010B Set up and create content for a web server	2.4.20 Programming elements
	2.4.21 Client side programming
	2.4.22 Server scripting
	2.4.23 Database access
	2.4.24 Web application and services
	2.18.1 Occupational Health and Safety principles
UEENEED011B Develop object oriented code	2.4.43.2 Object oriented programming
UEENEED012B Support computer software and hardware	2.4.13 Computer peripherals
	2.4.15 Computer operating systems
UEENEED013B Install and administer Unix based computers	2.4.15 Computer operating systems
	2.4.27.1 Unix fundamentals
	2.18.1 Occupational Health and Safety principles
	OR
	2.4.15 Computer operating systems
	2.4.27.2 Linux fundamentals
	2.18.1 Occupational Health and Safety principles
	OR
	2.4.15 Computer operating systems
	2.4.27.3 Mac OSX fundamentals

Competency Standard Units (CSUs)	Essential knowledge and associated skills
	2.18.1 Occupational Health and Safety principles
UEENEED014B Design and manage enterprise networks	2.4.25.2 Network services design processes
	2.4.26 Network services management processes
	2.18.1 Occupational Health and Safety principles
UEENEED015B Administer user networks	2.4.27.1 Unix fundamentals
	2.4.28 Network operating systems essentials
	2.4.29 Network operating systems implementation
UEENEED016B Develop network services	2.4.30 Network infrastructure
	2.4.31 Directory services
	2.18.1 Occupational Health and Safety principles
UEENEED017B Install and configure internetworking systems	2.4.3.2 Networking fundamentals
	2.4.39 Internet, network basics
	2.4.40 Internet, network routing
	2.5.7 Technical standards, regulations and codes for telecommunications cabling
	2.18.1 Occupational Health and Safety principles
UEENEED018B Design and implement internetworking systems	2.4.41 Internet, local area networking
	2.4.42 Internet, wide area networking
	2.18.1 Occupational Health and Safety principles
UEENEED019B Design and implement internetworking systems — Single-stage routing	2.4.34 Routing methods and protocols
	2.18.1 Occupational Health and Safety principles
UEENEED020B Design and	2.4.35 Networks, remote access

Competency Standard Units (CSUs)	Essential knowledge and associated skills
implement internetworking systems — remote access	2.18.1 Occupational Health and Safety principles
UEENEED021B Design and implement internetworking systems — multi-layer switching	2.4.36 Multi-layer switched networks
	2.18.1 Occupational Health and Safety principles
UEENEED022B Design and implement internetworking systems — security	2.4.37 Fundamentals of network security
	2.18.1 Occupational Health and Safety principles
UEENEED023B Design and implement internetworking systems — wireless LANs/WANs	2.4.38 Fundamentals of wireless security
	2.18.1 Occupational Health and Safety principles
UEENEED024B Integrate multiple computer operating systems on a client server network	2.4.32 Operating systems and networks fundamentals
	2.4.33 Operating systems and networks
	2.18.1 Occupational Health and Safety principles
UEENEED025B Design and configure Human-Machine Interface networks	2.3.11 Control system network basics
	2.4.30 Network infrastructure
	2.18.1 Occupational Health and Safety principles
UEENEED026B Design a computer based control system	2.3.10.3 PLC system applications
	2.3.12 Control network infrastructure
	2.3.19 Control programming fundamentals
	2.18.1 Occupational Health and Safety principles
UEENEED027B Develop structured programs to control external devices	2.3.19 Control programming fundamentals
	2.18.1 Occupational Health and Safety principles
UEENEED028B Develop and test code for microcontroller devices	2.3.20 Microcontroller programming basics
	2.9.5.1 Microprocessor fundamentals
	2.9.5.2 Microcontroller fundamentals

Competency Standard Units (CSUs)	Essential knowledge and associated skills
	2.18.1 Occupational Health and Safety principles
UEENEED029B Develop basic web pages for engineering applications	2.4.21 Client side programming
	2.4.22 Server scripting
	2.18.1 Occupational Health and Safety principles
UEENEED030B Select, install, configure and test multimedia devices	2.4.12.2 Multimedia computer components
UEENEED031B Develop and validate basic integrated systems	2.3.16 Integrated systems basics
	2.18.1 Occupational Health and Safety principles
UEENEED032B Design integrated systems	2.3.17 Integrated systems, subsystem interworking
UEENEED033B Design complex integrated systems	2.3.18 Complex integrated system programming
UEENEED034B Configure and maintain industrial control system networks	2.3.11 Control system network basics
	2.3.12 Control network infrastructure
	2.18.1 Occupational Health and Safety principles
UEENEED035A to UEENEED042A	Reserved
UEENEED043B Install and configure a computer operating system and software	2.4.14 Personal computer operating systems, basics
	2.4.15 Computer operating systems
	2.18.1 Occupational Health and Safety principles
UEENEED044B Commission computer systems	2.2.43 Commissioning processes and procedures
	2.18.1 Occupational Health and Safety principles

Competency Standard Units (CSUs)	Essential knowledge and associated skills
UEENEED045B Modify-redesign of computer system	2.2.50 Engineering design processes
	2.18.1 Occupational Health and Safety principles
UEENEED046B Set up and configure basic local area network	2.4.25.1 Local area network fundamentals
UEENEED047A Reserved	
UEENEED048B Plan computer systems projects	2.2.16.1 Project Planning
	2.2.18 Critical path and project analysis
	2.2.29 Electronic/Computer systems industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEED049A	Reserved
UEENEED050B Develop control programs for microcomputer equipped devices	2.3.20 Microcontroller programming basics
	2.4.44.1 Microprocessor/microcontroller assembler language programming
	2.4.44.2 High level programming
	2.18.1 Occupational Health and Safety principles
UEENEED051B Provide programming solution for engineering problems	2.3.19 Control Programming Fundamentals
	2.3.20 Microcontroller programming basics
	2.4.44.2 High level programming
	2.18.1 Occupational Health and Safety principles
UEENEED052B Design embedded controller systems	2.4.44.1 Microprocessor/microcontroller assembler language programming
	2.4.44.2 High level programming
	2.9.5.2 Microcontroller Fundamentals

Competency Standard Units (CSUs)	Essential knowledge and associated skills
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEED053B Set up and test biometric devices	2.9.71.1 Biometric devices
	2.18.9 Electronic Safe working practices
UEENEED054B – Analyse and implement biometric techniques and applications	2.9.70 Automatic data capture
	2.9.71.2 Biometrics Equipment Techniques and Applications
	2.9.71.3 Biometric Systems Techniques and Applications
UEENEED055B – Develop and validate biometric systems installation	2.9.71.2 Biometrics Equipment Techniques and Applications
	2.9.71.3 Biometric Systems Techniques and Applications
	2.9.71.4 Biometrics and Security
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices

E - Cross-discipline units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEE001B Apply OHS	2.18.1 Occupational Health and Safety

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
practices in the workplace	principles
UEENEEE002B Dismantle, assemble and fabricate electrotechnology components	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.4 Dismantling and assembling techniques
	2.18.1 Occupational Health and Safety principles
	2.20.1 Sustainable energy principles
UEENEEE003B Solve problems in extra-low voltage single path circuits	2.8.1.2 Fundamental electrical principles
	2.18.1 Occupational Health and Safety principles
UEENEEE004B Solve problems in multiple path d.c circuits	2.8.2.1 Direct current circuit principles
UEENEEE005B Fix and secure equipment	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.3.1 Fixing and support devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.20.2 Environmental and building regulation
UEENEEE006B Apply methods to maintain currency of industry developments	2.2.44 Requirements and methods for maintaining currency in industry developments
UEENEEE007B Use drawings, diagrams, schedules and manuals	2.5.1.2 Drawings and diagrams
	2.18.1 Occupational Health and Safety principles
UEENEEE008B Lay wiring/cabling and terminate accessories for extra-low voltage	2.1.1 Cable protection and support
	2.1.2 Cable types and applications

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
circuits	2.1.3 Cables in buildings, structures and premises
	2.1.4 Basic cable and conductor terminations
	2.5.5 Technical standards, regulations and codes for extra-low voltage work
	2.5.11 Environmental and heritage awareness
UEENEEE009B Comply with scheduled and preventative maintenance program processes	2.13.8 Schedule maintenance processors
	2.18.1 Occupational Health and Safety principles
UEENEEE010B Develop and implement maintenance programs	2.13.8 Schedule maintenance processors
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE011B Manage risk in electrotechnology activities	2.2.15 Risk management, application and techniques
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE012B Manage electrotechnology projects	2.2.17 Project management
	2.2.19 Customer/Client relations
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE013B Plan electrotechnology projects	2.2.16.1 Project Planning
	2.2.18 Critical path and project analysis
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE014B Supervise and	2.2.4 Problem solving techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
coordinate work activities	2.2.6 Enterprise quality management system, basics
	2.2.19 Customer/Client relations
	2.2.41 Supervision fundamentals
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE015B Develop design briefs for electrotechnology projects	2.2.5 Enterprise customer relation protocols
	2.2.18 Critical path and project analysis
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE016B Write specifications for electrotechnology projects	2.2.6 Enterprise quality management systems, basics
	2.2.7 Enterprise purchasing system
	2.2.10 Job costing techniques
	2.2.11.2 Specification development
	2.2.15 Risk management, application and techniques
	2.2.18 Critical path and project analysis
	2.2.19 Customer/client relations
	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE017B Implement and monitor OHS policies and procedures	2.18.8.1 Occupational Health and Safety, supervisory responsibilities
UEENEEE018B Establish, maintain and evaluate OHS	2.18.8.2 Occupational Health and Safety, enterprise responsibilities

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
systems	
UEENEEE019C Solve problems in multiple path a.c. circuits	2.8.2.3 Alternating current principles – single phase
UEENEEE020B Provide basic instruction in the use of electrotechnology apparatus	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.5 Enterprise customer relations protocols
	2.2.13 User instruction techniques
	2.18.1 Occupational Health and Safety principles
UEENEEE021B Plan an integrated cabling system	2.1.11 Integrated cabling arrangements
	2.5.2.1 Technical standards, regulations and codes for general electrical installations
	2.5.7 Technical standards, regulations and codes for telecommunications cabling
	2.5.9 Building codes, applicable to general electrotechnology installations
	2.7.4.2 Electrical installations, circuit arrangements and cable selection
	2.18.2 Electrical Safe working practices
UEENEEE022B Carry out preparatory electrotechnology work activities	2.1.1 Cable protection and support
	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.3.1 Fixing and support devices and techniques
	2.18.1 Occupational Health and Safety principles
UEENEEE023B Solve basic	2.9.1.5 Basic electronic principles

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
problems in electronic and digital equipment	2.9.1.6 Basic digital principles
	2.18.1 Occupational Health and Safety principles
UEENEEE024C Compile and produce an electrotechnology report	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.20 Computer use basics
	2.2.21 Engineering analysis, decision making and reporting
	2.2.33 Working in a team
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE025B Solve problems in complex multiple path circuits	2.8.9.1 Circuit analysis
	2.18.1 Occupational Health and Safety principles
UEENEEE026B Provide computational solutions to basic engineering problems	2.8.10.2 Engineering maths
	2.18.1 Occupational Health and Safety principles
UEENEEE027B Use advanced computational processes to provide solutions to engineering problems	2.8.10.3 Single-stage Engineering maths
	OR
	2.8.10.4 Engineering Mathematics with Calculus
	2.18.1 Occupational Health and Safety principles
UEENEEE028B Develop engineering solutions to photonic problems	2.9.87 Photonic principles and applications
UEENEEE029B Solve electrotechnical problems	2.8.1.3 Electrotechnical principles
	2.18.1 Occupational Health and Safety

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles
UEENEEE030B Provide solutions to and report on routine electrotechnology problems	2.8.14.3 Electrotechnology Numeracy Diagnostic Assessment Methods
	2.8.14.4 Electrotechnology Literacy Diagnostic Assessment Methods
	2.18.1 Occupational Health and Safety principles
UEENEEE031A	Reserved
UEENEEE032B Document occupational hazards and risks in computer systems	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.18.1 Occupational Health and Safety principles
	2.18.16 Documenting hazards and identifying risks
UEENEEE033B Document occupational hazards and risks in electrical work	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.18.1 Occupational Health and Safety principles
	2.18.16 Documenting hazards and identifying risks
UEENEEE034B Document occupational hazards and risks in electronics	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.18.1 Occupational Health and Safety principles
	2.18.16 Documenting hazards and identifying risks
UEENEEE035B Document occupational hazards and risks in	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
instrumentation	2.18.1 Occupational Health and Safety principles
	2.18.16 Documenting hazards and identifying risks
UEENEEE036B Document occupational hazards and risks in refrigeration and air-conditioning	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.18.1 Occupational Health and Safety principles
	2.18.16 Documenting hazards and identifying risks
UEENEEE037B Document occupational hazards and risks in electrotechnology	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.18.1 Occupational Health and Safety principles
	2.18.16 Documenting hazards and identifying risks
UEENEEE038B Participate in development and follow a personal competency development plan	2.2.45 Responsibilities under a competency development plan
	2.2.46 Methods of monitoring and reporting competency development activities
UEENEEE039A	RESERVED
UEENEEE041B Use of routine equipment/plant/technologies in an electrotechnology environment	2.2.40 Electrotechnology industry organisations and practices
	2.8.1.2 Fundamental electrical principles
	2.8.13 Parts and component selection
	2.18.1 Occupational Health and Safety principles
UEENEEE042B Produce routine products for carrying out	2.2.40 Electrotechnology Industry organisations and practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
electrotechnology work activities	2.5.1.1 Drawings interpretation and sketching
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.8.13 Parts and component selection
	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.4 Dismantling and assembling techniques
	2.11.13.2 Introduction to welding
	2.11.19 Electrotechnology engineering practices
	2.18.1 Occupational health and safety principles
UEENEEE043B Produce routine tools/devices for carrying out electrotechnology work activities	2.2.40 Electrotechnology Industry organisations and practices
	2.5.1.1 Drawings interpretation and sketching
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.8.13 Parts and component selection
	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.4 Dismantling and assembling techniques
	2.11.13.2 Introduction to welding
	2.11.19 Electrotechnology engineering practices
	2.18.1 Occupational health and safety principles
UEENEEE044B Apply technologies and concepts to	2.2.20 Computer use basics
	2.2.40 Electrotechnology industry organisations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
electrotechnology work activities	and practices
	2.4.11 Personal computers hardware structure
	2.5.1.1 Drawings Interpretation and Sketching
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.8.13 Parts and component selection
	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.4 Dismantling and assembling techniques
	2.18.1 Occupational Health and Safety principles
UEENEEE045B Apply computation when using equipment/materials/concepts in an electrotechnology environment	2.2.40 Electrotechnology industry organisations and practices
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.8.13 Parts and component selection
	2.8.15.1 Applied mathematical concepts
	2.18.1 Occupational Health and Safety principles
UEENEEE046B Identify effects of energy on machinery and materials in an electrotechnology environment	2.8.15.2 Applied physics concepts
	2.18.1 Occupational Health and Safety principles
UEENEEE047B Identify building techniques, methods and materials used in electrotechnology work activities	2.2.40 Electrotechnology organisations and practices
	2.5.1.1 Drawings Interpretation and Sketching
	2.7.1.1 Electrotechnology, building systems and materials

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.8.8 Electrotechnology science and materials
	2.8.13 Parts and component selection
	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.4 Dismantling and assembling techniques
	2.18.1 Occupational Health and Safety principles
UEENEEE048C Carry out routine work activities in an electrotechnology environment	2.2.40 Electrotechnology Industry organisations and practices
	2.18.1 Occupational Health and Safety principles
UEENEEE049B Contribute to the operation of support plant and equipment used in electricity supply	2.2.40 Electrotechnology organisations and practices
	2.5.1.1 Drawings Interpretation and Sketching
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.8.8 Electrotechnology science and materials
	2.8.13 Parts and component selection
	2.11.1 Hand tools
	2.11.2.1 Power tools
	2.11.4 Dismantling and assembling techniques
	2.18.17 Powerline safety practices
UEENEEE050B Undertake	2.8.10.4 Engineering mathematics with calculus

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
computations in an electrotechnology environment	2.8.15.1 Applied mathematical concepts
	2.18.1 Occupational Health and Safety principles
UEENEEE051B Transport apparatus and materials	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.4 Problem solving techniques
	2.2.5 Enterprise customer relations protocols
	2.2.9 Enterprise stock control methods
	2.18.1 Occupational Health and Safety principles
UEENEEE060B Provide solutions for uses of materials and thermodynamic effects	2.21.9 Material science
	2.21.10 Thermodynamics
	2.18.1 Occupational Health and Safety principles
UEENEEE061B Analyse static and dynamic parameters of equipment	2.21.4 Statics and dynamics
	2.18.1 Occupational Health and Safety principles
UEENEEE062B Select drive components for equipment design	2.21.2 Mechanical drives and engineering
UEENEEE063B Analyse materials for suitability in equipment	2.21.3 Materials and strengths of materials
UEENEEE064B Design machine drives and production layout plans	2.21.1 Machine design and positioning
UEENEEE065A to UEENEEE069A	Reserved
UEENEEE070 Write	2.2.11.2 Specification development

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
specifications for computer systems engineering projects	2.2.19 Customer/client relations
	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE071B Write specifications for electrical engineering projects	2.2.11.2 Specification development
	2.2.19 Customer/client relations
	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE072B Write specifications for electronics and communications engineering projects	2.2.11.2 Specification development
	2.2.19 Customer/client relations
	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE073B Write specifications for refrigeration and air conditioning engineering projects	2.2.11.2 Specification development
	2.2.19 Customer/client relations
	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE074B Write specifications for renewable energy	2.2.11.2 Specification development
	2.2.19 Customer/client relations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
engineering projects	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE075B Write specifications for industrial electronics and control projects	2.2.11.2 Specification development
	2.2.19 Customer/client relations
	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE076A (Reserved)	Reserved
UEENEEE077B Write specifications for automated systems projects	2.2.11.2 Specification development
	2.2.19 Customer/client relations
	2.2.20 Computer use basics
	2.2.25 Research concepts
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEE078B Contribute to risk management in electrotechnology systems	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
	2.18.18 Principles of risk management, applications, practices and techniques
UEENEEE079A Identify & select components, accessories and materials for electrotechnology work activities	2.2.40 Electrotechnology Industry organisations and practices
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.8.13 Parts and component selection
	2.18.1 Occupational Health and Safety

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles

F - Data and voice communication units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEF016A Lay and connect cables cabling for direct access to telecommunications service	2.4.1.1 Telecommunications CPR regulations and installations
UEENEEF002B Lay and connect cables for multiple access to telecommunication services	2.1.1 Cable protection and support
	2.1.2 Cable types and applications
	2.1.3 Cables in buildings, structures and premises
	2.1.6.1 Telecommunication cable and conductor terminations
	2.4.1.2 Telephone system fundamentals
	2.4.2.1 Telecommunication earthing and protection
	2.5.7 Technical standards, regulations and codes for telecommunications cabling
	2.5.11 Environmental and heritage awareness
UEENEEF003B Install and maintain cabling for telecommunication services in lifts	2.18.2 Electrical Safe working practices
	2.4.1.4 Lift telecommunications cabling regulations and installation
UEENEEF004B Install and modify performance data communication structured cabling	2.1.7.1 Performance (copper) data cable installation and terminations
	2.11.8 Data and voice cabling testing devices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.13.8 Schedule maintenance processors
UEENEEF005B Install and modify performance data communication optical fibre cabling	2.1.7.3 Optical fibre cabling installation and terminations
	2.11.8 Data and voice cabling testing devices
	2.13.8 Schedule maintenance processors
UEENEEF006B Solve problems in data and voice communications circuits	2.10.31 Electrotechnology communications principles
	2.18.1 Occupational Health and Safety principles
UEENEEF007B Set up the wireless capabilities of communications and data storage devices	2.10.30 Wireless devices
	2.18.1 Occupational Health and Safety principles
UEENEEF008B Select and arrange equipment for wireless networks	2.2.2 Enterprise work activities records
	2.4.3.2 Networking fundamentals
	2.4.4 Wireless networks infrastructure
	2.18.1 Occupational Health and Safety principles
UEENEEF009B Install and connect voice and data communications equipment	2.4.3.2 Networking fundamentals
UEENEEF010B Select and arrange equipment for local area networks	
	2.1.7.2 Coaxial cable installation and terminations
	2.1.7.3 Optical fibre cabling installation and terminations
	2.2.2 Enterprise work activities records

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.4.3.2 Networking fundamentals
	2.4.6 PABX fundamentals
	2.4.8 Switches, hubs and routers
	2.4.9 Decoders
UEENEEF011B Test, report and rectify faults in voice and data installations	2.4.3.2 Networking fundamentals
	2.11.5 Basic electrical testing and measuring devices and techniques
	2.11.8 Data and voice cabling testing and testing devices
UEENEEF012B Install aerial communication cables	2.1.6.2 Telecommunication aerial cabling
	2.18.14 Aerial safety practice
UEENEEF013B Install below ground communication cables	2.1.6.3 Telecommunication below ground cabling
	2.18.15 Trenching safety practices
UEENEEF014B Set up and configure basic data communications systems	2.4.3.1 Data Communication Fundamentals
UEENEEF015B Assemble and connect communication frames and cabinets	2.1.6.4 Voice and data cabinet cabling terminations
	2.4.2.2 Voice and data cabinet assembly and terminations
	2.18.2 Electrical Safe working practices

G - Electrical Units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEG001B Solve problems in electrical power circuits.	2.8.6 Electromagnetic principles
	2.11.1 Hand tools
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
UEENEEG002B Solve problems in single and three phase low voltage circuits	2.8.2.2 Alternating current principles - power
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
UEENEEG003B Install wiring and accessories for low voltage circuits	2.1.3 Cables in buildings, structures and premises
	2.1.5.1 Power cable and conductor terminations
	2.5.2.1 Technical standards, regulations and codes for general electrical installations
	2.5.11 Environmental and heritage awareness
	2.7.1.2 Electrical installations, wiring and accessories
	2.7.1.3 Electrical wiring systems
	2.7.2 Electrical installations, equipment requirements
	2.18.2 Electrical Safe working practices
UEENEEG004B Install low voltage electrical apparatus and associated equipment	2.1.3 Cables in buildings, structures and premises
	2.1.5.1 Power cable and conductor terminations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.5.2.1 Technical standards, regulations and codes for electrical installations
	2.5.11 Environmental and heritage awareness
	2.6.6.2 Alternating current rotating machines
	2.6.8.2 Single and three-phase transformers
	2.6.9.2 Luminaries and lighting systems
	2.7.1.2 Electrical installations, wiring and accessories
	2.7.1.3 Electrical wiring systems
	2.7.2 Electrical installations, equipment requirements
	2.18.2 Electrical Safe working practices
UEENEEG005B Verify compliance and functionality of general electrical installations	2.7.5.1 Electrical installations, testing and verification
UEENEEG006A (Reserved)	Reserved
UEENEEG007B Select and arrange equipment for general electrical installations	2.1.1 Cable protection and support
	2.1.2 Cable types and applications
	2.1.3 Cables in buildings, structures and premises
	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.3.1 Electrical control devices
	2.5.1.2 Drawings and diagrams
	2.5.2.1 Technical standards, regulations and codes for electrical installations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.6.1 Protection devices and applications
	2.6.2.1 Switchboards/distribution boards
	2.7.1.2 Electrical installations, wiring and accessories
	2.7.1.3 Electrical wiring systems
	2.7.2 Electrical installations, equipment requirements
	2.7.3 Electrical installations, safety principles and requirements
	2.7.4.1 Electrical installations, protection methods and devices
	2.7.4.2 Electrical installations, circuit arrangements and cable selection
	2.11.3.1 Fixing and support devices and techniques
UEENEEG008B Find and repair faults in electrical apparatus and circuits	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.3 Fault finding techniques
	2.3.1 Electrical control devices
	2.3.2 Control circuit fundamentals
	2.5.10 Technical manuals and catalogues

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.6.9.1 Lighting fundamentals
	2.6.10 Electrical heating
	2.7.4.1 Electrical installations, protection methods and devices
	2.7.4.2 Electrical installations, circuit arrangements and cable selection
	2.9.77 Electronic components and system, industrial applications
UEENEEG009B Develop and connect control circuits	2.2.1 Enterprise communication methods
	2.2.2 Enterprise work activities records
	2.2.3 Fault finding techniques
	2.3.1 Electrical control devices
	2.3.2 Control circuit fundamentals
UEENEEG010B Find and repair faults in d.c. electrical apparatus and circuits	2.6.12 Direct current machines
	2.6.16 Direct current motor controls
UEENEEG011B Carry out basic repairs to electrical apparatus	2.1.4 Basic cable and conductor terminations
	2.11.2.2 Electrical workshop machines
	2.18.2 Electrical Safe working practices
UEENEEG012B Solve fundamental problems in electrical systems	2.8.2.2 Alternating current principles - power
	2.8.6 Electromagnetic principles
	2.8.8 Electrotechnology science and materials
	2.18.2 Electrical Safe working practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEG013B Install and maintain emergency systems.	2.6.17 Cells and batteries
	2.7.6 Electrical installations, emergency systems
UEENEEG015B Find and rectify faults in energy supply network equipment	
	2.6.21 Electricity supply and reticulation
	2.6.22.1 Electrical power system protection
UEENEEG016B Diagnose and Rectify Faults in Lifts Systems	2.5.3 Technical standards, regulations and codes for lifts and escalators
	2.6.46 Lift systems – basic operations
	2.6.47 Lift components – electro-mechanical
	2.6.48 Electric lifts – mechanics
	2.6.49 Electro - hydraulic lifts
	2.6.50 Electro-hydraulic lifts – mechanical operation
	2.6.51 Emergency release procedures – trapped passengers
UEENEEG018B Maintain operation of electrical mining equipment	2.5.19 Technical standards, regulations and codes for mining
	2.6.20 Electrical mining systems overview
UEENEEG019B Maintain the operation of electrical marine equipment	2.6.17 Cells and batteries
	2.6.23 Marine Electrical Systems overview
UEENEEG020B Select and arrange equipment for special electrical installations	2.5.2.2 Technical standards, regulations and codes for special electrical installations
UEENEEG021B Verify compliance and functionality of special electrical installations	2.5.2.2 Technical standards, regulations and codes for special electrical installations
	2.7.5.2 Electrical installations, testing and verification of special installations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEG022B Conduct compliance inspection of single phase electrical installations	2.2.2 Enterprise work activities records
	2.2.5 Enterprise customer relations protocols
	2.5.12 Electricity distributors, supply requirements
	2.5.13 Electricity regulatory safety requirements
	2.7.9.1 Electrical installations, single phase inspections
UEENEEG023B Conduct compliance inspection of electrical installations with demand exceeding 100A per phase	2.7.9.2 Electrical installations, inspections and safety compliance audits
UEENEEG024B Conduct compliance inspection of special electrical installations	2.5.2.2 Technical standards, regulations and codes for special electrical installations
UEENEEG025B Plan electrical installations with a LV demand up to 400A per phase	2.6.2.2 Electrical metering arrangements
UEENEEG026B Install and maintain field power and distribution systems with a LV demand up to 200A per phase	2.6.3 Single phase alternators
	2.6.4 Three phase alternators
	2.6.32 Field power and distribution systems
UEENEEG027B Design electrical installations with a LV demand greater than 400A per phase	2.5.12 Electricity distributors, supply requirements
	2.7.4.3 Electrical installations, Single-stage methods of cable and protection selection
	2.7.5.1 Electrical installations, testing and verification
	2.7.5.2 Electrical installations, testing and verification of special installations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.7.10 Electrical installations, determination of demand
	2.7.11 Electrical installations, overcurrent protection
	2.7.12 Electrical installations, overvoltage and undervoltage protection
UEENEEG028B Plan switchboard and control panel layouts	2.3.1 Electrical control devices
	2.6.1 Protection devices and applications
	2.6.2.2 Electrical metering arrangements
	2.6.24.1 Switchgear/controlgear
	2.6.24.2 Control panel wiring
UEENEEG029B Overhaul and repair major switchgear / controlgear	2.6.24.1 Switchgear/controlgear
	2.7.4.1 Electrical installations, protection methods and devices
UEENEEG030B Design switchboards rated for high fault levels	2.8.8 Electrotechnology science and materials
	2.8.15.3 Fault current calculations
UEENEEG031B Evaluate performance of electrical apparatus	2.5.23 Performance standards and regulatory requirement for electrical equipment
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
UEENEEG032B Carry out electrical field testing and report findings	
	2.11.6.1 Advance electrical testing and measuring devices
	2.11.6.2 Electrical field testing and

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	measurement techniques
	2.11.6.3 Power cable fault detection techniques
UEENEEG033A (Reserved)	RESERVED
UEENEEG034B Perform High Voltage Field Switching Operation To a Given Schedule	T2.4.3 High voltage switching principles
	T2.4.4 High voltage fault switching principles
	T2.4.5 High voltage distribution transformer principles
	T2.4.6 High voltage SWER system
	T2.4.7 Feeder automation system
UEENEEG035B Diagnose and rectify faults in a.c. motor drive systems	2.6.33 Variable speed drives for a.c. motors
UEENEEG036B Diagnose and rectify faults in d.c. motor drive systems	2.6.34 Variable speed drives for d.c. motors
UEENEEG037B Diagnose and rectify faults in energy supply apparatus	2.6.22.2 Electrical power system operations
UEENEEG038B Diagnose and rectify faults in electrical energy distribution systems	2.6.22.6 Electrical power distribution systems diagnostic
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEG039B Diagnose and rectify faults in distributed generation systems	2.6.22.4 Distributive generation systems
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEG040B Develop engineering solutions for energy supply power transformer	2.6.8.3 Power transformers diagnostics

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
problems	
UEENEEG041B Diagnose and rectify faults in servo drive systems	2.6.35 Servomechanism systems
UEENEEG042B Diagnose and rectify faults in electrical energy supply transmission system	2.6.22.3 Electrical power system transmission faults
UEENEEG043B Develop engineering solution for synchronous machine problems	2.6.36 Synchronous machine diagnostics
UEENEEG044B Develop engineering solution for d.c. machine problems	2.6.38 Direct current machines diagnostics
UEENEEG045B Develop engineering solution for induction motor problems	2.6.37 Induction motors diagnostics
UEENEEG046B Develop engineering solutions for energy supply system protection problems	2.6.22.5 Electrical power system protection diagnostic
UEENEEG047B Provide computational solutions to power engineering problems	2.8.11 Power engineering computations
UEENEEG048B Solve problems in complex multipath path power circuits	2.8.9.2 Electrical power circuit analysis
UEENEEG049B Solve problems in complex polyphase power circuits	2.8.9.3 Polyphase power circuit analysis
UEENEEG050B Wind coils	2.6.29 Coil winding basics
	2.6.30 Coil testing
UEENEEG051B Place and connect coils	2.1.9 Winding wire types and connections
	2.6.31.1 Electrical machine winding basic
UEENEEG052B Rewind single	2.3.2 Control circuit fundamentals

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
phase induction machines	2.6.6.2 Alternating current rotating machines
	2.6.31.1 Electrical machine winding basic
	2.18.1 Occupational Health and Safety principles
UEENEEG053B Rewind three phase induction machines rated for low voltage	2.6.8.2 Single & three-phase transformers
	2.6.28 Motor windings
	2.6.31.2 Low voltage three phase motor winding techniques
UEENEEG054B Rewind direct current machines rated for low voltage	2.6.28 Motor windings
	2.6.31.3 Direct current motor winding techniques
UEENEEG055B Rewind three phase induction machines rated for high voltage to 3.3 kV	2.1.10 High voltage motor winding, conductors, connections methods and insulation
	2.6.31.4 High voltage three phase motor winding techniques
UEENEEG056B Rewind three phase induction machines rated for high voltage above 3.3 kV	2.1.10 High voltage motor winding, conductors, connections methods and insulation
	2.6.31.4 High voltage three phase motor winding techniques
UEENEEG057B Conduct electrical tests on low voltage electrical machines	2.7.4.1 Electrical installations, protection methods and devices
	2.11.20.1 Low voltage motor testing devices and techniques
UEENEEG058B Conduct electrical tests on high voltage electrical machines	2.11.20.2 High voltage motor testing devices and techniques
UEENEEG059B Conduct mechanical tests of electrical machines	2.6.31.5 Electrical machines, mechanical components
	2.11.20.3 Electric motor mechanical measuring and testing devices and techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEG060B Evaluate performance of electrical machines	2.5.22 Performance standards and regulatory requirements for the electrical rotating machine
	2.6.31.6 Electrical machines, performance monitoring
UEENEEG061B Design and develop modifications to electrical machines	2.6.28 Motor windings
UEENEEG062B Set up and place electrical apparatus and associated circuits into service	2.2.2 Enterprise work activities records
	2.2.4 Problem solving techniques
	2.2.5 Enterprise customer relations protocols
	2.2.43 Commissioning processes and procedures
UEENEEG063A (Reserved)	Reserved
UEENEEG064B Repair mechanical components of electrical machines	2.6.31.5 Electrical machines, mechanical components
	2.11.2.2 Electrical workshop machines
UEENEEG065B Maintain and service traction lifts	2.6.39 Lubrication of lift components
	2.6.40 Lift systems, roping
	2.6.41 Lift systems, rope inspection
UEENEEG066B Installation and maintenance of escalators, moving walks and tread ways	2.6.39 Lubrication of lift components
	2.6.42 Escalators, moving walk and tread way mechanics
UEENEEG067B Align and Install Lift Equipment	2.6.43 Lift systems, plumbing and setting out
	2.6.44 Lift equipment alignment techniques
UEENEEG068B Diagnose and rectify faults in complex lifts systems	2.6.45 Lift components - electrical/electronic

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEG069B Manage electrical projects	2.2.17 Project management
	2.2.19 Customer/Client relations
	2.2.28 Electrical industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEG070B Plan electrical projects	2.2.16.1 Project Planning
	2.2.18 Critical path and project analysis
	2.2.28 Electrical industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEG071B Install and set up interval metering	2.5.2.1 Technical standards, regulations and codes for general electrical installations
	2.5.12 Electricity distributors, supply requirements
	2.6.2.2 Electrical metering arrangements
	2.6.2.3 Interval metering concepts and applications
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
UEENEEG072C Investigate and report on electrical incidents	2.2.49 Procedure and protocols for giving evidence in a court of law
	2.7.14 Procedures and processes for responding to reported electrical incidents
	2.7.15 Causes and consequence of unsafe and misuse of electrical installations and equipment.
	2.11.6.1 Advance electrical testing and

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	measuring devices
	2.11.6.2 Electrical field testing and measurement techniques
UEENEEG075A Develop compliance policies and plans to conduct a contracting business	2.2.23 Enterprise regulatory requirements and non regulatory standards
	2.5.12 Electricity distributors, supply requirements
	2.5.13 Electricity regulatory safety requirements
	2.18.8.1 Occupational Health and Safety, supervisory responsibilities

H - Electronic units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH001B Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies	2.1.8 Electronic cable and conductor terminations
	2.4.11 Personal computers, hardware structure
	2.18.9 Electronic safe working practices
UEENEEH002B Carry out basic repairs to electronic apparatus by replacement of components	2.1.8 Electronic cable and conductor terminations
	2.9.1.1 Electronic component basics
	2.11.11.1 Electronic soldering equipment and techniques
	2.18.9 Electronic safe working practices
UEENEEH003B Carry out basic	2.1.8 Electronic cable and conductor

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
repairs to business equipment	terminations
	2.2.1 Enterprise communication methods
	2.4.18 Business equipment software basics
	2.9.73 Operational concepts of business machines
	2.9.74.1 Electro-mechanics of business machines
	2.18.9 Electronic Safe working practices
UEENEEH004B Set-up and test residential audio/video equipment	2.1.8 Electronic cable and conductor terminations
	2.9.15 Audio and video component functional controls
	2.9.42 Audio and video system set up
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH005B Verify compliance and functionality of custom electronic installations	2.9.72 Custom electronic installations, testing and verification methods
UEENEEH006B Assemble and set up fixed audio/video components and systems in buildings and premises	2.9.16.1 Sound reproduction fundamentals
	2.9.17.1 Audio reproduction, electronic components
	2.9.18 Audio reproduction, speaker fundamentals
	2.9.19 Audio/video recording and replay components repair basics
	2.9.43 Video systems installation
	2.9.81 Audio/video control equipment

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH007B Carry out repairs of predicable faults in general electronic apparatus	2.5.10 Technical manuals and catalogues
	2.9.83 General electronic apparatus repair basics
UEENEEH008B Assemble and erect reception antennae and signal distribution equipment	2.1.7.2 Coaxial cable installation and terminations
	2.10.14 TV antenna systems
	2.10.15 Antenna installation and servicing
	2.18.9 Electronic Safe working practices
UEENEEH009B Set-up and test gaming/games equipment	2.2.1 Enterprise communication methods
	2.2.5 Enterprise customer relations protocols
	2.5.18 Regulatory requirements and codes of practice for the gaming equipment
	2.9.22 Gaming machine systems and equipment overview
	2.9.23.1 Gaming machine equipment adjustment and maintenance
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH010B Install commercial audio/video system components	2.1.7.4 Specialist audio/video cabling installation and termination
	2.9.16.1 Sound reproduction fundamentals
	2.9.17.1 Audio reproduction, electronic components
	2.9.18 Audio reproduction, speaker fundamentals
	2.9.19 Audio/video recording and replay components repair basics

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.9.46 Professional audio electronics
	2.9.47 Loud speakers and microphones
	2.9.80 Video and display set up
	2.9.81 Audio/video control equipment
	2.18.9 Electronic Safe working practices
UEENEEH011B Troubleshoot d.c. power supplies with single phase input	2.9.12 Electronic fault finding
	2.9.63 Direct current power supplies
	2.11.7.1 Electronic testing and measuring devices and techniques
UEENEEH012B Troubleshoot digital subsystems	2.9.4.1 Digital electronics fundamentals
	2.9.12 Electronic fault finding
	2.11.7.1 Electronic testing and measuring devices and techniques
UEENEEH013B Troubleshoot amplifiers	2.9.9.1 Single-stage amplifiers
	2.9.9.2 Amplifier applications
	2.11.7.1 Electronic testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH014B Troubleshoot frequency dependent circuits	2.8.10.1 Engineering maths fundamentals
	2.9.1.4.1 Frequency dependent circuit principles
	2.9.1.4.2 Filters and Resonance
	2.18.9 Electronic Safe working practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH015B Develop software solutions in microcontroller based systems	2.9.5.1 Micro programming fundamentals
	2.9.12 Electronic fault finding
	2.11.7.1 Electronic testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
	2.11.7.2 Advanced electronics testing and measuring devices and techniques
UEENEEH016B Find and repair faults in the microwave amplifier sections of electronic apparatus	2.9.9.3 Microwave amplifiers
	2.9.12 Electronic fault finding
	2.10.18 Electronic communications, microwave antennae and waveguide fundamentals
	2.11.7.2 Advanced electronic testing and measuring devices and techniques
UEENEEH017B Carry out repairs of predictable faults in audio and video replay/recording apparatus	2.5.10 Technical manuals and catalogues
	2.9.19 Audio/video recording and replay components repair basics
	2.9.27 Digital versatile disc (DVD) and compact disc (CD)
	2.9.48 Digital audio
	2.9.52 Digital versatile disk processors
	2.9.53 Compact disk players

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH018B Find and repair faults in electronic apparatus	2.5.1.2 Drawings and diagrams
	2.9.12 Electronic fault finding
	2.11.7.1 Electronic testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH019B Carry out repairs of predicable faults in television receivers	2.5.10 Technical manuals and catalogues
	2.9.29 Television scanning and deflection
	2.9.30 Television chrominance and luminance
	2.9.57.1 Introduction to television
	2.9.57.2 Television receiver repair basics
UEENEEH020B Find and repair faults in gaming and games equipment	2.4.19 Gaming equipment communications
	2.9.23.2 Gaming machine fault finding
UEENEEH021B Find and repair faults in high volume office equipment	2.4.45 Copier/printer software functions and configuration
	2.9.74.2 Business machine transducers
	2.9.75.1 High volume business machine functions and faults
	2.9.75.2 Colour photocopiers operating principles
	2.9.75.3 Facsimile machine operating principles
UEENEEH022B Find and repair	2.9.28 Hand held remote control units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
faults in remote control apparatus	
UEENEEH023B Find and repair faults in microwave heating apparatus	2.9.76 Microwave heating
UEENEEH024B Carry out repairs to predicable faults in audio components	2.5.10 Technical manuals and catalogues
	2.9.15 Audio and video component functional controls
	2.9.17.1 Audio reproduction, electronic components
	2.9.17.2 Audio component repair basics
UEENEEH025B Provide solution to single phase electronic power control problems	2.9.7.1 Single phase power control
UEENEEH026B Provide solutions to polyphase electronic power control problems	2.9.7.2 Polyphase power control
UEENEEH027B Commission commercial radio frequency (RF) transmission and reception systems	2.10.8 Electronic communications, transmission lines
	2.10.9 Electronic communications, antennas and wave propagation
	2.10.19 Electronic communications, commissioning process
	2.11.7.2 Advanced electronics testing and measuring devices and techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH028B Install microwave and antennae and waveguides	2.10.18 Electronic communications, microwave antennas and wave guide fundamentals
	2.18.9 Electronic Safe working practices
UEENEEH029B Diagnose and rectify faults in navigation systems	2.10.26 Electronic communications, navigation systems
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH030B Diagnose and rectify faults in satellite-based surveillance and observation systems	2.10.11 Electronic communications, satellite
	2.10.27 Electronic communications, surveillance and observation
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH031B Diagnose and rectify faults in radar apparatus and systems	2.10.23 Electronic communications, secondary radar and related systems
	2.10.24 Electronic communications, radar and sonar displays devices
	2.10.25 Electronic communications, radar fundamentals
	2.11.7.2 Advanced electronics testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
	2.18.9 Electronic Safe working practices
UEENEEH032B Diagnose and rectify faults in global positioning systems	2.10.28 Electronic communications, global positioning systems
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
	2.18.9 Electronic Safe working practices
UEENEEH033B Diagnose and rectify faults in telecommunication apparatus and systems	2.4.1.2 Telephone system fundamentals
	2.4.1.3 Telephone network facilities
	2.4.2.1 Telecommunication earthing and protection
	2.4.6 PABX fundamentals
	2.4.7 PABX programming
	2.4.8 Switches, hubs and routers
	2.4.9 Decoders
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
	2.18.9 Electronic Safe working practices
UEENEEH034B Diagnose and rectify faults in medical equipment	2.12.22.1 Medical equipment principles
	2.12.22.2 Medical equipment, anatomy and physiology and infection control
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.10 Medical equipment safe working practices
UEENEEH035B Design custom electronic installations	2.5.5 Technical standards, regulations and codes for extra-low voltage work
	2.5.11 Environmental and heritage awareness
	2.9.16.2 Acoustics, spatial treatment and sound reproduction
	2.9.40 Integrated audio systems
	2.9.80 Video and display set up
	2.9.81 Audio/video control equipment
	2.18.1 Occupational Health and Safety principles
UEENEEH036B Design commercial audio/video installations	2.5.5 Technical standards, regulations and codes for extra-low voltage work
	2.5.11 Environmental and heritage awareness
	2.6.9.3 Venue lighting for audio/video/live presentations
	2.9.16.2 Acoustics, spatial treatment and sound reproduction
	2.18.1 Occupational Health and Safety principles
UEENEEH037B Program and commission commercial audio/video systems	2.9.50 Commercial audio/video systems commissioning process
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH038B Find and repair faults in complex power supplies	2.9.11 Linear and switch mode power supplies
	2.9.65 Regulated power supplies

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2. 9.66 Switching power supplies
	2.11.7.1 Electronic testing and measuring devices and techniques
UEENEEH039B S Troubleshoot basic amplifiers	2.9.8 Amplifier Fundamentals
	2.9.12 Electronic fault finding
	2.11.7.1 Electronic testing and measuring devices and techniques
UEENEEH040B Diagnose and rectify faults in sonar apparatus and systems	2.10.20 Electronic communications, sonar Transducers and arrays
	2.10.21 Electronic communications, sonar system operating principles
	2.10.22 Electronic communications, sonar measurement and set up
	2.10.24 Electronic communications, radar and sonar displays devices
	2.11.7.2 Advanced electronics testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
	2.18.9 Electronic Safe working practices
UEENEEH041B Manage electronics/computer systems projects	2.2.17 Project management
	2.2.19 Customer/Client relations
	2.2.29 Electronic/computer systems industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH042B Troubleshoot	2.9.67 Feedback filters and oscillators

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
oscillators	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH043B Diagnose and rectify faults in digital subsystems of electronic controls	2. 9.4.1 Digital electronics fundamentals
	2.9.12 Electronic fault finding
	2.11.7.1 Electronic testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH044B Diagnose and rectify faults in analogue circuits and components in electronic control systems	2.9.8 Amplifier fundamentals
	2.9.9.1 Single-stage amplifiers
	2.9.9.2 Amplifier applications
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
	2.18.9 Electronic safe working practices
UEENEEH045B Develop solutions to analogue electronic problems	2.9.84 Single-stage analogue electronics
	2.9.85 Single-stage power amplifiers
	2.18.1 Occupational Health and Safety principles
UEENEEH046B Solve fundamental problems in electronic communications systems	2.10.1.1 Electronic communications, principles
UEENEEH047B Assess compliance of electronic apparatus	2.2.24 Technical examination and testing methods
	2.5.8 Technical standards, regulations and codes

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	for electronic apparatus
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH048B Design and develop advance digital systems	2.9.4.4 Digital applications
	2.11.7.1 Electronic testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH049B Develop solutions to audio electronics problems	2.11.7.2 Advanced electronics testing and measuring devices and techniques
	2.9.16.2 Acoustics, spatial treatment and sound reproduction
	2.9.17.1 Audio reproduction, electronic components
	2.9.86 Audio system advance diagnostic techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH050B Assemble and set up basic wired and wireless security systems	2.5.11 Environmental and heritage awareness
	2.5.20 Technical standards, regulations and codes for security systems
	2.9.41.1 Security systems installation basics
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH051B Install large wired and wireless security systems	2.9.59 Closed circuit televisions
	2.9.61 Single-stage electronic security systems
	2.9.71.1 Biometric devices
	2.18.9 Electronic Safe working practices
UEENEEH052B Enter instructions and test basic wired and wireless security systems	2.4.46 Security systems basic software functions and configuration
	2.18.9 Electronic Safe working practices
UEENEEH053B Program and test large wired and wireless security systems	2.4.47 Security systems programming methods
	2.18.2 Electrical Safe working practices
UEENEEH054B Program and commission commercial security alarm systems	2.4.48 Security systems alarms programming
	2.18.9 Electronic Safe working practices
UEENEEH055B Program and commission commercial security access control systems	2.4.49.1 Security systems access control programming
	2.18.9 Electronic Safe working practices
UEENEEH056B Program and commission commercial security closed circuit television (CCTV) systems	2.4.49.2 Security systems closed circuit television programming
	2.18.9 Electronic Safe working practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH057B Develop basic integrated security systems plan	2.9.78 Common security scenarios and solutions
UEENEEH058B Design integrated security systems for a single site	2.4.50.1 Integrated security systems
UEENEEH059B Design integrated complex security systems	2.4.50.2 Internetworking security systems
UEENEEH060B Plan electronic projects	2.2.16.1 Project Planning
	2.2.18 Critical path and project analysis

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.2.29 Electronic systems industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH061B Position and terminate fire detection and warning system apparatus	2.5.21 Technical standards, regulations and codes for fire protection and warning systems
	2.9.36 Fire detection and warning system and apparatus fundamentals
	2.9.79.1 Fire protection technologies
	2.18.1 Occupational Health and Safety principles
	2.18.11 Fire protection equipment safe working practices
UEENEEH062B Verify compliance and functionality of fire protection installations	2.5.21 Technical standards, regulations and codes for fire protection and warning systems
	2.7.5.3 Fire protection installations, testing and verification methods
	2.9.36 Fire detection and warning system and apparatus fundamentals
	2.9.37 Fire alarm routine testing
	2.9.79.1 Fire protection technologies
	2.18.1 Occupational Health and Safety principles
	2.18.11 Fire protection equipment safe working practices
UEENEEH063B Enter and verify programs in preparation for commissioning fire protection systems	2.4.51 Fire protection systems programming methods
	2.18.1 Occupational Health and Safety principles
	2.18.11 Fire protection equipment safe working

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	practices
UEENEEH064B Commission commercial fire protection systems	2.9.79.2 Fire protection systems, commissioning process
	2.18.1 Occupational Health and Safety principles
	2.18.11 Fire protection equipment safe working practices
UEENEEH065B Find and repair faults in fire protection systems	2.2.3 Fault finding techniques
	2.2.4 Problem solving techniques
	2.9.79.3 Fire protection systems faults
	2.18.1 Occupational Health and Safety principles
	2.18.11 Fire protection equipment safe working practices
UEENEEH066B Fault find Microcontroller based hardware	2.9.5.2 Microcontroller fundamentals
	2.9.12 Electronic fault finding
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic safe working practices
UEENEEH067B Commission electronics and communications systems	2.2.43 Commissioning processes and procedures
	2.18.1 Occupational Health and Safety principles
UEENEEH068B Modify-redesign of electronics and communications system	2.2.50 Engineering design processes
	2.18.1 Occupational Health and Safety principles
UEENEEH069B Solve problems in electronic circuits	2.8.1.4 Circuits principles
	2.11.5 Basic electrical testing and measuring devices and techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.1 Occupational Health and Safety principles
UEENEEH070B Terminate and connect components, conductors, wiring and cables for electronic circuits	2.1.4 Basic cable and conductor terminations
	2.1.8 Electronic cable and conductor terminations
	2.5.1.2 Drawings and diagrams
	2.9.1.1 Electronic component basics
	2.11.5 Basic electrical testing and measuring devices and techniques
	2.11.11.1 Electronic soldering equipment and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH071B Find and repair faults in television receivers	2.9.29 Television scanning and deflection
	2.9.30 Television chrominance and luminance
	2.9.31.2 Power supplies for TVs and VCRs
	2.9.31.3 Television RF Stages
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH072C Find and repair faults in communication systems	2.9.39 AM and FM tuners
	2.10.4 Electronic communications, modulation circuits
	2.10.5 Electronic communications, receivers
	2.10.6 Electronic communications, transmitters
	2.10.16 Transmission lines and antennae

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH073B Find and repair faults in professional audio reproduction components	2.9.16.1 Sound reproduction fundamentals
	2.9.17.1 Audio reproduction, electronic components
	2.9.45.1 Audio electronics
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH074B Find and repair faults in audio/video recording equipment	2.9.51 Camcorders
	2.9.52 Digital versatile disk processors
	2.9.53 Compact disk players
	2.9.54 VCR basic principles
	2.9.55 VCR fault finding
	2.9.56 VCR Single-stage principles
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH075B Find and rectify faults/malfunctions in security installations	2.9.41.2 Security systems installation faults
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH076B Diagnose and rectify faults in display circuits	2.9.24 Cathode ray tube displays
	2.9.25 Plasma displays
	2.9.26.1 Liquid crystal displays
	2.9.26.2 Display circuit diagnostics
	2.11.7.2 Advanced electronics testing and measuring devices and techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH077B Diagnose and rectify faults in recording and replay apparatus	2.9.45.2 Recording and replay apparatus diagnostics
	2.11.7.2 Advanced electronics testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH078B Diagnose and rectify faults in camera circuits	2.9.32.1 Camcorders and digital cameras
	2.9.32.2 Camera circuits diagnostics
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEH079B Diagnose and rectify faults in digital television apparatus	2.9.34.1 Digital Television Receivers
	2.9.34.2 Digital television principles
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEH080B Diagnose and rectify faults in digital transmission systems	2.9.34.3 Single-stage digital television principles
	2.10.29 Digital television transmission towers and equipment
	2.18.1 Occupational Health and Safety principles
UEENEEH081B Design printed circuit board design	2.9.91 Printed circuit board design techniques
	2.9.1.2 Electronic component parameters and selection methods
	2.18.1 Occupational Health and Safety principles
UEENEEH082B Develop solutions to RF amplifiers problems	2.9.90 RF amplifiers
	2.10.16 Transmission lines and antennae
	2.18.1 Occupational Health and Safety principles
UEENEEH083B Analyse the performance of wireless-based electronic systems	2.4.3.2 Networking fundamentals
	2.4.4 Wireless networks infrastructure
	2.4.38 Fundamentals of wireless security
	2.18.1 Occupational Health and Safety principles
UEENEEH084B Modify DSP based sub-systems	2.8.10.4 Engineering Mathematics with Calculus
	2.9.4.2 Digital Signal Processing
	2.9.4.3 Digital Signal Processing development
	2.18.1 Occupational Health and Safety principles
UEENEEH085B Design a signal-conditioning subsystem	2.9.88 Principles of Signal Conditioning
	2.9.89 Analogue Integrated Circuits

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.1 Occupational Health and Safety principles
UEENEEH086B Commission microwave and satellite communication systems	2.10.10 Microwave amplifiers
	2.10.11 Electronic communications, satellite
	2.10.19 Electronic communications, commissioning process
	2.11.7.2 Advanced electronics testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic safe working practices
UEENEEH087B Solve problems in musical equipment circuits	2.9.92 Vacuum tube amplifiers
	2.9.93 Electronic Musical Instruments
	2.11.7.2 Advanced electronics testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic safe working practices
UEENEEH088B Design and develop electronics/computer systems project	2.11.7.1 Electronic testing and measuring devices and techniques
	2.2.50 Engineering design processes
	2.18.1 Occupational Health and Safety principles
	2.18.9 Electronic Safe working practices
UEENEEH089A	Reserved
UEENEEH090A Provide solutions to air traffic control system problems	2.10.90 Air traffic control systems technology

I - Instrumentation and control units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEI001B Install and set up transducers and sensing devices	2.1.4 Basic cable and conductor terminations
	2.3.4 Pneumatic/hydraulic control tubing/piping
	2.5.14 Technical standards, regulations and codes applicable to instrumentation and control
	2.12.1 Instrumentation principles
	2.12.23 Transducers and sensing devices
	2.18.7 Instrumentation safe working practices
UEENEEI002B Solve problems in pressure measurement systems	2.11.12 Instrumentation testing and measuring field devices
	2.12.2 Pressure
UEENEEI003B Solve problems in density/level measurement systems	2.11.12 Instrumentation testing and measuring field devices
	2.12.3 Density and level
UEENEEI004B Solve problems in flow measurement systems	2.11.12 Instrumentation testing and measuring field devices
	2.12.4 Fluid flow
UEENEEI005B Solve problems in temperature measurement systems	2.11.12 Instrumentation testing and measuring field devices
	2.12.5 Temperature
UEENEEI006B Solve problems in process controllers, transmitters and converters	2.3.3 Process control principles
	2.5.10 Technical manuals and catalogues
	2.11.12 Instrumentation testing and measuring field devices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.12.6 Process control systems
	2.12.10 Transmitters and converters
UEENEEI007C Install process instrumentation and control cabling and tubing	2.1.3 Cables in buildings, structures and premises
	2.1.8 Electronic cable and conductor terminations
UEENEEI008C Install process control apparatus and associated equipment	2.1.8 Electronic cable and conductor terminations
	2.12.20 Process equipment installation requirements and techniques
UEENEEI009B Set-up process measuring and control instruments	2.12.11.1 Industrial processes
	2.12.14 Indicators and methods of recording process data
	2.12.15 Gas analysis
	2.12.16 Water analysis
	2.12.17 Scientific analysis
	2.12.18 Weight measurement principles
	2.12.19 Instrument calibration methods
UEENEEI010B Set-up and adjust process control loops	2.12.11.1 Industrial processes
UEENEEI011B Find and rectify faults in process control valve and associated equipment	2.12.7 Control valve principles
	2.12.8 Control valve selection
	2.12.9 Actuators and positioners
UEENEEI012B Verify compliance and functionality of process control installations	2.12.21 Control system installation, testing and verification methods
UEENEEI013B Select equipment for process control systems	2.5.10 Technical manuals and catalogues
	2.5.15 Measurement standards applicable to

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	process instrumentation
	2.12.12 Distributive control principles (DCS)
	2.12.13 Instrumentation and control communications
	2.12.14 Indicators and methods of recording process data
	2.12.20.1 Process equipment installation requirements and techniques
	2.12.20.2 Process control arrangements and equipment selection
UEENEEI014B Find and rectify faults in process control systems	2.2.3 Fault finding techniques
	2.3.3 Process control principles
	2.12.6 Process control systems
UEENEEI015B Find and rectify faults in medical equipment control systems	2.12.22.1 Medical equipment principles
	2.12.22.2 Medical equipment, anatomy and physiology and infection control
	2.18.7 Instrumentation safe working practices
	2.18.10 Medical equipment safe working practices
UEENEEI016A Reserved	Reserved
UEENEEI017B Calibrate and test measuring instruments	2.5.16 Measurement standards applicable to scientific instruments
	2.9.14 Fundamentals of calibration
	2.12.24 Calibration techniques
	2.18.1 Occupational Health and Safety principles
	2.18.7 Instrumentation safe working practices
UEENEEI018A	Reserved

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEI019B Set up field control devices	2.1.4 Basic cable and conductor terminations
	2.3.4 Pneumatic/hydraulic control tubing/piping
	2.5.14 Technical standards, regulations and codes applicable to instrumentation and control
	2.12.23 Transducers and sensing devices
	2.18.7 Instrumentation safe working practices
UEENEEI020B Provide solution to problems in basic industrial control systems	2.12.6 Process control systems
	2.18.1 Occupational Health and Safety principles
UEENEEI021B Find and repair faults in measuring and analysis systems	2.9.13 Measurement circuits and applications
	2.12.15 Gas analysis
	2.12.16 Water analysis
	2.12.17 Scientific analysis
	2.12.18 Weight measurement principles
UEENEEI022B Assist in commissioning process control systems	2.12.11.2 Process control, commissioning
UEENEEI023B Design electronic control systems	2.3.21 Complex Control Systems
UEENEEI024A	Reserved
UEENEEI025B Provide solutions to fluid circuit operations	2.21.13 Fluid power control
UEENEEI026B Provide solutions to pneumatic/hydraulic system operations	2.21.11 Pneumatics
	2.21.12 Hydraulics
UEENEEI027B Analyse complex electronic circuits controlling fluids	2.21.7 Electronic control of fluid processes

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEI028B Set up controls on complex fluid systems	2.21.5 Single-stage fluid mechanics
UEENEEI029B Set up electronically controlled mechanically operated complex systems	2.21.6 Electronic interfacing to mechanical processes
UEENEEI030B Set up electronically controlled robotically operated complex systems	2.18.1 Occupational Health and Safety principles
	2.21.8 Electronic interfacing to robotic processes
UEENEEI031A	Reserved
UEENEEI032A	Reserved
UEENEEI033A	Reserved
UEENEEI034B Manage control projects	2.2.17 Project management
	2.2.19 Customer/Client relations
	2.2.30 Control systems industry sector customs and practices
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEI035B Plan control projects	2.2.16.1 Project Planning
	2.2.18 Critical path and project analysis
	2.2.30 Control systems industry sector customs and practices
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEI036B Manage automated systems projects	2.2.17 Project management
	2.2.19 Customer/Client relations
	2.2.26 Automated systems industry sector customs and practices
	2.18.1 Occupational Health and Safety principles
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEI037B Plan automated systems projects	2.2.16.1 Project Planning
	2.2.18 Critical path and project analysis
	2.2.26 Automated systems industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities

J - Refrigeration and Air conditioning units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEJ001A	Reserved
UEENEEJ002B Prepare refrigeration tubing and fittings	2.11.13.1 Brazing and soldering equipment and techniques
	2.11.14 Piping and tubing techniques
	2.18.1 Occupational Health and Safety principles
UEENEEJ003B Determine the basic operating conditions of	2.11.9.1 Basic refrigeration testing and measuring field devices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
vapour compression systems	2.11.9.2 Fitting and removing refrigeration service gauges
	2.15.1 Refrigeration compressors
	2.15.2 Condensers
	2.15.3 Evaporators
	2.15.4.3 Refrigerant Metering Devices
	2.17.1.1 Refrigeration fundamentals
	2.17.1.2 Basic refrigeration system operating conditions
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ004B Determine the basic operating conditions of air conditioning systems	2.11.10.1 Basic air conditioning measurement devices
	2.17.4 Air conditioning fundamentals
	2.18.1 Occupational Health and Safety principles
UEENEEJ005B Position, assemble and start up split air conditioning systems	2.16.6 Split air conditioning system installation
	2.18.1 Occupational Health and Safety principles
	2.18.3.2 Split air conditioning safe working practices
	2.20.1 Sustainable energy principles
	2.20.2 Environmental and building regulation
UEENEEJ006B Install pipework for refrigeration and air conditioning systems	2.3.5.1 Refrigerant pressure sensing controls
	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.15.1.4 Flow controls
	2.16.1 Refrigeration pipework and accessories

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.16.2 Refrigeration pipework layout
	2.16.3 Refrigeration installations, equipment requirements
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
	2.20.1 Sustainable energy principles
	2.20.2 Environmental and building regulation
UEENEEJ007B Install refrigeration and air conditioning systems, major components and associated equipment	2.3.5.2 Refrigeration system control
	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.15.6 Fans and air distribution
	2.15.24 Cool rooms/freezer rooms systems
	2.15.25 Package air conditioning systems
	2.15.26 Merchandising and display cabinets
	2.15.27 Cooling towers, evaporative condensers, evaporative coolers and associated equipment
	2.15.28 Residential air conditioning
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ008B Recover, pressure and leak test, evacuate and charge refrigerants	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.11.9.3 Replacement of basic components on a refrigeration system

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.17.2.1 Refrigerants
	2.17.2.4 High pressure refrigerants
	2.17.2.5 Natural refrigerants
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ009B Verify compliance and functionality of refrigeration and air conditioning installations	2.16.5 Refrigeration and air conditioning installations, testing and verification methods
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ010B Select refrigeration pipe/tube, accessories and associated controls	2.2.1 Enterprise communication methods
	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.15.4.2 Refrigerant control selection
	2.16.1 Refrigeration pipework and accessories
	2.16.2 Refrigeration pipework layout
	2.16.3 Refrigeration installations, equipment requirements
	2.16.4 Refrigeration pipe selection and sizing
	2.17.3.1 Refrigeration systems capacity control
	2.18.1 Occupational Health and Safety principles
UEENEEJ011B Diagnose and rectify faults in refrigeration and	2.15.9.1 Appliance refrigeration systems
	2.15.29 Servicing refrigeration and air

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
air conditioning systems and components	conditioning systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ012B Diagnose and rectify faults in complex refrigeration/air conditioning systems	2.3.5 Refrigeration system controls
	2.3.6 Air conditioning system controls
	2.17.13 Refrigeration system analysis
	2.2.3 Fault finding techniques
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ013B Commission refrigeration and air conditioning systems	2.2 Enterprise communication methods
	2.11.10.2 Air conditioning testing devices
	2.15.30 Commissioning refrigeration and air conditioning systems
	2.16.17 Retrofitting refrigeration systems
	2.17.3 Refrigeration systems and compressor operations
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ014B Solve problems in hydronic systems	2.17.6 Hydronic systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	working practices
UEENEEJ015B Solve problems in beverage dispensers	2.17.7 Beverage dispensers
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ016B Solve problems in transport refrigeration systems	2.17.8 Transport refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ017B Solve problems in Ultra-low temperature refrigeration systems	2.17.9 Ultra-low temperature refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ018B Solve problems in post mix refrigeration systems	2.17.10.1 Post mix refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ019B Solve problems in ice making systems	2.17.11 Ice making systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ020B Solve problems in industrial refrigeration systems	2.17.12 Industrial refrigeration systems
	2.18.1 Occupational Health and Safety

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ021B Monitor and adjust energy management systems on refrigeration systems	2.15.16 Energy management systems for commercial refrigeration
	2.18.1 Occupational Health and Safety principles
UEENEEJ022B Diagnose faults in complex refrigeration or HVAC control systems	2.15.17 Refrigeration/HVAC direct digital controls
	2.15.18 Refrigeration/HVAC pneumatic controls
	2.18.1 Occupational Health and Safety principles
UEENEEJ023B Commission complex heating, ventilation and air conditioning (HVAC) systems	2.15.19 HVAC air systems
	2.16.9 Commissioning - HVAC system
	2.18.1 Occupational Health and Safety principles
UEENEEJ024B Commission hydronic systems for refrigeration and/or air conditioning	2.15.20 HVAC hydronic systems
	2.16.9 Commissioning - HVAC system
	2.18.1 Occupational Health and Safety principles
UEENEEJ025B Commission complex refrigeration systems	2.16.9 Commissioning - HVAC system
	2.16.10 Commissioning commercial/industrial refrigeration systems
	2.18.1 Occupational Health and Safety principles
UEENEEJ026B Commission complex control systems for refrigeration/air conditioning	2.15.21 Refrigeration/HVAC electronic controls
	2.16.9 Commissioning - HVAC system
	2.18.1 Occupational Health and Safety

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles
UEENEEJ027B Determine thermodynamic parameters of refrigeration and air conditioning systems	2.17.14.1 Refrigeration engineering mathematics fundamentals
	2.17.15 Refrigeration science
	2.18.1 Occupational Health and Safety principles
UEENEEJ028B Produce HVAC/R drawings	2.16.11 Air conditioning drawing
	2.18.1 Occupational Health and Safety principles
UEENEEJ029B Determine the heat loads for commercial refrigeration and air conditioning applications	2.17.16 Heat load estimating of commercial refrigeration
	2.17.17.1 HVAC load estimating fundamentals
	2.18.1 Occupational Health and Safety principles
UEENEEJ030B Produce HVAC/R control system diagrams	2.15.15 HVAC control system fundamentals
	2.18.1 Occupational Health and Safety principles
UEENEEJ031B Provide solutions to vibration problems in HVAC/R system design	2.17.20 Materials strength fundamentals
	2.17.21.1 Noise and vibration control fundamentals
	2.18.1 Occupational health and safety principles
UEENEEJ032B Design commercial refrigeration systems	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.16.16 Refrigeration System Components and Piping
	2.17.22 Refrigeration and food storage technology
	2.18.1 Occupational health and safety principles
UEENEEJ033B Design industrial	2.5.6 Technical standards, regulations and codes

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
refrigeration systems	for refrigeration and air conditioning
	2.16.16 Refrigeration System Components and Piping
	2.17.22 Refrigeration and food storage technology
	2.17.23.1 Industrial refrigeration systems design fundamentals
	2.18.1 Occupational Health and Safety principles
UEENEEJ034B Design heating, ventilation and air conditioning (HVAC) systems	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.16.16 Refrigeration System Components and Piping
	2.17.24 Commercial air conditioning systems design
	2.18.1 Occupational Health and Safety principles
UEENEEJ035B Design control systems for a heating, ventilation, air conditioning or refrigeration system	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.15.17 Refrigeration/HVAC direct digital controls
	2.15.18 Refrigeration/HVAC pneumatic controls
	2.18.1 Occupational Health and Safety principles
UEENEEJ036B Evaluate and report on energy management	2.16.12 Energy management
	2.16.13 Building management systems
	2.18.1 Occupational Health and Safety principles
UEENEEJ037B Evaluate and	2.16.14 Management of indoor air quality

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
report on air quality in buildings	2.18.1 Occupational Health and Safety principles
UEENEEJ038B Analyse noise and vibration in refrigeration and air conditioning systems	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.17.18.2 Thermodynamics
	2.17.21.1 Noise and vibration parameters and requirements
	2.17.21.2 Single-stage noise and vibration control
	2.17.25 Statics
	2.18.1 Occupational health and safety principles
UEENEEJ039B Develop specifications and prepare drawings for HVAC/R project	2.2.11.2 Specification development
	2.16.15 Computer aided drafting
	2.18.1 Occupational Health and Safety principles
UEENEEJ040B Manage refrigeration and air conditioning projects	2.2.17 Project management
	2.2.19 Customer/Client relations
	2.2.31 Refrigeration and air conditioning industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEJ041B Design complex commercial refrigeration systems	2.17.26 Commercial refrigeration system design
	2.18.1 Occupational Health and Safety principles
UEENEEJ042B Design complex industrial refrigeration systems	2.17. 23.2 Industrial refrigeration system design
	2.18.1 Occupational Health and Safety principles
UEENEEJ043B Design complex	2.17.17.2 HVAC load estimating

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
air conditioning systems	2.17.27 Air conditioning system design
	2.17.28 Psychrometrics - Single-stage
	2.18.1 Occupational Health and Safety principles
UEENEEJ044B Design mechanical ventilation/exhaust systems	2.17.29 Exhaust systems design
	2.18.1 Occupational Health and Safety principles
UEENEEJ045B Design hydronic systems	2.15.20 HVAC hydronic systems
	2.17.30 Heating systems design
	2.17.31 Hydronic system design
	2.18.1 Occupational Health and Safety principles
UEENEEJ046B Design complex control systems for a heating, ventilation, air conditioning or refrigeration system	2.15.17 Refrigeration/HVAC direct digital controls
	2.15.18 Refrigeration/HVAC pneumatic controls
	2.18.1 Occupational Health and Safety principles
UEENEEJ047B Audit energy use for commercial HVAC/R systems	2.16.12.2 Energy management
	2.18.1 Occupational Health and Safety principles
UEENEEJ048B Audit HVAC/R control systems for compliance with standards and regulations	2.15.22 HVAC control systems
	2.16.5 Refrigeration and air conditioning installations, testing and verification methods
	2.16.13 Building management systems
	2.18.1 Occupational Health and Safety principles
UEENEEJ049B Develop	2.17.18.2 Thermodynamics

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
specifications for heat exchanger design	2.17.18.3 Heater exchanger designs
	2.18.1 Occupational Health and Safety principles
UEENEEJ050B Evaluate alternative and new technologies applicable to electrotechnology applications	2.17.32 Sources of technical development and processes for their adoption
	2.18.1 Occupational Health and Safety principles
UEENEEJ051B Service small appliances and power tools	2.6.25 Hand power tools repairs
	2.15.7 Small appliance repair
	2.18.1 Occupational Health and Safety principles
	2.18.13 Appliance servicing safe working practices
UEENEEJ052B Carry out repairs to appliance refrigeration systems	2.15.8 Appliance refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
	2.18.13 Appliance servicing safe working practices
UEENEEJ053B Find and rectify faults in appliance motors and associated controls	2.6.1 Protection devices and applications
	2.6.26 Appliance motors and circuits
	2.11.5 Basic electrical testing and measuring devices and techniques
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ054B Find and rectify	2.3.15 Appliances, electronic controls and

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
faults in appliance control devices and systems	communications basics
	2.11.9.4 Appliance diagnostic tools
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
	2.18.13 Appliance servicing safe working practices
UEENEEJ055B Service refrigerated appliances	2.15.8 Domestic appliance principles
	2.15.9.1 Appliance refrigeration systems
	2.15.9.2 Capillary systems
	2.15.9.3 Retrofitting domestic refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
	2.18.13 Appliance servicing safe working practices
UEENEEJ056B Service clothes washers and dryers	2.15.8 Domestic appliance principles
	2.15.10 Clothes washers and dryers
	2.18.1 Occupational health and safety principles
	2.18.13 Appliance servicing safe working practices
UEENEEJ057B Service electric heating appliances	2.6.27.1 Electric heating appliances
	2.18.1 Occupational health and safety principles
	2.18.13 Appliance servicing safe working practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEJ058B Service dish washing machines	2.15.11 Dish washing machines
	2.18.1 Occupational health and safety principles
	2.18.13 Appliance servicing safe working practices
UEENEEJ059B Service gas appliances	2.15.12 Gas cooking appliances
	2.18.1 Occupational health and safety principles
	2.18.13 Appliance servicing safe working practices
	2.17.4 Air conditioning fundamentals
	2.18.1 Occupational health and safety principles
	2.18.3.2 Split air conditioning systems safe working practices
	2.18.13 Appliance servicing safe working practices
UEENEEJ061B Verify compliance and functionality of appliances	2.15.14 Appliance, testing and compliance verification methods
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
	2.18.13 Appliance servicing safe working practice
UEENEEJ062C Recover, pressure and leak test, evacuate and charge refrigerants appliance	2.11.9.1 Basic refrigeration testing and measuring field devices
	2.11.9.2 Fitting and removing refrigeration service gauges
	2.17.1.1 Refrigeration fundamentals
	2.17.2.3 Appliance refrigerants

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ063B Analyse the psychrometric performance of HVAC/R systems	2.17.33 Refrigeration systems
	2.17.34 Air conditioning systems
	2.17.35 Applied psychrometrics
	2.18.1 Occupational Health and Safety principles
UEENEEJ064B Analyse the operation of HVAC/R systems	2.15.19 HVAC air systems
	2.15.20 HVAC hydronic systems
	2.16.16 Refrigeration System Components and Piping
	2.17.36 Ventilation systems
	2.18.1 Occupational Health and Safety principles
UEENEEJ065B Evaluate fluid and thermodynamic parameters of refrigeration systems	2.17.14.2 Refrigeration engineering Single-stage mathematics
	2.17.18.1 Thermodynamics fundamentals
	2.17.19 Fluid mechanics fundamentals
	2.18.1 Occupational Health and Safety principles
UEENEEJ066B Solve problems in dairy refrigeration systems	2.17.10.2 Dairy refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ067B Solve problems in	2.17.5 Central plant air conditioning systems

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
central plant air conditioning systems	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ068B Maintain microbial control of air and water systems	2.13.8 Scheduled maintenance processors
	2.15.23 Microbial control fundamentals
	2.18.1 Occupational Health and Safety Principles
UEENEEJ069B Plan Refrigeration and air conditioning projects	2.2.16.1 Project Planning
	2.2.18 Critical path and project analysis
	2.2.31 Refrigeration and air conditioning industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEJ070B Diagnose and rectify faults in refrigeration and air conditioning control systems	2.2.1 Enterprise communication methods
	2.2.3 Fault finding techniques
	2.3.5 Refrigeration system controls
	2.3.6 Air conditioning system controls
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical safe working practices
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ071B Solve problems in refrigerated beverage vending cabinets	2.17.37 Beverage vending cabinets
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEJ072B Recover, pressure and leak test, evacuate and charge refrigerants — split air conditioning systems	2.11.9.1 Basic refrigeration testing and measuring field devices
	2.11.9.2 Fitting and removing refrigeration service gauges
	2.17.1.1 Refrigeration fundamentals
	2.17.2.2 Split air conditioning refrigerants
	2.18.1 Occupational Health and Safety principles
	2.18.3.2 Split air conditioning systems safe working practices
UEENEEJ073B Service microwave ovens	2.6.27.2 Microwave ovens
	2.18.1 Occupational health and safety principles
	2.18.13 Appliance servicing safe working practices
UEENEEJ074A Apply safety awareness and legal requirements for hydrocarbon refrigerants	2.18.3.3 Safe working practices with hydrocarbon refrigerants
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices
UEENEEJ075A Service and Repair Hydrocarbon Refrigeration Systems	2.17.40.1 Servicing and repair techniques for hydrocarbon refrigeration Systems
	2.17.40.2 Operating conditions for hydrocarbon refrigeration systems
	2.17.40.3 Hydrocarbon refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEJ076A Install and commission hydrocarbon refrigeration systems, major components and associated equipment	2.16.19.1 Installation techniques for hydrocarbon refrigeration Systems
	2.16.19.2 Commissioning Hydrocarbon refrigeration systems
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe Working Practices
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices
UEENEEJ077A Design Hydrocarbon refrigeration systems	2.17.40.4 Technical standards, regulations and codes for hydrocarbon refrigeration systems
	2.17.40.5 Hydrocarbon refrigeration design requirements
	2.17.40.6 Hydrocarbon refrigeration system components and piping
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ078A Apply safety awareness in using Ammonia as a refrigerant	2.18.3.5 Safe working practices with Ammonia refrigerant
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices
UEENEEJ079A Service and Repair Ammonia Refrigeration Systems	2.17.38.1 Servicing and repair techniques for Ammonia Refrigeration systems
	2.17.38.2 Operating conditions of Ammonia Refrigeration Systems

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.17.38.3 Ammonia Refrigeration Systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ080A Install and Commission Ammonia Refrigeration Systems	2.16.20.1 Installation techniques for Ammonia refrigeration Systems
	2.16.20.2 Commissioning Ammonia Refrigeration Systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices
UEENEEJ081A Design ammonia refrigeration systems	2.17.38.4 Technical standards, regulations and codes for ammonia refrigeration systems
	2.17.38.5 Ammonia refrigeration systems design requirements
	2.17.38.6 Ammonia refrigeration system components and piping
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ082A Service and repair secondary refrigeration systems	2.17.41.1 Service and repair secondary refrigeration systems
	2.17.41.2 Components of secondary refrigeration systems
	2.17.41.3 Maintenance procedures for secondary refrigeration systems
	2.18.1 Occupational Health and Safety principles

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ083A Design secondary refrigeration systems	2.17.41.4 Technical standards, regulations and codes for secondary refrigeration systems 2.17.41.5 Secondary refrigeration system design requirements 2.17.41.6 Secondary refrigeration system components and piping 2.18.1 Occupational Health and Safety principles 2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ084A Apply safety awareness in using carbon dioxide as a refrigerant	2.18.3.4 Safe working practices with carbon dioxide refrigerant
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices
UEENEEJ085A Service and Repair Carbon Dioxide Refrigeration Systems	2.17.39.3 Servicing and repair techniques for Sub-Critical carbon dioxide refrigeration Systems
	2.17.39.1 Operating conditions of Sub-Critical carbon dioxide Refrigeration Systems
	2.17.39.2 Sub- Critical Carbon Dioxide Refrigeration Systems
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices
UEENEEJ086A Install and Commission Carbon Dioxide Refrigeration Systems	2.17.39.1 Operating conditions of Sub-Critical carbon dioxide Refrigeration Systems
	2.17.39.2 Sub- Critical Carbon Dioxide Refrigeration Systems

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.16.18.1 Installation and commissioning procedures for Carbon Dioxide refrigeration systems
	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning
	2.18.1 Occupational Health and Safety principles
	2.18.3.1 Refrigeration and Air Conditioning Safe working Practices
UEENEEJ087A Design complex carbon dioxide refrigeration systems	2.17.39.4 Technical standards, regulations and codes for carbon dioxide refrigeration systems 2.17.39.5 Carbon dioxide refrigeration system design requirements 2.17.39.6 Carbon dioxide refrigeration system components and piping 2.18.1 Occupational Health and Safety principles 2.18.3.1 Refrigeration and air conditioning safe working practices
UEENEEJ088A Service and Repair Self Contained Carbon Dioxide Refrigeration and Heat Pump Systems	2.17.39.7 Trans-Critical Carbon Dioxide Refrigeration and Heat Pump Systems
UEENEEJ089A Service room air conditioners	2.15.13 Room air conditioners
	2.17.4 Air conditioning fundamentals
	2.18.1 Occupational health and safety principles
	2.18.3.2 Split air conditioning systems safe working practices
	2.18.13 Appliance servicing safe working practices
UEENEEJ090A Select basic commercial refrigeration system equipment and components	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning 2.17.43 Refrigeration system components &

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	piping selection
UEENEEJ091A Select residential air conditioning system equipment and components	2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning 2.17.42 Air Conditioning Systems Equipment and Component Selection

K - Renewable sustainable units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEK001B Maintain safety and tidiness of remote area power supply (RAPS) systems	2.13.1 RAPS plant area cleaning
	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working practices
UEENEEK002B Work safely in remote area power supply (RAPS) systems	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working practices
UEENEEK003B Conduct periodic maintenance of remote area power supply (RAPS) battery banks	2.13.2 RAPS systems battery bank maintenance techniques
	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working practices
UEENEEK004B Conduct periodic maintenance of remote area power supply (RAPS) generator sets	2.13.3 RAPS systems generator sets maintenance techniques
	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working

	practices
UEENEEK005B Conduct periodic maintenance of remote area power supply (RAPS) photo voltaic arrays	2.13.4 RAPS systems photo voltaic array maintenance techniques
	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote Area Power Supply safe working practices
UEENEEK006B Conduct periodic maintenance of remote area power supply (RAPS) wind generators	2.13.5 RAPS systems wind generator maintenance techniques
	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote Area Power Supply safe working practices
UEENEEK007B Conduct checks in the demand side use of remote area power supplies	2.13.7 RAPS systems maintenance scheduling
	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote Area Power Supply safe working practices
UEENEEK008B Plan periodic maintenance schedules of remote area power supplies	2.13.1 RAPS plant area cleaning
	2.13.2 RAPS system battery bank maintenance techniques
	2.13.4 RAPS systems photo voltaic array maintenance techniques
	2.13.7 RAPS system maintenance scheduling
	2.13.8 Scheduled maintenance processors
	2.18.1 Occupational Health and Safety principles
	2.20.3 Introduction to renewable energy technologies
	2.20.5 Remote area essential services facilities
UEENEEK009B Attend to	2.13.1 RAPS plant area cleaning

breakdowns in remote area power supplies	2.13.2 RAPS system battery bank maintenance techniques
	2.13.4 RAPS systems photo voltaic array maintenance techniques
	2.18.1 Occupational Health and Safety principles
	2.20.3 Introduction to renewable energy technologies
	2.20.5 Remote area essential services facilities
UEENEEK010B Co-ordinate maintenance of renewable energy apparatus and systems	2.13.1 RAPS plant area cleaning
	2.13.2 RAPS system battery bank maintenance techniques
	2.13.4 RAPS systems photo voltaic array maintenance techniques
	2.18.1 Occupational Health and Safety principles
	2.20.3 Introduction to renewable energy technologies
UEENEEK011B Assemble and connect remote area power supplies (RAPS)	2.20.5 Remote area essential services facilities
	2.13.2 RAPS Systems battery bank maintenance techniques
	2.18.1 Occupational Health and Safety principles
	2.20.3 Introduction to renewable energy technologies
	2.20.5 Remote area essential services facilities
UEENEEK012B Provide basic sustainable energy solutions for energy reduction in domestic premises	2.20.6 Remote area essential services power plant
	2.8.1.2 Fundamental electrical principles
	2.8.2.1 Direct current circuit principles
	2.18.1 Occupational Health and Safety

	principles
	2.20.3 Introduction to renewable energy technologies
UEENEEK013B Apply sustainable energy practice in daily activities	2.18.1 Occupational Health and Safety principles
	2.20.3 Introduction to renewable energy technologies
	2.20.4 Greenhouse reduction strategies
UEENEEK014B Promote sustainable energy practice in the community	2.18.1 Occupational Health and Safety principles
	2.20.3 Introduction to renewable energy technologies
	2.20.4 Greenhouse reduction strategies
UEENEEK016A Maintain and repair remote area power generation facilities	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working practices
	2.20.28 Minor maintenance of generating plant
UEENEEK017B Maintain and repair facilities associated with remote area essential service operations	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working practices
	2.20.5 Remote area essential services facilities
UEENEEK020B Maintain operation of remote area power plant	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working practices
	2.20.6 Remote area essential services power plant
UEENEEK021B Manage renewable energy projects	2.2.17 Project management
	2.2.19 Customer/Client relations

	2.2.32 Renewable energy industry sector customs and practices
	2.18.8.2 Occupational Health and Safety, enterprise responsibilities
UEENEEK022B Plan renewable energy projects	2.2.16.1 Project planning
	2.2.18.2 Critical path and project analysis
	2.2.32 Renewable energy industry sector customs and practices
	2.18.8.8 Occupational Health and Safety, enterprise responsibilities
UEENEEK023B Carry out basic repairs to renewable energy apparatus by replacement of components	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical safe working practices
	2.20.3 Introduction to renewable energy technologies
UEENEEK025C Solve basic problems in photovoltaic energy apparatus	2.20.14 Photovoltaic power systems
UEENEEK026C Install and set up grid connected photovoltaic power systems	2.20.19 Grid connected inverters
UEENEEK027B Diagnose faults in renewable energy control systems	2.2.3 Fault finding techniques
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.20.15 Renewable energy system electronics
UEENEEK028B Solve problems in stand-alone renewable energy systems	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.20.9.1 Stand alone renewable energy system components

UEENEEK029B Design renewable energy heating systems	2.17.18.2 Thermodynamics
	2.18.1 Occupational Health and Safety principles
	2.20.18 Solar water heating systems
	2.20.20 Renewable energy heating
UEENEEK030B Solve problems in wind energy conversion systems	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.20.16.1 Types, construction and operating features of small WECS
UEENEEK031B Design wind energy conversion systems rated to 10 kW.	2.18.1 Occupational Health and Safety principles
	2.20.16.2 Installation and maintenance of small WECS
	2.20.16.3 WECS siting and performance assessment
UEENEEK032B Develop strategies to address sustainability issues	2.18.1 Occupational Health and Safety principles
	2.20.11 Sustainability and greenhouse reduction strategies
UEENEEK033B Design set up hybrid power systems	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.20.10 Hybrid Energy Systems
UEENEEK034B Install standalone photovoltaic power systems	2.5.5 Technical standards, regulations and codes for extra-low voltage work
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practice
	2.20.9.1 Stand-alone RE system components

	2.20.13 Photovoltaic installations
	2.20.14 Photovoltaic power systems
UEENEEK035C Design grid connected power supply systems	2.5.2.1 Technical standards, regulations and codes for general electrical installations
	2.5.12 Electricity distributors, supply requirements
	2.6.2.2 Electrical metering arrangements
	2.20.14.1 Photovoltaic power systems (design)
	2.20.19 Grid connected inverters
UEENEEK036B Prepare grid connected photovoltaic power systems for LV connection	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practice
	2.20.19 Grid connected inverters
UEENEEK037B Install and set up micro-hydro systems	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.20.17.1 Micro-hydro systems installation and maintenance processes
UEENEEK038B Design micro-hydro systems	2.18.1 Occupational Health and Safety principles
	2.20.17.1 Micro-hydro systems installation and maintenance processes
	2.20.17.2 Micro-hydro systems
UEENEEK039B Design stand-alone renewable energy systems	2.18.1 Occupational Health and Safety principles
	2.20.9.2 Stand-alone renewable energy system design consideration
UEENEEK040B Develop engineering solution to renewable energy problems	2.17.18.1 Thermodynamics fundamentals
	2.18.1 Occupational Health and Safety principles

	2.20.21 Distributed generation
UEENEEK042A Participate in environmentally sustainable work practices	2.18.1 Occupational Health and Safety principles
	2.20.22 Environmentally sustainable work practice
UEENEEK043A Install small wind energy conversion systems for stand-alone applications	2.5.5 Technical standards, regulations and codes for extra-low voltage work
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practice
	2.20.16.1 Types, construction features and operating characteristics of small WECS
	2.20.16.2 Installation and maintenance of small WECS
	2.20.16.3 WECS siting and performance assessment
UEENEEK044A Reserved	
UEENEEK045A Implement & monitor, policies & procedures for environmentally sustainable electrotech work practice	2.20.23 Environmentally sustainable work practice, supervisory responsibilities
UEENEEK046A Design energy management controls for electrical installations in buildings	2.16.13 Building management systems
	2.18.1 Occupational Health and Safety principles
	2.20.12 Energy efficient building design
UEENEEK047A Maintain and monitor remote area essential service operations	2.18.1 Occupational Health and Safety principles
	2.18.4 Remote area power supply safe working practices
	2.20.26 Power station and compound maintenance
	2.20.27 Power Station instrument/meter reading

	and maintenance scheduling
UEENEEK048A Install, configure and commission grid connected photovoltaic power systems	2.20.13 Photovoltaic installations
	2.20.19 Grid connected inverters
UEENEEK049A Verify functionality and compliance of renewable energy installations	2.20.25 RE installations, ELV installation requirements
UEENEEK050A Assemble and set up photovoltaic apparatus in a domestic dwellings	2.20.13 Photovoltaic installations
UEENEEK051A Develop effective strategies for energy reduction in buildings	2.16.13 Building management systems
	2.18.1 Occupational Health and Safety principles
	2.20.12 Energy efficient building design

M - Hazardous areas units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEM019A Attend to breakdowns in hazardous areas - coal mining	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM020A Attend to breakdowns in hazardous areas - gas atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM021A Attend to breakdowns in hazardous areas - dust atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM022A Attend to breakdowns in hazardous areas - pressurisation	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM023A Install explosion-protected equipment and wiring systems — coal mining	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM024A Install explosion-protected equipment and wiring systems— gas atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM025A Install explosion-protected equipment and wiring systems — dust atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM026A Install explosion-protected equipment and wiring systems — pressurisation	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM027A Maintain equipment in hazardous areas — coal mining	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM028A Maintain equipment in hazardous areas — gas atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM029A Maintain equipment in hazardous areas — dust atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM030A Maintain equipment in hazardous areas — pressurisation	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
UEENEEM031A Overhaul and repair explosion-protected equipment — coal mining	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.13.1 Explosion protected equipment overhaul and repair — General requirements
	2.22.13.2 Explosion protected equipment overhaul and repair — Overhaul and repair requirements specific to each explosion-protection technique
UEENEEM032A Overhaul and repair explosion-protected equipment — flameproof enclosures	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	explosion-protection techniques
	2.22.13.1 Explosion protected equipment overhaul and repair — General requirements
	2.22.13.2 Explosion protected equipment overhaul and repair — Overhaul and repair requirements specific to each explosion-protection technique
UEENEEM033A Overhaul and repair explosion-protected equipment — gas atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.13.1 Explosion protected equipment overhaul and repair — General requirements
	2.22.13.2 Explosion protected equipment overhaul and repair — Overhaul and repair requirements specific to each explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEM034A Overhaul and repair explosion-protected equipment — dust atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.13.1 Explosion protected equipment overhaul and repair — General requirements
	2.22.13.2 Explosion protected equipment overhaul and repair — Overhaul and repair requirements specific to each explosion-protection technique
UEENEEM035A Conduct a conformity assessment of explosion-protected equipment — coal mining	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.30.1 Conformity assessment of explosion-protected equipment — Documentation
	2.22.30.2 Conformity assessment of explosion-protected equipment — Conformity assessment processes
UEENEEM036A Conduct a conformity assessment of explosion-protected equipment — gas atmospheres	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.30.1 Conformity assessment of explosion-protected equipment — Documentation
	2.22.30.2 Conformity assessment of explosion-protected equipment — Conformity assessment processes
UEENEEM037A Conduct a conformity assessment of explosion-protected equipment — dust atmospheres	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.30.1 Conformity assessment of explosion-protected equipment — Documentation
	2.22.30.2 Conformity assessment of explosion-protected equipment — Conformity assessment processes

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEM038A Conduct testing of hazardous area installations — coal mining	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.22 Hazardous areas installation testing
UEENEEM039A Conduct testing of hazardous area installations — gas atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.22 Hazardous areas installation testing
UEENEEM040A Conduct testing of hazardous area installations — dust atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.22 Hazardous areas installation testing
UEENEEM041A Conduct testing of hazardous area installations — pressurisation	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.22 Hazardous areas installation testing
UEENEEM042A Conduct close visual inspection of existing	2.22.18 Hazardous areas close visual inspection requirements

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
hazardous areas installations	
UEENEEM043A Conduct detailed inspection of hazardous areas installations — coal mining	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.12 Hazardous areas detailed inspection techniques
UEENEEM044A Conduct detailed inspection of hazardous areas installations — gas atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’)

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.12 Hazardous areas detailed inspection techniques
UEENEEM045A Conduct detailed inspection of hazardous areas installations — dust atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p')

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.12 Hazardous areas detailed inspection techniques
UEENEEM046A Conduct detailed inspection of hazardous areas installations — pressurisation	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques
	2.22.12 Hazardous areas detailed inspection techniques
UEENEEM047A Develop and manage maintenance programs for hazardous areas electrical equipment — coal mining	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.19 Hazardous areas management
UEENEEM048A Develop and manage maintenance programs for hazardous areas electrical	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
equipment — gas atmospheres	technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.19 Hazardous areas management
UEENEEM049A Develop and manage maintenance programs for hazardous areas electrical equipment — dust atmospheres	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.19 Hazardous areas management
UEENEEM050A Develop and manage maintenance programs for hazardous areas electrical equipment — pressurisation	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.19 Hazardous areas management
UEENEEM051A Manage compliance of hazardous areas	2.22.1 Hazardous areas and explosion-protection principles
	2.22.19 Hazardous areas management
UEENEEM052A Classify hazardous areas — gases	2.22.1 Hazardous areas and explosion-protection principles
	2.22.17 Hazardous areas classification techniques
UEENEEM053A Classify hazardous areas — dusts	2.22.1 Hazardous areas and explosion-protection principles

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.17 Hazardous areas classification techniques
UEENEEM054A Plan electrical installations in hazardous areas — gas atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.15 Hazardous areas installation planning
	2.22.16 Common classified hazardous areas
UEENEEM055A Plan electrical installations in hazardous areas — dust atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment —

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.15 Hazardous areas installation planning
	2.22.16 Common classified hazardous areas
UEENEEM056A Plan electrical installations in hazardous areas — pressurisation	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.15 Hazardous areas installation planning
	2.22.16 Common classified hazardous areas
UEENEEM057A Design explosion-protected electrical systems — gas atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i')

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.15 Hazardous areas installation planning
	2.22.16 Common classified hazardous areas
	2.22.20 Explosion-protected electrical systems design
UEENEEM058A Design explosion-protected electrical systems — dust atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.15 Hazardous areas installation planning
	2.22.16 Common classified hazardous areas
	2.22.20 Explosion-protected electrical systems design
UEENEEM059A Design explosion-protected electrical systems — pressurisation	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.15 Hazardous areas installation planning

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.16 Common classified hazardous areas
	2.22.20 Explosion-protected electrical systems design
UEENEEM060A Carry out overhaul and repair of explosion-protected equipment — Coal mining	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM061A Carry out overhaul and repair of explosion-protected equipment — flameproof enclosures	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM062A Carry out overhaul and repair of explosion-protected equipment — gas atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM063A Carry out overhaul and repair of explosion-protected equipment — dust atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
UEENEEM064A Conduct audit of hazardous areas installations — coal mining	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.10.1 Hazardous areas installation requirements
	2.22.32 Hazardous areas auditing processes
UEENEEM065A Conduct audit of hazardous areas installations — gas atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.32 Hazardous areas auditing processes
UEENEEM066A Conduct audit of hazardous areas installations — dust atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i') explosion-protection technique
	2.22.7 Pressurization (Ex'p') explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.32 Hazardous areas auditing processes
UEENEEM067A Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — coal mining	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.5 Non-sparking (Ex'n') explosion-protection technique

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.12 Hazardous areas detailed inspection techniques
	2.22.18 Hazardous areas visual inspection requirements
	2.22.30.1 Conformity assessment of explosion-protected equipment — Documentation
	2.22.30.2 Conformity assessment of explosion-protected equipment — Conformity assessment processes
	2.22.31 Fitness-for-purpose of equipment for use in a hazardous area
	2.22.32 Hazardous areas auditing processes
UEENEEM068A Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — gas atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.12 Hazardous areas detailed inspection techniques
	2.22.18 Hazardous areas visual inspection requirements
	2.22.30.1 Conformity assessment of explosion-protected equipment — Documentation
	2.22.30.2 Conformity assessment of explosion-protected equipment — Conformity assessment processes
	2.22.31 Fitness-for-purpose of equipment for

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	use in a hazardous area
	2.22.32 Hazardous areas auditing processes
UEENEEM069A Assess the fitness-for-purpose of hazardous areas explosion-protected equipment — dust atmospheres	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.12 Hazardous areas detailed inspection techniques
	2.22.18 Hazardous areas visual inspection

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	requirements
	2.22.30.1 Conformity assessment of explosion-protected equipment — Documentation
	2.22.30.2 Conformity assessment of explosion-protected equipment — Conformity assessment processes
	2.22.31 Fitness-for-purpose of equipment for use in a hazardous area
	2.22.32 Hazardous areas auditing processes
UEENEEM070A Repair reeling, trailing and flexible cables	2.22.1 Hazardous areas and explosion-protection principles
	2.22.33 Reeling, trailing and flexible cables and repair techniques
UEENEEM071A Test reeling, trailing and flexible cables	2.22.1 Hazardous areas and explosion-protection principles
	2.22.33 Reeling, trailing and flexible cables and repair techniques
	2.22.34 Electrical fundamentals and cables testing techniques
UEENEEM072A Inspect and fit plugs/couplers for reeling, trailing and flexible cables	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protection equipment — Principles
	2.22.2.2 Explosion-protection equipment — Ex certification schemes
	2.22.3 Flameproof (Ex'd') explosion-protection technique
	2.22.4 Increased safety (Ex'e') explosion-protection technique
	2.22.6 Intrinsic safety (Ex'i')

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.35 Reeling, trailing and flexible cable plug and coupler inspection and fitting techniques
UEENEEM073A Verify compliance of repaired reeling, trailing and flexible cables	2.22.33 Reeling, trailing and flexible cables and repair techniques
	2.22.34 Electrical fundamentals and cables testing techniques techniques
	2.22.35 Reeling, trailing and flexible cable plug and coupler inspection and fitting
UEENEEM074A Plan electrical installations in hazardous areas — Coal mining	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protected techniques—Principles
	2.22.2.2 Explosion-protection techniques—Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.15 Hazardous areas installation planning
	2.22.16 Common classified hazardous areas
UEENEEM075A Design explosion-protected electrical systems — Coal mining	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion-protected techniques—Principles
	2.22.2.2 Explosion-protection techniques—Ex certification schemes
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.15 Hazardous areas installation planning

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.16 Common classified hazardous areas
	2.22.20 Explosion-protected electrical systems design
	2.22.24 Gas detection-portable devices
UEENEEM076A Use and maintain the integrity of a portable gas detection device	2.22.27 Basic properties, behaviour and detection of gases and vapours
	2.22.28 Gas detection — Instructions in the use of portable devices
UEENEEM077A Install and maintain the integrity of fixed gas detection equipment	2.22.2 Explosion-protected equipment
	2.22.3 Flameproof (Ex‘d’) explosion-protection technique
	2.22.4 Increased safety (Ex‘e’) explosion-protection technique
	2.22.5 Non-sparking (Ex‘n’) explosion-protection technique
	2.22.6 Intrinsic safety (Ex‘i’) explosion-protection technique
	2.22.7 Pressurization (Ex‘p’) explosion-protection technique
	2.22.8 Explosion-protection techniques for dusts
	2.22.9 Common characteristics of explosion-protection techniques
	2.22.10.1 Hazardous areas installation requirements
	2.22.10.2 Hazardous areas maintenance requirements
	2.22.11.1 Hazardous areas cable termination devices and applications
	2.22.11.2 Hazardous areas cable termination techniques

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.22.25 Gas detection-Fixed equipment installation and maintenance
	2.22.26 Evaluation and selection of gas detection equipment — Portable and fixed
	2.22.27 Basic properties, behaviour and detection of gases and vapours.
UEENEEM078A Manage compliance of hazardous areas	2.22.1 Hazardous areas and explosion-protection principles
	2.22.19 Hazardous areas management
UEENEEM079A Design of gas detection systems	2.22.10.2 Hazardous areas maintenance requirements
	2.22.25 Gas detection — Fixed equipment installation and maintenance
	2.22.26 Evaluation and selection of gas detection equipment (portable and fixed)
	2.22.27 Basic properties, behaviour and detection of gases and vapours
	2.22.29 Gas detection selection and installation design
UEENEEM080A Report on the integrity of explosion-protected equipment in a hazardous area	2.18.6 Hazardous area safe working practices
	2.22.1 Hazardous areas and explosion-protection principles
	2.22.2.1 Explosion protected equipment - Principles
	2.22.23 Explosion-protection visual checks

N - Rail signalling units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEEN001B Service mechanical signalling equipment and infrastructure	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.14.1 Basic rail operations
	2.14.2.2 Rail signalling principles, mechanical
	2.14.3 Rail signalling, mechanical equipment
	2.14.5 Rail signalling, point actuators devices
	2.14.11.2 Rail signalling, interlocking systems, Mechanical
	2.14.13 Rail signalling, electro-pneumatic equipment
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN002B Assemble and wire internal electrical signalling equipment	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.2 Inverters
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.9 Rail signalling, train detection

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.14.10 Rail signalling, remote control systems
	2.14.11.1 Rail signalling, interlocking systems, Electrical
	2.14.12 Rail signalling, power supplies
	2.14.13 Rail signalling, electro-pneumatic equipment
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN003B Install and maintain track circuit leads and bonds	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.14.1 Basic rail operations
	2.14.9 Rail signalling, train detection
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN004B Perform cable system tests	2.2.2 Enterprise work activities records
	2.4.16 Personal computers, engineering applications software basic

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.11.8 Data and voice cabling testing devices
	2.14.1 Basic rail operations
	2.14.9 Rail signalling, train detection
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN005B Install and maintain signalling power supplies	2.2.2 Enterprise work activities records
	2.4.16 Personal computers, engineering applications software basic
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.3 Electronic switching
	2.9.3.2 Inverters
	2.9.11 Linear and switch mode power supplies
	2.14.12 Rail signalling, power supplies 2.14.14 Rail signalling, drawings and diagrams

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN006B Maintain remote control and non-vital interlocking control systems	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.4.11 Personal computers, hardware structure
	2.4.13 Computer peripherals
	2.4.16 Personal computers, engineering applications software basic
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.2 Inverters
	2.9.3.3 Electronic switching
	2.9.11 Linear and switch mode power supplies
	2.10.1.1 Electronic communications, principles
	2.14.6 Rail signalling, electronic equipment
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN007B Maintain power signalling and protected level crossing equipment	2.2.2 Enterprise work activities records
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.10.1.1 Electronic communications, principles
	2.14.1 Basic rail operations
	2.14.3 Rail signalling, mechanical equipment
	2.14.4 Rail signalling, electrical equipment
	2.14.5 Rail signalling, point actuators devices
	2.14.9 Rail signalling, train detection
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN008B Maintain on-site power operated point-activating devices	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.5.11 Environmental and heritage awareness
	2.14.1 Basic rail operations
	2.14.3 Rail signalling, mechanical equipment
	2.14.4 Rail signalling, electrical equipment
	2.14.5 Rail signalling, point actuators devices
	2.14.13 Rail signalling, electro-pneumatic equipment
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN009B Maintain track circuit equipment	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.4.16 Personal computers, engineering applications software basic
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.14.1 Basic rail operations
	2.14.9 Rail signalling, train detection
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN010B Maintain electronic signalling and communication systems	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.4.11 Personal computers, hardware structure
	2.4.16 Personal computers, engineering applications software basic
	2.4.13 Computer peripherals
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.3 Electronic switching
	2.9.3.2 Inverters
	2.9.11 Linear and switch mode power supplies
	2.10.1.1 Electronic communications, principles
	2.14.1 Basic rail operations
	2.14.4 Rail signalling, electrical equipment
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.9 Rail signalling, train detection
	2.14.10 Rail signalling, remote control systems

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.14.11.1 Rail signalling, interlocking systems, electrical
	2.14.11.2 Rail signalling interlocking systems, mechanical
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN011B Install and maintain power operated signalling equipment	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.14.1 Basic rail operations
	2.14.2.1 Rail signalling principles, electrical
	2.14.3 Rail signalling, mechanical equipment
	2.14.4 Rail signalling, electrical equipment
	2.14.5 Rail signalling, point actuators devices
	2.14.7 Rail signalling, computer-based equipment
	2.14.13 Rail signalling, electro-pneumatic equipment

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN012B Maintain power signalling and protective relay interlocking systems	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.4.16 Personal computers, engineering applications software basic
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.14.1 Basic rail operations
	2.14.2.1 Rail signalling principles, electrical
	2.14.4 Rail signalling, electrical equipment
	2.14.11 Rail signalling, interlocking systems, electrical
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN013B Install and test computer based interlocking	2.2.2 Enterprise work activities records
	2.4.13 Computer peripherals

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
equipment	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.9.3.3 Electronic switching
	2.9.3.2 Inverters
	2.9.11 Linear and switch mode power supplies
	2.10.1 Electronic communications, principles
	2.14.1 Basic rail operations
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.11.1 Rail signalling, interlocking systems, electrical
	2.14.11.2 Rail signalling interlocking systems, mechanical
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN014B Maintain computer based and solid state interlocking systems	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.4.11 Personal computers, hardware

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	structure
	2.4.13 Computer peripherals
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.3 Electronic switching
	2.9.3.2 Inverters
	2.9.11 Linear and switch mode power supplies
	2.10.1.1 Electronic communications, principles
	2.14.1 Basic rail operations
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.11 Rail signalling, interlocking systems, electrical
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN015B Conduct routine inspection and testing of new signal cables and lines	2.2.2 Enterprise work activities records
	2.4.16 Personal computers, engineering applications software basic
	2.5.4 Technical standards, regulations and codes rail networks

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.11.8 Data and voice cabling testing and testing devices
	2.14.4 Rail signalling, electrical equipment
	2.14.5 Rail signalling, point actuators devices
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.9 Rail signalling, train detection
	2.14.10 Rail signalling, remote control systems
	2.14.11 Rail signalling, interlocking systems, electrical
	2.14.12 Rail signalling, power supplies
	2.14.13 Rail signalling, electro-pneumatic equipment
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN016B Maintain electronic switched and microprocessor-based remote control systems	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.4.11 Personal computers, hardware structure
	2.4.16 Personal computers, engineering applications software basic

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.4.13 Computer peripherals
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.3 Electronic switching
	2.9.3.2 Inverters
	2.9.11 Linear and switch mode power supplies
	2.10.1.1 Electronic communications, principles
	2.14.6 Rail signalling, electronic equipment
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN017B Install and maintain transmission interface equipment	2.2.2 Enterprise work activities records
	2.3.13 Using supervisory control and data acquisition systems
	2.4.11 Personal computers, hardware structure
	2.4.16 Personal computers, engineering applications software basic
	2.4.13 Computer peripherals
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.10.1.1 Electronic communications,

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN018B Find and repair wiring system faults	2.2.2 Enterprise work activities records
	2.4.16 Personal computers, engineering applications software basic
	2.4.13 Computer peripherals
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.9.3.2 Inverters
	2.9.3.3 Electronic switching
	2.9.11 Linear and switch mode power supplies
	2.10.1.1 Electronic communications, principles
	2.11.8 Data and voice cabling testing and testing devices
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.11.1 Rail signalling, interlocking systems, electrical
	2.14.11.2 Rail signalling interlocking systems, mechanical
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN019B Test and isolate faults	2.2.2 Enterprise work activities records
	2.4.11 Personal computers, hardware structure
	2.4.16 Personal computers, engineering applications software basic
	2.4.13 Computer peripherals
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage awareness
	2.9.3.2 Inverters
	2.9.3.3 Electronic switching
	2.9.11 Linear and switch mode power supplies
	2.10.1.1 Electronic communications, principles
	2.14.1 Basic rail operations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.14.2.2 Rail signalling principles, mechanical
	2.14.3 Rail signalling, mechanical equipment
	2.14.5 Rail signalling, point actuators devices
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.11.2 Rail signalling, interlocking systems, mechanical
	2.14.13 Rail signalling, electro-pneumatic equipment
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN020B Install electrical power and control equipment for rail networks	2.2.2 Enterprise work activities records
	2.4.16 Personal computers, engineering applications software basic
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.2 Inverters
	2.9.3.3 Electronic switching
	2.9.11 Linear and switch mode power supplies
	2.14.12 Rail signalling, power supplies
	2.14.13 Rail signalling, electro-pneumatic

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	equipment
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN021A	Reserved
UEENEEN022A	Reserved
UEENEEN023A	Reserved
UEENEEN024A	Reserved
UEENEEN025B Co-ordinate and manage track protection	2.5.4 Technical standards, regulations and codes rail networks
	2.5.11 Environmental and heritage awareness
	2.14.1 Basic rail operations
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN026B Develop maintenance programmes	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.5.11 Environmental and heritage

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	awareness
	2.14.1 Basic rail operations
	2.14.2.2 Rail signalling principles, mechanical
	2.14.3 Rail signalling, mechanical equipment
	2.14.5 Rail signalling, point actuators devices
	2.14.11.2 Rail signalling, interlocking systems, Mechanical
	2.14.13 Rail signalling, electro-pneumatic equipment
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN027B Decommission electrical and electro-mechanical signalling from service	2.2.2 Enterprise work activities records
	2.4.11 Personal computers, hardware structure
	2.4.16 Personal computers, engineering applications software basic
	2.4.13 Computer peripherals
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.2 Inverters
	2.9.3.3 Electronic switching
	2.9.11 Linear and switch mode power supplies

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.10.1.1 Electronic communications, principles
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.11.1 Rail signalling interlocking systems, electrical
	2.14.11.2 Rail signalling interlocking systems, mechanical
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices
UEENEEN028B Test and commission Power Signalling Equipment	2.2.2 Enterprise work activities records
	2.4.11 Personal computers, hardware structure
	2.4.13 Computer peripherals
	2.4.16 Personal computers, engineering applications software basic
	2.5.4 Technical standards, regulations and codes rail networks
	2.5.10 Technical manuals and catalogues
	2.9.3.2 Inverters

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.9.3.3 Electronic switching
	2.9.11 Linear and switch mode power supplies
	2.10.1.1 Electronic communications, principles
	2.14.6 Rail signalling, electronic equipment
	2.14.7 Rail signalling, computer-based equipment
	2.14.8 Rail signalling, computer applications
	2.14.10 Rail signalling, remote control systems
	2.14.11.1 Rail signalling interlocking systems, electrical
	2.14.11.2 Rail signalling interlocking systems, mechanical
	2.14.12 Rail signalling, power supplies
	2.14.14 Rail signalling, drawings and diagrams
	2.14.15 Rail signalling, regulations and codes
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.18.5 Rail safe working practices

P - Restricted and specialist electrical work units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEPP001B Disconnect and	2.1.5.1 Power cable and conductor terminations

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
reconnect fixed wired electrical equipment connected to a Low Voltage supply	2.2.2 Enterprise work activities records
	2.8.1.1 Basic electrical principles
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.22.29 Disconnect/Reconnect
	2.19.28 Fault find – General principles
	2.22.39 Produce Status Reports using established procedures
UEENEEP002B Attach cords and plugs to electrical equipment for connection to a single phase 250 Volt supply	2.8.1.1 Basic electrical principles
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.19.30 Flexible cords and plugs to 250V
	2.19.36 Fault find to 250 V – General appliances
	2.19.39 Produce Status Reports using established procedures
UEENEEP003B Attach cords and plugs to electrical equipment for connection to 1000 V.a.c. or 1500 V.d.c. supply	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical safe working practices
	2.19.31 Flexible cords/cables to 1000 V
	2.19.39 Produce Status Reports using established procedures
UEENEEP004B Disconnect and reconnect explosion-protected electrical equipment connected to Low Voltage supply	2.18.1 Occupational Health and Safety principles
	2.18.6 Hazardous area safe working practices
	2.22.1 Hazardous area and explosion protection

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	principles
	2.22.2 Explosion-Protected equipment
	2.22.11 Hazardous areas cable termination techniques
	2.19.39 Produce Status Reports using established procedures
UEENEEP005B Disconnect and reconnect 3.3 kV electric propulsion components of self-propelled earth moving vehicles	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical safe working practices
	2.19.32 Disconnect and reconnect HV electric propulsion components
	2.19.39 Produce Status Reports using established procedures
UEENEEP006B Attach flexible cables and plugs to electrical equipment connected to a high voltage supply	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical safe working practices
	2.19.33 High voltage flexible cables and plugs exceeding 1000 V
	2.19.39 Produce Status Reports using established procedures
UEENEEP007B Locate and rectify faults in electrical low voltage equipment following prescribed procedures - <i>General single phase motors, composite equipment, and/or control devices</i>	2.18.1 Occupational Health and Safety principles
	2.18.13 Appliance servicing working practices
	2.19.36 Fault find to 250 V – General appliances
	2.19.39 Produce Status Reports using established procedures
UEENEEP007B Locate and rectify faults in electrical low voltage equipment following prescribed procedures - <i>Multi phase motor</i>	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical safe working practices

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
<i>endorsements, composite equipment, and/or control devices</i>	2.19.34 Fault find to 250 V - Motors
	2.19.37 Fault find to 1000 V - Motors
	2.19.39 Produce Status Reports using established procedures
UEENEEP007B Locate and rectify faults in electrical low voltage equipment following prescribed procedures - <i>Water heater endorsements</i>	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical safe working practices
	2.19.35 Fault find to 250 V – Water heaters
	2.19.38 Fault find to 1000 V – Water heaters
	2.19.39 Produce Status Reports using established procedures
UEENEEP008B Conduct in-service safety testing of electrical cord assemblies and cord connected equipment	2.5.2.3 Technical standards, regulations and codes for testing and tagging portable and cord connected electrical apparatus
	2.6.1 Protection devices and applications
	2.8.1.1 Basic electrical principles
	2.11.5 Basic electrical testing and measuring devices and techniques
	2.11.15 Portable apparatus testing (PAT) devices
	2.18.1 Occupational Health and Safety principles
	2.18.2 Electrical Safe working practices
	2.19.39 Produce Status Reports using established procedures
UEENEEP009B Locate and rectify faults in electrical low voltage appliances up to 250V following	General appliances:
	2.18.1 Occupational Health and Safety principles

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
prescribed procedures	2.18.13 Appliance servicing working practices
	2.19.36 Fault find to 250 V – General Principles
	2.19.39 Produce Status Reports using established procedures
	OR
	Water heaters:
	2.18.1 Occupational Health and Safety principles
	2.18.13 Appliance servicing working practices
	2.19.35 Fault find to 250 V – Water Heaters
	2.19.39 Produce Status Reports using established procedures
	OR
	Single phase motors:
	2.18.1 Occupational Health and Safety principles
	2.18.13 Appliance servicing working practices
	2.19.34 Fault find to 250 V – Motors
	2.19.39 Produce Status Reports using established procedures

R - Research units

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
UEENEER001B Contribute to the	2.2.16.1 Project planning

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
planning of a research project	2.2.17 Project management
	2.2.25 Research concepts
	2.2.33 Working in a team
	2.2.34 Scientific writing and communication
	2.2.35 Data collection techniques
	2.2.36 Data analysis and presentation
	2.2.37 Product development and trials
	2.2.38 Intellectual property concepts
	2.2.39 Commercialisation concepts
	2.18.1 Occupational Health and Safety principles
UEENEER002B Contribute to the conduct of a research project	2.2.17 Project management
	2.2.25 Research concepts
	2.2.33 Working in a team
	2.2.34 Scientific writing and communication
	2.2.35 Data collection techniques
	2.2.36 Data analysis and presentation
	2.2.37 Product development and trials
	2.2.38 Intellectual property concepts
	2.18.1 Occupational Health and Safety principles
UEENEER003B Contribute to the development of a Product/Application/Service	2.2.17 Project management
	2.2.25 Research concepts
	2.2.33 Working in a team

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.2.34 Scientific writing and communication
	2.2.35 Data collection techniques
	2.2.36 Data analysis and presentation
	2.2.37 Product development and trials
	2.2.38 Intellectual property concepts
	2.18.1 Occupational Health and Safety principles
UEENEER004B Contribute to the trial of a Product/Application/Service	2.2.17 Project management
	2.2.25 Research concepts
	2.2.33 Working in a team
	2.2.34 Scientific writing and communication
	2.2.35 Data collection techniques
	2.2.36 Data analysis and presentation
	2.2.37 Product development and trials
	2.2.38 Intellectual property concepts
UEENEER005B Contribute to Intellectual Property Management	2.2.17 Project management
	2.2.33 Working in a team
	2.2.38 Intellectual property concepts
	2.18.1 Occupational Health and Safety principles
UEENEER006B Contribute to the commercialisation of products/applications/ services	2.2.33 Working in a team
	2.2.38 Intellectual property concepts
	2.2.39 Commercialisation concepts

Competency Standard Units (CSUs)	Essential knowledge & Associated Skills Clause
	2.18.1 Occupational Health and Safety principles

Appendix 2 - Essential Knowledge and Associated Skills to Unit Relationship

Appendix 2 - Essential Knowledge and Associated Skills to Unit Relationship

2.1 - Cables, conductors and terminations

Essential knowledge & Associated Skills Clause	Competency Standard Units (CSUs)
2.1.1 Cable protection and support	E008B; E022B; F002B; G007B;
2.1.2 Cable types and applications	E008B; F002B; G007B;
2.1.3 Cables in buildings, structures and premises	E008B; F002B; G003B; G004B; G007B; I007C;
2.1.4 Basic cable and conductor terminations	E008B; G011B; H070B; I001B;; I019B;
2.1.5.1 Power cable and conductor terminations	A013B; G003B; G004B; P001B;
2.1.5.2 Bus bar techniques	A012B;
2.1.6.1 Telecommunication cable and conductor terminations	F002B;
2.1.6.2 Telecommunication aerial cabling	F012B;
2.1.6.3 Telecommunication below ground cabling	F013B;
2.1.7.1 Performance (copper) data cable installation and terminations	D017B; F004B; F010B;

2.1.7.2 Coaxial cable installation and terminations	D017B; F010B; H008B;
2.1.7.3 Optical fibre cabling installation and terminations	D017B; F005B; F010B;
2.1.7.4 Specialist audio/video cabling installation and termination	H010B;
2.1.8 Electronic cable and conductor terminations	H001B; H002B; H003B; H004B; H070B; I007C; I008C;
2.1.9 Winding wire types and connections	G051B;
2.1.10 High voltage motor winding, conductors, connections methods and insulation	G055B; G056B;
2.1.11 Integrated cabling arrangements	E021B;

2.2 - Common, commercial, processes and enterprise specific knowledge and skills

Essential knowledge & Associated Skills Clause	Competency Standard Units (CSUs)
2.2.1 Enterprise communication methods	C001B; C002B; C003B; C008B; C009B; C010B; C012B; E020B; E024B; E032B; E033B; E034B; E035B; E036B; E037B; E051B; G007B; G008B; G009B; G032B; H003B; H009B; J010B; J070B; T001B; T002B; T003B; T004B;
2.2.2 Enterprise work activities records	C001B; C002B; C003B; C008B; C009B; C010B; C012B; E020B; E024B; E032B; E033B; E034B; E035B; E036B; E037B; E051B; F008B; F010B; G007B; G008B; G009B; G022B; G032B; G062B; N004B; N005B; N006B; N007B;

Essential knowledge & Associated Skills Clause	Competency Standard Units (CSUs)
	N008B; N009B; N010B; N011B; N012B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N027B; N028B; P001B;
2.2.3 Fault finding techniques	G008B; G009B; G015B; H065B; I014B; J012B; J070B; K027B;
2.2.4 Problem solving techniques	C010B; E014B; E051B; G062B; H065B;
2.2.5 Enterprise customer relations protocols	C003B; C009B; C010B; C012B; E015B; E020B; E051B; G022B; G062B; H009B;
2.2.6 Enterprise quality management system, basics	A004B; A006B; C010B; C012B; E014B; E016B;
2.2.7 Enterprise purchasing system	C002B; E016B;
2.2.8 Enterprise costing methods	C003B; C009B;
2.2.9 Enterprise stock control methods	C008B; E051B;
2.2.10 Job costing techniques	C003B; C009B; E016B;
2.2.11.1 Estimating techniques	C005B; C007B;
2.2.11.2 Specification development	C004B; E016B; E070B; E071B; E072B; E073B; E074B; E075B; E077B; E084B; J039B;
2.2.12 Tendering requirements	C006B;
2.2.13 User instruction techniques	C010B; E020B;
2.2.14 Contracts, format, responsibilities and obligations	C007B;
2.2.15 Risk management, application and techniques	E011B; E016B;
2.2.16.1 Project Planning	D048B; E013B; G070B; H060B; I035B; I037B; J069B;

Essential knowledge & Associated Skills Clause	Competency Standard Units (CSUs)
	R001B;
2.2.16.2 Project development	None
2.2.17 Project management	E012B; G069B; H041; 1034B; 1036B; J040B; K021B; R001B; R002B; R003B; R004B; R005B;
2.2.18 Critical path and project analysis	D048B; E013B; E015B; E016B; G070B; H060B; 1035B; 1037B; J069B;
2.2.19 Customer/Client relations	E012B; E014B; E016B; E070B; E071B; E072B; E073B; E074B; E075B; E077B; E084B; G069B; H041B; 1034B; 1036B; J040B; K021B;
2.2.20 Computer use basics	C001B; C002B; C008B; D001B; E016B; E024C; E044B; E070B; E071B; E072B; E073B; E074B; E075B; E077B; E084B; T001B; T002B; T003B; T004B;
2.2.21 Engineering analysis, decision making and reporting	E024C;
2.2.22 Enterprise work/business coverage	C012B;
2.2.23 Enterprise regulatory requirements and non regulatory standards	G075A;
2.2.24 Technical examination and testing methods	H047;
2.2.25 Research Concepts	E016B; E024C; E070B; E071B; E072B; E073B; E074B; E075B; E077B; E084B; R001B; R002B; R003B; R004B;
2.2.26 Automated systems industry sector customs and practices	1036B; 1037B;
2.2.27 Data and voice industry sector customs and practices	None

Essential knowledge & Associated Skills Clause	Competency Standard Units (CSUs)
2.2.28 Electrical industry sector customs and practices	G069B; G070B;
2.2.29 Electronic/computer systems industry sector customs and practices	D048B;H041B; H060B;
2.2.30 Control systems industry sector customs and practices	1034B; 1035B;
2.2.31 Refrigeration and air conditioning industry sector customs and practices	J040B; J069B;
2.2.32 Renewable energy industry sector customs and practices	K021B; K022B;
2.2.33 Working in a Team	E024C; R001B; R002B; R003B; R004B; R005B; R006B; T001B;
2.2.34 Scientific Writing and Communication	R001B; R002B; R003B;R004B;
2.2.35 Data Collection Techniques	E024B; R001B; R002B; R003B; R004B;
2.2.36 Data Analysis and Presentation	E024C; R001B; R002B; R003B; R004B;
2.2.37 Product Development and Trials	R001B; R002B; R003B; R004B;
2.2.38 Intellectual Property Concepts	R001B; R002B; R003B; R004B; R005B; R006B;
2.2.39 Commercialisation Concepts	R001B; R006B;
2.2.40 Electrotechnology Industry organisations and practices	E079A; E041B; E042B; E043B; E044B; E045B; E047B; E048B; E049B;
2.2.41 Supervision fundamentals	E014B;
2.2.42 Business Concepts	None
2.2.43 Commissioning processes and procedures	D044B; H067B; G062B;
2.2.44 Requirements and methods for maintaining currency in industry developments	E006C;

Essential knowledge & Associated Skills Clause	Competency Standard Units (CSUs)
2.2.45 Responsibilities under a competency development plan	C013B;C014B; C015B; C016B; C017B; C018B; C019B; C020B; C021B; C022B; C023B; C024B; C025B; C026B; C027BA; C028B; C029B; E038B;
2.2.46 Methods of monitoring and reporting competency development activities	C013B;C014B; C015B; C016B; C017B; C018B; C019B; C020B; C021B; C022B; C023B; C024B; C025B; C026B; C027BA; C028B; C029B; E038B;
2.2.49 Procedure and protocols for giving evidence in a court of law	G072C;
2.2.50 Engineering design processes	D045B; H048B; H088B;

2.3 - Control technologies

Essential knowledge and associated skills	Competency Standard Units
2.3.1 Electrical control devices	A013B; G007B; G008B; G009B; G028B;
2.3.2 Control circuit fundamentals	A013B; G008B; G009B; G052B;
2.3.3 Process control principles	I006B; I014B;
2.3.4 Pneumatic/hydraulic control tubing/piping	I001B; I019B;
2.3.5 Refrigeration system controls	J012B; J070B;
2.3.6 Air conditioning system controls	J012B; J070B;
2.3.7 Smart device basics	D005B;
2.3.8 Programmable controller basics	D007B;

2.3.9 PLC programming basics	D007B;
2.3.10.1 PLC programming	D007B;
2.3.10.2 PLC high level programming	D009B;
2.3.10.3 PLC system applications	D026B;
2.3.11 Control system network basics	D025B; D034B;
2.3.12 Control network infrastructure	D026B; D034B;
2.3.13 Using supervisory control and data acquisition systems	N006B; N008B; N009B; N010B; N011B; N012B; N014B; N016B; N017B;
2.3.14 Supervisory control and data acquisition systems programming	D008B;
2.3.15 Appliances, electronic controls and communications basics	J054B;
2.3.16 Integrated systems basics	D031B;
2.3.17 Integrated systems, subsystem interworking	D032B;
2.3.18 Complex integrated system programming	D033B;
2.3.19 Control programming fundamentals	D026B; D027B; D051B
2.3.20 Microcontroller programming basics	D028B; D050B; D051B
2.3.21 Complex control systems	I023B;

2.4 - Communications and computer technologies

Essential knowledge and associated skills	Competency Standard Units
2.4.1.1 Telecommunications CPR regulations and installations	F016A;
2.4.1.2 Telephone system fundamentals	F002B; F010B; H033B;

Essential knowledge and associated skills	Competency Standard Units
2.4.1.3 Telephone network facilities	H033B;
2.4.1.4 Lift telecommunications cabling regulations and installation	F003B;
2.4.2.1 Telecommunication earthing and protection	F002B; F010B; H033B;
2.4.3.1 Data communication fundamentals	F014B;
2.4.3.2 Networking fundamentals	D017B; F008B; F009B; F010B; F011B; H083B;
2.4.4 Wireless networks infrastructure	F008B; H083B;
2.4.5 Wide area networks infrastructure	None
2.4.6 PABX fundamentals	F010B; H033B;
2.4.7 PABX programming	H033B;
2.4.8 Switches, hubs and routers	F010B; H033B;
2.4.9 Decoders	F010B; H033B;
2.4.10 (Reserved)	Reserved
2.4.11 Personal computers, hardware structure	D002B; E044B; H001B; N006B; N010B; N014B; N016B; N017B; N019B; N027B; N028B;
2.4.12.1 Computer hardware sub-assemblies	D002B;
2.4.12.2 Multimedia computer components	D030B;
2.4.13 Computer peripherals	D12B; N006B; N010B; N013B; N014B; N016B; N017B; N018B; N019B; N027B; N028B;
2.4.14 Personal computer operating systems, basics	D002B; D043B;
2.4.15 Computer operating systems	D012B; D013B; D043B;
2.4.16 Personal computers, engineering applications software basic	D004B; N004B; N005B; N006B; N009B; N010B; N012B; N015B; N016B;

Essential knowledge and associated skills	Competency Standard Units
	N017B; N018B; N019B; N020B; N027B; N028B;
2.4.17 Servers	None
2.4.18 Business equipment software basics	H003B;
2.4.19 Gaming equipment communications	H020B;
2.4.20 Programming elements	D010B;
2.4.21 Client Side programming	D010B; D029B;
2.4.22 Server scripting	D010B; D029B;
2.4.23 Database access	D010B;
2.4.24 Web applications and services	D010B;
2.4.25.1 Local area network fundamentals	D046B;
2.4.25.2 Network services design processes	D014B;
2.4.26 Network services management processes	D014B;
2.4.27.1 Unix fundamentals	D013B; D015B;
2.4.27.2 Linux fundamentals	D013B;
2.4.27.3 Mac OSX fundamentals	D013B;
2.4.28 Network operating systems essentials	D015B;
2.4.29 Network operating systems implementation	D015B;
2.4.30 Network infrastructure	D016B; D025B;
2.4.31 Directory Services	D016B;
2.4.32 Operating systems and networks fundamentals	D024B;
2.4.33 Operating systems and networks	D024B;
2.4.34 Routing methods and protocols	D019B;
2.4.35 Networks, remote access	D020B;
2.4.36 Multi-layer switched networks	D021B;

Essential knowledge and associated skills	Competency Standard Units
2.4.37 Fundamentals of network security	D022B;
2.4.38 Fundamentals of wireless security	D023B; H083B;
2.4.39 Internet, network basics	D017B;
2.4.40 Internet, network routing	D017B;
2.4.41 Internet, local area networking	D018B;
2.4.42 Internet, wide area networking	D018B;
2.4.43.1 Object orientated programming basics	D003B;
2.4.43.2 Object orientated programming	D011B;
2.4.44.1 Microprocessor/microcontroller assembler language programming	D050B; D052B;
2.4.44.2 High level programming	D050B; D051B; D052B;
2.4.44.3 Single-stage high-level programming	None
2.4.45 Copier/printer software functions and configuration	H021B;
2.4.46 Security systems basic software functions and configuration	H052B;
2.4.47 Security systems programming methods	H053B;
2.4.48 Security systems alarms programming	H054B;
2.4.49.1 Security systems access control programming	H055B;
2.4.49.2 Security systems closed circuit television programming	H056B;
2.4.50.1 Integrated security systems	H058B;
2.4.50.2 Internetworking security systems	H059B;
2.4.51 Fire protection systems programming methods	H063B;

2.5 - Drawings, diagrams, schedules, manuals, standards and regulations

Essential knowledge and associated skills	Competency Standard Units
2.5.1.1 Drawings interpretation and sketching	E042B; E043B;E044B; E047B; E049B;
2.5.1.2 Drawings and diagrams	E007B; G007B; H018B; H070B;
2.5.2.1 Technical standards, regulations and codes for general electrical installations	E021B; G003B; G004B; G007B; G008B; G071C; K035B;
2.5.2.2 Technical standards, regulations and codes for special electrical installations	G007B; G020B; G021B; G024B;
2.5.2.3 Technical standards, regulations and codes for testing and tagging portable and cord connected electrical apparatus	P008B;
2.5.3 Technical standards, regulations and codes for lifts and escalators	G016B;
2.5.4 Technical standards, regulations and codes rail networks	N001B; N002B; N003B; N004B; N005B; N006B; N007B; N008B; N009B; N010B; N011B; N012B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N025B; N026B; N027B; N028B;
2.5.5 Technical standards, regulations and codes for extra-low voltage work	E008B; H035B; H036B; K050A; K034B; K043A;
2.5.6 Technical standards, regulations and codes for refrigeration and air conditioning	J006B; J007B; J008B; J010B; J032B; J033B; J034B; J035B; J038B
2.5.7 Technical standards, regulations and codes for telecommunications cabling	D017B; E021B; F002B;
2.5.8 Technical standards, regulations and codes for electronic apparatus	H047;
2.5.9 Building codes for applicable to general electrotechnology installations	E021B;

2.5.10 Technical manuals and catalogues	G007B; G008B; H007B; H017B; H019B; H024B; I006B; I013B; N001B; N002B; N003B; N004B; N005B; N006B; N007B; N008B; N009B; N010B; N011B; N012B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N026B; N027B; N028B;
2.5.11 Environmental and heritage awareness	E008B; F002B; G003B; G004B; G007B; H035B; H036B; H050B; N001B; N003B; N004B; N007B; N008B; N011B; N013B; N015B; N018B; N019B; N025B; N026B;
2.5.12 Electricity distributors, supply requirements	G075A; G022B; G027B; G071C; K035B;
2.5.13 Electricity regulatory safety requirements	G075A; G022B;
2.5.14 Technical standards, regulations and codes applicable to instrumentation and control	I001B; ; I019B;
2.5.15 Measurement standards applicable to process instrumentation	I013B;
2.5.16 Measurement standards applicable to scientific instruments	I017B;
2.5.17 Regulatory requirements for the generation, transmission and distribution of electricity	None
2.5.18 Regulatory requirements and codes of practice for the gaming equipment	H009B;
2.5.19 Technical standards, regulations and codes for mining	G018B;
2.5.20 Technical standards, regulations and codes for security systems	H050B;
2.5.21 Technical standards, regulations and codes for fire protection and warning systems	H061B; H062B;

2.5.22 Performance standards and regulatory requirements for the electrical rotating machine	G060B;
2.5.23 Performance standards and regulatory requirements for electrical equipment	G031B;

2.6 - Electrical applications and apparatus

Essential knowledge and associated skills	Competency Standard Units
2.6.1 Protection devices and applications	G007B; G028B; J053B; P008B;
2.6.2.1 Switchboards/distribution boards	G007B; G028B;
2.6.2.2 Electrical metering arrangements	G025B; G028B; G071C; K035B;
2.6.2.3 Interval metering concepts and applications	G071C;
2.6.3 Single phase alternators	G026B;
2.6.4 Three phase alternators	G026B;
2.6.5 Single phase motors	None
2.6.6.1 Three phase motors	None
2.6.6.2 Alternating Current Rotating Machines	A010B; G003B; G008B; G052B;
2.6.7 Single phase transformers	None
2.6.8.1 Three phase transformers	None
2.6.8.2 Single & Three-Phase Transformers	A013B; G003B; G008B; G053B;
2.6.8.3 Power transformers diagnostics	G040B;
2.6.9.1 Lighting fundamentals	G008B;
2.6.9.2 Luminaires and lighting systems	G003B; G008B;

2.6.9.3 Venue lighting for audio/video/live presentations	H036B;
2.6.10 Electric Heating	G008B;
2.6.11 Direct current motor fundamentals	None
2.6.12 Direct current machines	G010B;
2.6.13 Motor starters and overload protection basics	None
2.6.14 Direct-on-line (DOL) motor starters	None
2.6.15 Reduced voltage a.c. motor starters	None
2.6.16 Direct current motor control	G010B;
2.6.17 Cells and batteries	G013B; G019B;
2.6.18 RAPS systems basics	Covered by 2.13 and 2.20 Clauses
2.6.19 RAPS systems demand side management	
2.6.20 Electrical mining systems overview	G018B;
2.6.21 Electricity supply and reticulation	G015B;
2.6.22.1 Electrical power system protection	G015B;
2.6.22.2 Electrical power system operations	G037B;
2.6.22.3 Electrical power system transmission faults	G042B;
2.6.22.4 Distributive generation systems	G039B;
2.6.22.5 Electrical power system protection diagnostic	G046B;
2.6.22.6 Electrical power distribution systems diagnostic	G038B;
2.6.23 Marine Electrical Systems overview	G019B;
2.6.24.1 Switchgear/controlgear	A010B; G028B; G029B;
2.6.24.2 Control panel wiring	A013B; G028B;
2.6.25 Hand power tools repairs	J051B;
2.6.26 Appliance motors and circuits	J053B;
2.6.27.1 Electric heating appliances	J057B;

2.6.27.2 Microwave ovens	J073B;
2.6.28 Motor windings	G053B; G054B; G061B;
2.6.29 Coil winding basics	G050B;
2.6.30 Coil testing	G050B;
2.6.31.1 Electrical machine winding basic	G051B; G052B;
2.6.31.2 Low voltage three phase motor winding techniques	G053B;
2.6.31.3 Direct current motor winding techniques	G054B;
2.6.31.4 High voltage three phase motor winding techniques	G055B; G056B;
2.6.31.5 Electrical machines, mechanical components	G059B; G064B;
2.6.31.6 Electrical machines, performance monitoring	G060B;
2.6.32 Field power and distribution systems	G026B;
2.6.33 Variable speed drives for a.c. motors	G035B;
2.6.34 Variable speed drives for d.c. motors	G036B;
2.6.35 Servomechanism systems	G041B;
2.6.36 Synchronous machine diagnostics	G043B;
2.6.37 Induction motors diagnostics	G045B;
2.6.38 Direct current machines diagnostics	G044B;
2.6.39 Lubrication of lift components	G065B; G066B;
2.6.40 Lift systems, roping	G065B;
2.6.41 Lift systems, rope inspection	G065B;
2.6.42 Escalators, moving walk and tread way mechanics	G066B;
2.6.43 Lift systems, plumbing and setting out	G067B;
2.6.44 Lift equipment alignment techniques	G067B;
2.6.45 Lift components – electrical/electronics.	G068B;

2.6.46 Lift systems – basic operations	G016B;
2.6.47 Lift components - electro-mechanical	G016B;
2.6.48 Electric lifts - mechanics	G016B;
2.6.49 Electro - hydraulic lifts	G016B;
2.6.50 Electro - hydraulic lifts - mechanical operation	G016B;
2.6.51 Emergency release procedures - trapped passengers	G016B;

2.7 - Electrical installations and systems

Essential knowledge and associated skills	Competency Standard Units
2.7.1.1 Electrotechnology, building systems and materials	E047B;
2.7.1.2 Electrical installations, wiring and accessories	G003B; G004B; G007B; G008B;
2.7.1.3 Electrical Wiring Systems	G003B; G004B; G007B;
2.7.2 Electrical installations, equipment requirements	G003B; G004B; G007B;
2.7.3 Electrical installations, safety principles and requirements	G007B; G025B;
2.7.4.1 Electrical Installations, Protection Methods and Devices	A013B; G007B; G008B; G029B; G057B;
2.7.4.2 Electrical installations, circuit arrangements and cable selection	E021B; G007B; G008B; G025B;
2.7.4.3 Electrical installations, Single-stage methods of cable and protection selection	G027B;
2.7.5.1 Electrical installations, testing and verification	G005B; G027B;
2.7.5.2 Electrical installations, testing and verification of special installations	G021B; G027B;
2.7.5.3 Fire protection installations, testing and verification methods	H062B;

2.7.6 Electrical installations, emergency systems	G013B;
2.7.7 Electrical installations, special installation requirements	None
2.7.8 Electrical installations, hazardous areas	Covered by 2.19 Clauses
2.7.9.1 Electrical installations, single phase inspections	G022B;
2.7.9.2 Electrical installations, inspections and safety compliance audits	G023B;
2.7.10 Electrical installations, determination of demand	G027B;
2.7.11 Electrical installations, overcurrent protection	G027B;
2.7.12 Electrical installations, overvoltage and undervoltage protection	G027B;
2.7.13 Electrical installations, programmable logic controller requirements	D007B;
2.7.14 Procedures and processes for responding to reported electrical incidents	G072C;
2.7.15 Causes and consequence of unsafe and misuse of electrical installations and equipment	G072C;

2.8 - Electrical principle

Essential knowledge and associated skills	Competency Standard Units
2.8.1.1 Basic electrical principles	P001B; P002B; P008B;
2.8.1.2 Fundamental electrical principles	E003B; E079A; E041B; E042B; E043B; E044B; E045B; E047B; E048B; E049B; K012B;
2.8.1.3 Electrotechnical principles	E029B;
2.8.1.4 Circuits principles	H069 A

2.8.2.1 Direct current circuit principles	E004B; E079A; E042B; E043B; E044B; E045B; E047B; E048B; E049B; K012B;
2.8.2.2 Alternating current principles - power	E019B; G002B; G012B;
2.8.3 Power factor	None
2.8.4 Three phase circuits	None
2.8.5 Magnetism	None
2.8.6 Electromagnetic principles	; G001B; G012B;
2.8.7 Harmonic fundamentals	None
2.8.8 Electrotechnology science and materials	E047B; E049B; G012B; G030B;
2.8.9.1 Circuit analysis	E025B;
2.8.9.2 Electrical power circuit analysis	G048B;
2.8.9.3 Polyphase power circuit analysis	G049B;
2.8.10.1 Engineering maths fundamentals	
2.8.10.2 Engineering maths	E026B; G061B;
2.8.10.3 Single-stage engineering maths	E027B;
2.8.10.4 Engineering Mathematics with Calculus	E027B; E50B; H084B;
2.8.11 Power engineering computations	G047B;
2.8.12 Electrical concepts and applications	None
2.8.13 Parts and component selection	E079A; E041B; E042B; E043B; E044B; E045B; E047B; E049B;
2.8.14.1 Electrotechnology calculations	None
2.8.14.2 Electrotechnology science	None
2.8.14.3 Electrotechnology Numeracy Diagnostic Assessment Methods	E030B;

2.8.14.4 Electrotechnology Literacy Diagnostic Assessment Methods	E030B;
2.8.15.1 Applied mathematical concepts	E045B; E050B;
2.8.15.2 Applied physics concepts	E046B;
2.8.15.3 Fault current calculations	G030B;

2.9 - Electronic principles and applications

Essential knowledge and associated skills	Competency Standard Units
2.9.1.1 Electronic component basics	A002B; H002B; H070B;
2.9.1.2 Electronic component parameters and selection methods	H081B;
2.9.1.3 Single phase rectifiers	None
2.9.1.4.1 Frequency dependant circuit principles	H014B;
2.9.1.4.2 Filters and Resonance	H014B;
2.9.1.5 Basic electronic principles	E023B;
2.9.1.6 Basic digital principles	E023B;
2.9.2 Multiphase rectifiers	None
2.9.3.1 Voltage regulators	None
2.9.3.2 Inverters	N002B; N005B; N006B; N010B; N013B; N014B; N016B; N018B; N019B; N020B; N027B; N028B;
2.9.3.3 Electronic switching	N005B; N006B; N010B; N013B; N014B; N016B; N018B; N019B; N020B; N027B; N028B;
2.9.4.1 Digital electronic fundamentals	None

Essential knowledge and associated skills	Competency Standard Units
2.9.4.2 Digital signal processing	H084B;
2.9.4.3 Digital signal processing development	H084B;
2.9.4.4 Digital applications	H048;
2.9.5.1 Micro programming fundamentals	D028B; H015B;
2.9.5.2 Microcontroller fundamentals	D028B; D052; H066B;
2.9.6 Operational amplifiers	None
2.9.7.1 Single phase power control	H025B;
2.9.7.2 Polyphase power control	H026B;
2.9.8 Amplifier Fundamentals	H039B; H044B;
2.9.9.1 Single-stage amplifiers	H013B; H044B;
2.9.9.2 Amplifier applications	H013B; H044;
2.9.9.3 Microwave amplifiers	H016B;
2.9.10 Reserved	Reserved
2.9.11 Linear and switch mode power supplies	H038; N005B; N006B; N010B; N013B; N014B; N016B; N018B; N019B; N020B; N027B; N028B;
2.9.12 Electronic fault finding	H011B; H012B; H015B; H016B; H018B; H039; H043; H066B;
2.9.13 Measurement circuits and applications	I021B;
2.9.14 Fundamentals of calibration	I017B;
2.9.15 Audio and video component functional controls	H004B; H024B;
2.9.16.1 Sound reproduction fundamentals	H006B; H010B; H073B;
2.9.16.2 Acoustics, spatial treatment and sound reproduction	H035B; H036B; H049B;
2.9.17.1 Audio reproduction, electronic components	H006B; H010B; H024B;

Essential knowledge and associated skills	Competency Standard Units
	H049B; H073B;
2.9.17.2 Audio component repair basics	H024B;
2.9.18 Audio reproduction, speaker fundamentals	H006B; H010B;
2.9.19 Audio/video recording and replay components repair basics	H006B; H010B; H017B;
2.9.20 Business equipment operational functions	Covered by 2.9.72/73
2.9.21 Business equipment components	
2.9.22 Gaming machine systems and equipment overview	H009B;
2.9.23.1 Gaming machine equipment adjustment and maintenance	H009B;
2.9.23.2 Gaming machine fault finding	H020B;
2.9.24 Cathode ray tube displays	H076B;
2.9.25 Plasma displays	H076B;
2.9.26.1 Liquid crystal displays	H076B;
2.9.26.2 Display circuit diagnostics	H076B;
2.9.27 Digital versatile disc (DVD) and compact disc (CD)	H017B;
2.9.28 Hand held remote control units	H022B;
2.9.29 Television scanning and deflection	H019B; H071B;
2.9.30 Television chrominance and luminance	H019B; H071B;
2.9.31.1 Television and video reception	None
2.9.31.2 Power supplies for TVs and VCRs	H071B;
2.9.31.3 Television RF Stages	H071B;
2.9.32.1 Camcorders and digital cameras	H078B;
2.9.32.2 Camera circuits diagnostics	H078B;

Essential knowledge and associated skills	Competency Standard Units
2.9.33 Video cassette recorder	None
2.9.34.1 Digital Television Receivers	H079B;
2.9.34.2 Digital television principles	H079B;
2.9.34.3 Single-stage digital television principles	H080B;
2.9.35 Micro computer systems	None
2.9.36 Fire detection and warning system and apparatus fundamentals	H061B; H062B;
2.9.37 Fire alarm routine testing	H062B;
2.9.38 Tape recorders	None
2.9.39 AM and FM tuners	H072C;
2.9.40 Integrated audio systems	H035B;
2.9.41.1 Security systems installation basics	H050B;
2.9.41.2 Security systems installation faults	H075B;
2.9.42 Audio and video system set up	H004B;
2.9.43 Video systems installation	H006B;
2.9.44 Consumer video equipment	None
2.9.45.1 Audio electronics	H073B;
2.9.45.2 Recording and replay apparatus diagnostics	H077B;
2.9.46 Professional audio electronics	H010B;
2.9.47 Loud speakers and microphones	H010B;
2.9.48 Digital audio	H017B;
2.9.49 Computer monitors	None
2.9.50 Commercial audio/video systems commissioning process	H037B;
2.9.51 Camcorders	H074B;

Essential knowledge and associated skills	Competency Standard Units
2.9.52 Digital versatile disk processors	H017B; H074B;
2.9.53 Compact disk players	H017B; H074B;
2.9.54 VCR basic principles	H074B;
2.9.55 VCR fault finding	H074B;
2.9.56 VCR Single-stage principles	H074B;
2.9.57.1 Introduction to television	H019B;
2.9.57.2 Television receiver repair basics	H019B;
2.9.58 TV RF signal stages	None
2.9.59 Closed circuit televisions	H051B;
2.9.60 Electronic security systems fundamentals	Covered in 2.9.41.1
2.9.61 Single-stage electronic security systems	H051B;
2.9.62 Security video monitoring and recording	None
2.9.63 Direct current power supplies	H011B;
2.9.64 Application of electronic devices	None
2.9.65 Regulated power supplies	None
2.9.66 Switching power supplies	None
2.9.67 Feedback filters and oscillators	H042B;
2.9.68 Filters and resonance	None
2.9.69 Digital subsystems	None
2.9.70 Automatic data capture	D054B;
2.9.71.1 Biometric devices	D053B; H051B;
2.9.71.2 Biometrics Equipment Techniques and Applications	D054B; D055B;
2.9.71.3 Biometric Systems Techniques and Applications	D054B; D055B;

Essential knowledge and associated skills	Competency Standard Units
2.9.71.4 Biometrics and Security	D055B;
2.9.72 Custom electronic installations, testing and verification methods	H005B;
2.9.73 Operational concepts of business machines	H003B;
2.9.74.1 Electro-mechanics of business machines	H003B;
2.9.74.2 Business machine transducers	H021B;
2.9.74.3 Photocopiers operating principles	None
2.9.75.1 High volume business machine functions and faults	H021B;
2.9.75.2 Colour photocopiers operating principles	H021B;
2.9.75.3 Facsimile machine operating principles	H021B;
2.9.76 Microwave heating	H023B;
2.9.77 Electronic components and system, industrial applications	G008B;
2.9.78 Common security scenarios and solutions	H057B;
2.9.79.1 Fire protection technologies	H061B; H062B;
2.9.79.2 Fire protection systems, commissioning process	H064B;
2.9.79.3 Fire protection systems faults	H065B;
2.9.80 Video and display set up	H010B; H035B;
2.9.81 Audio/video control equipment	H006B; H010B; H035B;
2.9.82 Introduction to optics	None
2.9.83 General electronic apparatus repair basics	H007B;
2.9.84 Single-stage analogue electronics	H045B;
2.9.85 Single-stage power amplifiers	H045B;
2.9.86 Audio system advance diagnostic techniques	H049B;

Essential knowledge and associated skills	Competency Standard Units
2.9.87 Photonic principles and applications	E028B;
2.9.88 Principles of Signal Conditioning	H085B;
2.9.89 Analogue Integrated Circuits	H085B;
2.9.90 RF Amplifiers	H082B;
2.9.91 Printed circuit board design techniques	H081B;
2.9.92 Vacuum tube amplifiers	H087B;
2.9.93 Electronic Musical Instruments	H087B;

2.10 - Electronic communications technology

Essential knowledge and associated skills	Competency Standard Units
2.10.1.1 Electronic communications, principles	H046B; N006B; N007B; N010B; N014B; N016B; N017B; N018B; N019B; N027B; N028B;
2.10.1.2 Electronic signals and systems	None
2.10.1.3 Electronic communications, technologies	None
2.10.2 Electronic communications, transmission principles	None
2.10.3 Electronic communications, modulation	None
2.10.4 Electronic communications, modulation circuits	H072C;
2.10.5 Electronic communications, receivers	H072C;
2.10.6 Electronic communications, transmitters	H072C;
2.10.7 Electronic communications, digital techniques	None
2.10.8 Electronic communications, transmission lines	H027B;
2.10.9 Electronic communications, antennas and wave	H027B;

propagation	
2.10.10 Electronic communications, microwave	H086B;
2.10.11 Electronic communications, satellite	H030B; H086B
2.10.12 Electronic communications, optical methods	None
2.10.13 Television and video reception	None
2.10.14 TV antenna systems	H008B;
2.10.15 Antenna installation and servicing	H008B;
2.10.16 Transmission lines and antennae	H027B; H072B; H082B;
2.10.17 Electronic communications, multiplexing and de multiplexing	None
2.10.18 Electronic communications, microwave antennas and wave guide fundamentals	H016B; H028B;
2.10.19 Electronic communications, commissioning process	H027B; H086B;
2.10.20 Electronic communications, sonar Transducers and arrays	H040B;
2.10.21 Electronic communications, sonar system operating principles	H040B;
2.10.22 Electronic communications, sonar measurement and set up	H040B;
2.10.23 Electronic communications, secondary radar and related systems	H031B;
2.10.24 Electronic communications, radar and sonar displays devices	H031B; H040B;
2.10.25 Electronic communications, radar fundamentals	H031B;
2.10.26 Electronic communications, navigation systems	H029B;
2.10.27 Electronic communications, surveillance and observation	H030B;
2.10.28 Electronic communications, global positioning systems	H032B;

2.10.29 Digital television transmission towers and equipment	H080B;
2.10.30 Wireless devices	F007B;
2.10.31 Electrotechnology communications principles	F006B;
2.10.32 Amateur radio communication principles, practices, and technical overview	B001B;
2.10.90 Air traffic control systems technology	H090A

2.11 - Equipment and tools

Essential knowledge and associated skills	Competency Standard Units
2.11.1 Hand tools	E002B; E005B;; E022B; E042B; E043B; E044B; E047B; E049B; G001B;
2.11.2.1 Power tools	E002B;E005B; E022B; E042B; E043B; E044B; E047B; E049B;
2.11.2.2 Electrical workshop machines	G011B; G064B;
2.11.3.1 Fixing and support devices and techniques	E005B; E022B; G007B;
2.11.3.2 Mobile plant, tools and equipment	None
2.11.4 Dismantling and assembling techniques	E002B; E042B; E043B; E044B; E047B; E049B;
2.11.5 Basic electrical testing and measuring devices and techniques	F011B; H069B; H070B; J053B; P008B;
2.11.6.1 Advance electrical testing and measuring devices	G032B; G072C;
2.11.6.2 Electrical field testing and measurement techniques	G032B; G072C;
2.11.6.3 Power cable fault detection techniques	G032B;
2.11.7.1 Electronic testing and measuring devices and	H011B; H012B; H013B; H015B; H018B; H038B; H039;

techniques	H043; H048B; H088B;
2.11.7.2 Advanced electronics testing and measuring devices and techniques	H015B; H016B; H027B; H031B; H040; H049; H076B; H077B; H086B;
2.11.8 Data and voice cabling testing and testing devices	F004B; F005B; F011B; N004B; N015B; N018B;
2.11.9.1 Basic refrigeration testing and measuring field devices	J003B; J062B; J072B;
2.11.9.2 Fitting and removing refrigeration service gauges	J003B; J062B; J072B;
2.11.9.3 Replacement of basic components on a refrigeration system	J008B;
2.11.9.4 Appliance diagnostic tools	J054B;
2.11.10.1 Basic air conditioning measurement devices	J004B;
2.11.10.2 Air conditioning testing devices	J013B;
2.11.11.1 Electronic soldering equipment and techniques	H002B; H070B;
2.11.11.2 Surface mount soldering techniques	A001B;
2.11.11.3 Printed circuit board repair techniques	A004B;
2.11.11.4 Lead-free soldering technology	A006B;
2.11.12 Instrumentation testing and measuring field devices	I002B; I003B; I004B; I005B; I006B;
2.11.13.1 Brazing and soldering equipment and techniques	J002B;
2.11.13.2 Introduction to welding	E042B; E043B;
2.11.14 Piping and tubing techniques	J002B;
2.11.15 Portable apparatus testing (PAT) devices	P008B;
2.11.16 Electronic component place equipment	A003B;
2.11.17 Electronic assembly correction and rework techniques	None
2.11.18 Electronic assembly functional and quality testing	A005B;
2.11.19 Electrotechnology engineering practice	E042B; E043B;

2.11.20.1 Low voltage motor testing devices and techniques	G057B;
2.11.20.2 High voltage motor testing devices and techniques	G058B;
2.11.20.3 Electric motor mechanical measuring and testing devices and techniques	G059B;

2.12 - Instrumentation

Essential knowledge and associated skills	Competency Standard Units
2.12.1 Instrumentation principles	I001B;
2.12.2 Pressure	I002B;
2.12.3 Density and level	I003B;
2.12.4 Fluid flow	I004B;
2.12.5 Temperature	I005B;
2.12.6 Process control systems	I006B; I014B; I020B;
2.12.7 Control valve principles	I011B;
2.12.8 Control valve selection	I011B;
2.12.9 Actuators and positioners	I011B;
2.12.10 Transmitters and converters	I006B;
2.12.11.1 Industrial processes	I009B; I010B;
2.12.11.2 Process control, commissioning	I022B;
2.12.12 Distributive control principles (DCS)	I013B;
2.12.13 Instrumentation and control communications	I013B;
2.12.14 Indicators and methods of recording process data	I009B; I013B;
2.12.15 Gas analysis	I009B; I021B;

2.12.16 Water analysis	I009B; I021B;
2.12.17 Scientific analysis	I009B; I021B;
2.12.18 Weight measurement principles	I009B; I021B;
2.12.19 Instrument calibration methods	I009B;
2.12.20.1 Process equipment installation requirements and techniques	I013B;
2.12.20.2 Process control arrangements and equipment selection	I013B;
2.12.21 Control system installation, testing and verification methods	I012B;
2.12.22.1 Medical equipment principles	H034B; I015B;
2.12.22.2 Medical equipment, anatomy and physiology and infection control	H034B; I015B;
2.12.23 Transducers and sensing devices	I001B; I019B;
2.12.24 Calibration techniques	I017B;

2.13 - Maintenance and repair

Essential knowledge and associated skills	Competency Standard Units
2.13.1 RAPS plant area cleaning	K001B; K008B; K009B; K010B;
2.13.2 RAPS systems battery bank maintenance techniques	K003B; K008B; K009B; K010B; K011B;
2.13.3 RAPS systems generator sets maintenance techniques	K004B;
2.13.4 RAPS systems photo voltaic array maintenance techniques	K005B; K008B; K009B; K010B;
2.13.5 RAPS systems wind generator maintenance	K006B;

techniques	
2.13.6 RAPS system use auditing techniques	None
2.13.7 RAPS systems maintenance scheduling	K007B; K008B;
2.13.8 Scheduled maintenance processors	E009B; E010B; F004B; F005B; J068B; K008B;
2.13.9 Business equipment fundamentals	None
2.13.10 Cooling plant maintenance procedures	None

2.14 - Rail signalling

Essential knowledge and associated skills	Competency Standard Units
2.14.1 Basic rail operations	; N001B; N003B; N004B; N007B; N008B; N009B; N010B; N011B; N012B; N013B; N014B; N019B; N025B; N026B;
2.14.2.1 Rail signalling principles, electrical	N011B; N012B;
2.14.2.2 Rail signalling principles, mechanical	N001B; N019B; N026B;
2.14.3 Rail signalling, mechanical equipment	N001B; N007B; N008B; N011B; N019B; N026B;
2.14.4 Rail signalling, electrical equipment	N007B; N008B; N010B; N011B; N012B; N015B;
2.14.5 Rail signalling, point actuating devices	N001B; N007B; N008B; N011B; N015B; N019B; N026B;
2.14.6 Rail signalling, electronic equipment	N002B; N006B; N010B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N027B; N028B;
2.14.7 Rail signalling, computer-based equipment	N002B; N010B; N011B; N013B; N014B; N015B;

Essential knowledge and associated skills	Competency Standard Units
	N017B; N018B; N019B; N027B; N028B;
2.14.8 Rail signalling, computer applications	N006B; N010B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N027B; N028B;
2.14.9 Rail signalling, train detection	N002B; N003B; N004B; N007B; N009B; N010B; N015B;
2.14.10 Rail signalling, remote control systems	N002B; N006B; N010B; N013B; N014B; N015B; N016B; N017B; N018B; N027B; N028B;
2.14.11.1 Rail signalling interlocking systems, Electrical	N002B; N010B; N013B; N018B; N027B; N028B;
2.14.11.2 Rail signalling interlocking systems, Mechanical	N001B; N010B; N013B; N018B; N019B; N026B; N027B; N028B;
2.14.12 Rail signalling, power supplies	N002B; N004B; N005B; N006B; N009B; N010B; N013B; N014B; N015B; N018B; N020B; N027B; N028B;
2.14.13 Rail signalling, electro-pneumatic equipment	N001B; N002B; N008B; N011B; N015B; N019B; N020B; N026B;
2.14.14 Rail signalling, drawings and diagrams	N001B; N002B; N003B; N004B; N005B; N006B; N007B; N008B; N009B; N010B; N011B; N012B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N025B; N026B; N027B; N028B;
2.14.15 Rail signalling, regulations and codes	; N001B; N002B; N003B; N004B; N005B; N006B; N007B; N008B; N009B; N010B; N011B; N012B;

Essential knowledge and associated skills	Competency Standard Units
	N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N025B; N026B; N027B; N028B;

2.15 - Refrigeration and air conditioning apparatus

Essential knowledge and associated skills	Competency Standard Units
2.15.1 Refrigeration compressors	J003B;
2.15.2 Condensers	J003B;
2.15.3 Evaporators	J003B;
2.15.4.1 Refrigerant flow controls and distributors	None
2.15.4.2 Refrigerant control selection	J0101B;
2.15.4.3 Refrigerant Metering Devices	J003C;
2.15.5 Pumps	None
2.15.6 Fans and air distribution	J007B;
2.15.7 Small appliance repair	J051B;
2.15.8 Domestic appliance principles	J052B; J055B; J056B;
2.15.9.1 Appliance refrigeration systems.	J011B; J055B;
2.15.9.2 Capillary systems	J055B;
2.15.9.3 Retrofitting domestic refrigeration systems	J055B;
2.15.9.4 Split air conditioning system	None
2.15.10 Clothes washers and dryers	J056B;
2.15.11 Dish washing machines	J058B;

2.15.12 Gas cooking appliances	J059B;
2.15.13 Room air conditioners	J089A;
2.15.14 Appliance, testing and compliance verification methods	J061B;
2.15.15 HVAC control systems fundamentals	J030B;
2.15.16 Energy management systems for commercial refrigeration	J021B;
2.15.17 Refrigeration/HVAC direct digital controls	J022B; J035B; J046B;
2.15.18 Refrigeration/HVAC pneumatic controls	J022B; J035B; J046B;
2.15.19 HVAC air systems	J023B; J064B;
2.15.20 HVAC hydronic systems	J024B; J045B; J064B;
2.15.21 Refrigeration/HVAC electronic controls	J026B;
2.15.22 HVAC control systems	J048B;
2.15.23 Microbial control fundamentals	J068B;
2.15.24 Cool rooms/freezer rooms	J007B;
2.15.25 Package air conditioning systems	J007B;
2.15.26 Merchandising and display cabinets	J007B;
2.15.27 Cooling towers, cooling towers, evaporative condensers, evaporative coolers and associated equipment	J007B;
2.15.28 Residential air conditioning	J007B;

2.16 - Refrigeration and air conditioning installations

Essential knowledge and associated skills	Competency Standard Units
2.16.1 Refrigeration pipework and accessories	J006B; J010B;

2.16.2 Refrigeration pipework layout	J006B; J010B;
2.16.3 Refrigeration installations, equipment requirements	J006B; J010B;
2.16.4 Refrigeration pipe selection and sizing	J010B;
2.16.5 Refrigeration and air conditioning installations, testing and verification methods	J009B; J048B;
2.16.6 Split air conditioning system installation	J005B;
2.16.7 High pressure refrigerant installation	None;
2.16.8 Fault-finding and diagnostic techniques	Covered by 2.2.3
2.16.9 Commissioning - HVAC systems	J023B; J024B; J025B; J026B;
2.16.10 Commissioning Commercial/Industrial Refrigeration Systems	J025B;
2.16.11 Air conditioning drawing	J028B;
2.16.12.1 Energy management fundamentals	None
2.16.12.2 Energy management	J047B;
2.16.13 Building management systems	J036B; J048B; K051A; K046A;
2.16.14 Management of indoor air quality	J037B;
2.16.15 Computer aided drafting	J039B;
2.16.16 Refrigeration System Components and Piping	J032B; J033B; J034B; J064B;
2.16.17 Retrofitting refrigeration systems	J013B;
2.16.18.1 Installation and commissioning procedures for Carbon Dioxide refrigeration systems	J086A
2.16.19.1 Installation techniques for hydrocarbon refrigeration systems	J076A
2.16.19.2 Commissioning hydrocarbon refrigeration systems	J076A
2.16.20.1 Installation techniques for Ammonia	J080A

refrigeration Systems	
2.16.20.2 Commissioning Ammonia Refrigeration Systems	J080A

2.17 - Refrigeration and air conditioning principles and applications

Essential knowledge and associated skills	Competency Standard Units
2.17.1.1 Refrigeration fundamentals	J003B; J062B; J072B;
2.17.1.2 Basic refrigeration system operating conditions	J003B;
2.17.2.1 Refrigerants	J008B;
2.17.2.2 Split air conditioning refrigerants	J072B;
2.17.2.3 Appliance refrigerants	J062B;
2.17.2.4 High pressure refrigerants	J008B;
2.17.3 Refrigeration systems and compressor operation	J013B;
2.17.4 Air conditioning fundamentals	J004B; J089A;
2.17.5 Central plant air conditioning systems	J067B;
2.17.6 Hydronic systems	J014B;
2.17.7 Beverage dispensers	J015B;
2.17.8 Transport refrigeration systems	J016B;
2.17.9 Ultra-low temperature refrigeration systems	J017B;
2.17.10.1 Post mix refrigeration systems	J018B;
2.17.10.2 Dairy refrigeration systems	J066B;
2.17.11 Ice making systems	J019B;

Essential knowledge and associated skills	Competency Standard Units
2.17.12 Industrial refrigeration systems	J020B;
2.17.13 Refrigeration system analysis	J012B;
2.17.14.1 Refrigeration engineering mathematics fundamentals	J027B;
2.17.14.2 Refrigeration engineering Single-stage mathematics	J065B;
2.17.15 Refrigeration science	J027B;
2.17.16 Heat load estimating of commercial refrigeration	J029B;
2.17.17.1 HVAC load estimating fundamentals	J029B;
2.17.17.2 HVAC load estimating	J043B;
2.17.18.1 Thermodynamics fundamentals	J065B; K040B;
2.17.18.2 Thermodynamics	J038B; J049B; K029B;
2.17.18.3 Heater exchanger design	J049B;
2.17.19 Fluid mechanics fundamentals	J065B;
2.17.20 Materials strength fundamentals	J031B;
2.17.21.1 Noise and vibration control fundamentals	J031B;
2.17.21.2 Single-stage noise and vibration control	J038B;
2.17.22 Refrigeration and food storage technology	J032B; J033B;
2.17.23.1 Industrial refrigeration systems design fundamentals	J033B;
2.17.23.2 Industrial refrigeration system design	None
2.17.24 Commercial air conditioning systems design	J034B;
2.17.25 Statics	J038B;
2.17.26 Commercial refrigeration system design	J041B;
2.17.27 Air conditioning system design	J043B;

Essential knowledge and associated skills	Competency Standard Units
2.17.28 Psychrometrics - Single-stage	J043B;
2.17.29 Exhaust systems design	J044B;
2.17.30 Heating systems design	J045B;
2.17.31 Hydronic system design	J045B;
2.17.32 Sources of technical development and processes for their adoption	J050B;
2.17.33 Refrigeration systems	J063B;
2.17.34 Air conditioning systems	J063B;
2.17.35 Applied psychrometrics	J063B;
2.17.36 Ventilation systems	J064B;
2.17.37 Beverage vending cabinets	J071B;
2.17.38.1 Servicing and repair techniques for Ammonia refrigeration Systems	J079A
2.17.38.2 Operating conditions of Ammonia Refrigeration Systems	J079A
2.17.38.3 Ammonia Refrigeration Systems	J079A
2.17.38.4 Technical standards, regulations and codes for ammonia refrigeration systems	J081A
2.17.38.5 Ammonia refrigeration system design requirements	J081A
2.17.38.6 Ammonia refrigeration system components and piping	J081A
2.17.39.1 Operating conditions of carbon dioxide Refrigeration Systems	J085A, J086A
2.17.39.2 Carbon Dioxide Refrigeration Systems	J085A, J086A
2.17.39.3 Servicing and repair techniques for carbon dioxide refrigeration systems	J085A
2.17.39.4 Technical Standards, Regulations and	J087A

Essential knowledge and associated skills	Competency Standard Units
Codes for carbon dioxide refrigeration systems	
2.17.39.5 Carbon Dioxide refrigeration system design requirements	J087A
2.17.39.6 Carbon Dioxide refrigeration system components and piping	J087A
2.17.39.7 Trans-Critical Carbon Dioxide Refrigeration and Heat Pump Systems	J088A
2.17.40.1 Self Contained Hydrocarbon refrigeration and Air Conditioning systems	J075A
2.17.40.2 Hydrocarbon Refrigeration System Design	J075A
2.17.41.1 Service and repair secondary refrigeration systems	J082A
2.17.41.2 Components of secondary refrigeration systems	J082A
2.17.41.3 Maintenance procedures for secondary refrigeration systems	J082A
2.17.41.4 Technical standards, regulations and codes for secondary refrigeration systems	J083A
2.17.41.5 Secondary refrigeration systems design requirements	J083A
2.17.41.6 Secondary refrigeration system components and piping	J083A
2.17.42 Air Conditioning System Equipment and Component Selection	J091A
2.17.43 Refrigeration System Components & Piping Selection	J090A

2.18 - Safety

Essential knowledge and associated skills	Competency Standard Units
2.18.1 Occupational Health and Safety principles	A001B; A002B; A003B; A004B; A005B; A006B; A010B; A012B; A013B;
2.18.1 Occupational Health and Safety principles	B001B
2.18.1 Occupational Health and Safety principles	C001B; C002B; C003B; C004B; C005B; C006B; C007B; C008B; C009B; C010B; C012B;
2.18.1 Occupational Health and Safety principles	D001B; D002B; D003B; D004B; D005B; D007B; D008B; D009B; D010B; D011B; D012B; D013B; D014B; D015B; D016B; D017B; D018B; D019B; D020B; D021B; D022B; D023B; D024B; D025B; D026B; D027B; D028B; D029B; D030B; D031B; D032B; D033B; D034B; D043B; D046B; D050B; D051B; D052B; D053B; D054B; D055B;
2.18.1 Occupational Health and Safety principles	E001B; E002B; E003B; E004B; E005B; E006B; E007B; E008B; E009B; E010B;; E020B; E021B; E022B; E023B; E025B; E026B; E027B; E028B; E029B; E030B; E032B; E033B; E034B; E035B; E036B; E037B; E079A; E041B; E042B; E043B; E044B; E045B; E046B; E047B; E048B; E050B; E051B; E060B; E061B; E062B; E063B; E064B;
2.18.1 Occupational Health and Safety principles	; F006B; F007B; F008B; ;
2.18.1 Occupational Health and Safety principles	; ; G031B; G032B; ;
2.18.1 Occupational Health and Safety principles	H001B; H004B; H009B; H013B; H015B; H016B; H017B; H018B; H019B; H022B; H023B; H024B; H025B; H026B; H027B; H028B; H029B; H030B; H031B; H032B; H033B; H034B; H035B; H036B; H037B; H040B; H042B; H043B; H044B; H045B; H047B; H048B;

	H049B; H050B; H061B; H062B; H063B; H064B; H065B; H066B; H069B; H070B; H071B;; H073B; H074B; H075B; H076B; H077B; H078B; H079B; H080B; H081B; H082B; H083B; H084B; H085B; H086B; H087B; H088B
2.18.1 Occupational Health and Safety principles	; I015B; I017B; I020B; I030B; I034B; I035B; I036B;
2.18.1 Occupational Health and Safety principles	J002B; J003B; J004B; J005B; J006B; J007B; J008B; J009B; J010B; J011B; J012B; J013B; J014B; J015B; J016B; J017B; J018B; J019B; J020B; J021B; J022B; J023B; J024B; J025B; J026B; J027B; J028B; J029B; J030B; J031B; J032B; J033B; J034B; J035B; J036B; J037B; J038B; J039B; J041B; J042B; J043B; J044B; J045B; J046B; J047B; J048B; J049B; J050B; J051B; J052B; J053B; J054B; J055B; J056B; J057B; J058B; J059B; J089A; J061B; J062B; J063B; J064B; J065B; J066B; J067B; J068B; J070B; J071B; J072B; J073B;
2.18.1 Occupational Health and Safety principles	K001B; K002B; K003B; K004B; K005B; K006B; K007B; K008B; K009B; K010B; K011B; K012B; K013B; K014B; K017B; ; K020B; K023B;;; K027B; K028B; K029B; K030B; K031B; K032B; K033B;; K037B; K038B; K039B; K040B; K051A; K034B; K036B; K042A; K043A; K046A;
2.18.1 Occupational Health and Safety principles	N001B; N002B; N003B; N004B; N005B; N006B; N007B; N008B; N009B; N010B; N011B; N012B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N025B; N026B; N027B; N028B;
2.18.1 Occupational Health and Safety principles	P001B; P002B; P003B; P004B; P005B; P006B; P007B; P008B; P009B;
2.18.1 Occupational Health and Safety principles	R001B; R002B; R003B; R004B;

	R005B; R006B;
2.18.2 Electrical safe working practices	A010B; A012B; A013B;
2.18.2 Electrical safe working practices	E021B;
2.18.2 Electrical safe working practices	; F002B; F004B; F005B; ; F015B;
2.18.2 Electrical safe working practices	G001B;; G003B; G004B; G011B; G012B; ; G031B; G032B; ; G052B; G071B;
2.18.2 Electrical safe working practices	H053B;
2.18.2 Electrical safe working practices	I015B;
2.18.2 Electrical safe working practices	J007B; J009B; J070B;
2.18.2 Electrical safe working practices	K023B;; K027B; K028B; K030B; K033B; K034B; K036B; K037B; K043A;
2.18.2 Electrical safe working practices	N001B; N002B; N003B; N004B; N005B; N006B; N007B; N008B; N009B; N010B; N011B; N012B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N025B; N026B; N027B; N028B;
2.18.2 Electrical safe working practices	P001B; P002B; P003B; P005B; P006B; P007B; P008B;
2.18.3.1 Refrigeration and air conditioning safe working practices	J003B; J006B; J007B; J008B; J009B; J011B; J012B; J013B; J014B; J015B; J016B; J017B; J018B; J019B; J020B; J052B; J053B; J054B; J055B; J061B; J062B; J066B; J067B; J070B; J071B;
2.18.3.2 Split air conditioning systems safe working practices	J005B; J089A; J072B;
2.18.3.3 Safe working practices with hydrocarbon refrigerants	J074A;
2.18.3.4 Safe working practices with carbon dioxide refrigerant	J084A;
2.18.3.5 Safe working practices with Ammonia refrigerant	J078A;

2.18.4 Remote area power supply safe working practices	K001B; K002B; K003B; K004B; K005B; K006B; K007B; K017B; K020B;
2.18.5 Rail safe working practices	N001B; N002B; N003B; N004B; N005B; N006B; N007B; N008B; N009B; N010B; N011B; N012B; N013B; N014B; N015B; N016B; N017B; N018B; N019B; N020B; N025B; N026B; N027B; N028B;
2.18.6 Hazardous area safe working practices	M080A;; M076A;; ; P004B;
2.18.7 Instrumentation safe working practices	I001B; ; I015B; I017B; I019B;
2.18.8.1 Occupational Health and Safety, supervisory responsibilities	E017B;
2.18.8.2 Occupational Health and Safety, enterprise responsibilities	C004B; C005B; C006B; C007B; D048B; E010B; E011B; E012B; E013B; E014B; E015B; E016B; E018B; E024C; E070B; E071B; E072B; E073B; E074B; E075B; E077B; E084B; G075A; G038B; G039B; G069B; G070B; H029B; H030B; H031B; H032B H033B; H040; H041; H044B; H056B; H060B; H076B; H077B; H078B; H079B; 1034B; 1035B; 1036B; 1037B; J040B; J069B; K021B; T001B; T003B; T004B;
2.18.9 Electronic Safe working practices	D002B; D012B; D030B; D052B; D053B; D054B; D055B
2.18.9 Electronic Safe working practices	H001B; H002B; H003B; H004B; H005B; H006B; H008B; H009B; H010B; H012B; H013B; H014B; H015B; H016B; H017B; H018B; H020B; H021B; H022B; H023B; H024B; H027B; H028B; H029B; H030B; H031B; H032B; H033B; H034B; H037B; H040B; H042B; H043B; H044B; H047B; H048B; H049B; H050B; H051B; H052B; H054B; H055B; H056B; H066B; H070B; H071B;; H073B; H074B; H075B; H076B; H077B; H078B;

	H079B; H086B; H087B; H088B;
2.18.9 Electronic Safe working practices	; H088B;
2.18.10 Medical equipment safe working practices	H034B; I015B;
2.18.11 Fire protection equipment safe working practices	H061B; H062B; H063B; H064B; H065B;
2.18.12 Business equipment servicing safe working practices	None
2.18.13 Appliance servicing safe working practices	J051B; J052B; J054B; J055B; J056B; J057B; J058B; J059B; J089A; J061B; J073B; P007B; P009B;
2.18.14 Aerial safety practice	F012B;
2.18.15 Trenching safety practices	F013B;
2.18.16 Documenting hazards and identifying risks	E032B; E033B; E034B; E035B; E036B; E037B;
2.18.17 Powerline safety practices	E049B;
2.18.18 Principles of risk management, applications, practices and techniques	E078B;

2.19 - Special requirements

2.19.28 Fault Find — General principles	P001B;
2.19.29 Disconnect/Reconnect	P001B;
2.19.30 Flexible cords and plugs to 250 V	P002B;
2.19.31 Flexible Cords/Cables and Plugs to 1000 V	P003B;
2.19.32 Disconnect and reconnect HV electric propulsion components	P005B;
2.19.33 High Voltage Flexible Cables and Plugs Exceeding 1000 V	P006B;

2.19.34 Fault Find to 250 V — Motors	P007B; Multi phase motor endorsements, composite equipment, and/or control devices endorsement; P009B Single phase motors endorsement;
2.19.35 Fault Find to 250 V — Water Heaters	P007B Water heater endorsements; P009B Water heater endorsements;
2.19.36 Fault Find to 250 V — General appliances	P002B; P007B General single phase motors, composite equipment, and/or control devices endorsement; P009B General appliances endorsement;
2.19.37 Fault Find to 1000 V - Motors	P007B; Multi phase motor endorsements, composite equipment, and/or control devices endorsement
2.19.38 Fault Find to 1000 V — Water Heaters	P007B; Water heater endorsements
2.19.39 Produce Status Reports Using Established Procedures	P001B; P002B; P003B; P004B; P005B; P006B; P007B; P008B; P009B;

2.20 - Sustainable energy and environment

Essential knowledge and associated skills	Competency Standard Units
2.20.1 Sustainable energy principles	E002B; J005B; J006B;
2.20.2 Environmental and building regulation	E005B; J005B; J006B;
2.20.3 Introduction to renewable energy technologies	K008B; K009B; K010B; K011B; K012B; K013B; K014B; K023B;
2.20.4 Greenhouse reduction strategies	K013B; K014B;
2.20.5 Remote area essential services facilities	K008B; K009B; K010B; K011B; K017B;
2.20.6 Remote area essential services power plant	K011B; K020B;

2.20.7 Remote area essential services waste water facilities	None
2.20.8 Remote area essential services water facilities	None
2.20.9.1 Stand-alone renewable energy system components	K028B; K034B
2.20.9.2 Stand-alone renewable energy system design consideration	K039B;
2.20.10 Hybrid Energy Systems	K033B;
2.20.11 Sustainability and greenhouse reduction strategies	K032B;
2.20.12 Energy efficient building design	K051A; K046A;
2.20.13 Photovoltaic installations	K050A; K034B; K048A;
2.20.14 Photovoltaic power systems	K025C; K034B
2.20.15 Renewable energy system electronics	K027B;
2.20.16.1 Types, construction and operating features of small WECS	K030B; K043A;
2.20.16.2 Installation and maintenance of small WECS	K031B; K043A;
2.20.16.3 WECS siting and performance assessment	K031B; K043A;
2.20.17.1 Micro-hydro systems installation and maintenance processes	K037B; K038B;
2.20.17.2 Micro-hydro systems	K038B;
2.20.18 Solar water heating systems	K029B;
2.20.19 Grid connected inverters	K026C; K035C; K036B; K048A;
2.20.20 Renewable energy heating	K029B;
2.20.21 Distributed generation	K040B;
2.20.22 Environmentally sustainable work practice	K042A;
2.20.23 Environmentally sustainable work practice, supervisory responsibilities	K045A;

2.20.24 Reserved	
2.20.25 RE installations, ELV installation requirements	K049A;

2.21 - System — control and automated

Essential knowledge and associated skills	Competency Standard Units
2.21.1 Machine design and positioning	E064B;
2.21.2 Mechanical drives and engineering	E062B;
2.21.3 Materials and strength of materials	E063B;
2.21.4 Statics and dynamics	E061B;
2.21.5 Single-stage fluid mechanics	I028B;
2.21.6 Electronic interfacing to mechanical processes	I029B;
2.21.7 Electronic control of fluid processes	I027B;
2.21.8 Electronic interfacing to robotic processes	I030B;
2.21.9 Material science	E060B;
2.21.10 Thermodynamics	E060B;
2.21.11 Pneumatics	I026B;
2.21.12 Hydraulics	I026B;
2.21.13 Fluid power control	I025B;

2.22 - Hazardous areas

Essential knowledge and associated skills	Competency Standard Units

Essential knowledge and associated skills	Competency Standard Units
2.22.1 Hazardous areas and explosion-protection principles	M080A; M077A; M031A, M032A, M033A, M034A; M035A, M036A, M037A; M078A; M051A; M052A, M053A; M054A; M055A; M056A; M057A; M058A; M059A; P004B;
2.22.2.1 Principles	M031A;M032A; M033A; M034A; M035A; M036A; M054A; M055A; M056A; M057A; M058A; M059A; M064A; M065A; M066A; M067A; M068A; M069A; M072A; M074A; M080A;
2.19.2.2 Ex certification schemes	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A M027A; M028A; M029A; M030A; M031A;M032A; M033A; M034A; M035A; M036A M038A; M039A; M040A; M041A; M043A; M044A; M045A; M046A; M047A; M048A; M049A; M050A; M054A; M055A; M056A; M057A; M058A; M059A; M064A; M065A; M066A; M067A; M068A; M069A; M072A; M074A; M080A;
2.22.3 Flameproof (Ex'd') explosion-protection technique	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A;; M077A; M027A; M028A; M029A; M030A M031A; M032A; M033A; M034A M035A; M036A; M037A; M038A; M039A; M040A; M041A M042A; M042A; M047A; M048A; M049A; M050A; M051A; M054A; M055A; M056A M057A; M058A; M059A;
2.22.4 Increased safety (Ex'e') explosion-protection technique	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M031A; M032A; M033A; M034A; M035A; M036A; M037A; M038A; M039A; M040A; M041A; M042A; M042A; M047A;

Essential knowledge and associated skills	Competency Standard Units
	M048A; M049A; M050A; M051A; M054A; M055A; M056A; M057A; M058A; M059A;
2.22.5 Non-sparking (Ex'n') explosion-protection technique	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M031A; M032A; M033A; M034A; M035A; M036A; M037A; M038A; M039A; M040A; M041A; M042A; M042A; M047A; M048A; M049A; M050A; M051A; M054A; M055A; M056A; M057A; M058A; M059A;
2.22.6 Intrinsic safety (Ex'i') explosion-protection technique	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M031A; M032A; M033A; M034A; M035A; M036A; M037A; M038A; M039A; M040A; M041A; M042A; M042A; M047A; M048A; M049A; M050A; M051A; M054A; M055A; M056A; M057A; M058A; M059A;
2.22.7 Pressurization (Ex'p') explosion-protection technique	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M031A; M032A; M033A; M034A; M035A; M036A; M037A; M038A; M039A; M040A; M041A; M042A; M042A; M047A; M048A; M049A; M050A; M051A; M054A; M055A; M056A; M057A; M058A; M059A;
2.22.8 Explosion-protection techniques for dusts	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M031A; M032A; M033A; M034A; M035A; M036A; M037A; M038A; M039A; M040A; M041A; M042A; M042A; M047A; M048A; M049A; M050A; M051A; M054A; M055A; M056A; M057A;

Essential knowledge and associated skills	Competency Standard Units
	M058A; M059A;
2.22.9 Common characteristics of explosion-protection techniques	M019A; M020A; M021A; M022A; M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M031A; M032A; M033A; M034A; M035A; M036A; M037A; M038A; M039A; M040A; M041A; M042A; M042A; M047A; M048A; M049A; M050A; M051A; M054A; M055A; M056A; M057A; M058A; M059A;; ;
2.22.10 Hazardous areas installation and maintenance requirements	M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M038A; M039A; M040A; M041A; M042A; M042A; M047A; M048A; M049A; M050A; M054A; M055A; M056A; M057A; M058A; M059A;
2.22.11 Hazardous areas cable termination techniques	M023A; M024A; M025A; M026A; M077A; M027A; M028A; M029A; M030A; M038A; M039A; M040A; M041A; P004B;
2.22.12 Hazardous areas detailed inspection techniques	M042A;
2.22.13.1 Explosion-protected equipment overhaul and repair, general requirements	M031A; M032A; M033A; M034A; M051A;
2.22.13.2 Overhaul and repair requirements specific to each explosion-protection technique	M031A; M032A; M033A; M034A; M051A;
2.22.14.1 Explosion-protected equipment modification, general requirements	M051A;
2.22.14.2 Modification requirements specific to each explosion-protection technique	M051A;
2.22.15 Hazardous areas installation planning	M054A; M055A; M056A; M057A; M058A; M059A;
2.22.16 Common classified hazardous areas	M054A; M055A; M056A; M057A; M058A; M059A;

Essential knowledge and associated skills	Competency Standard Units
2.22.17 Hazardous areas classification techniques	M052A; M053A
2.22.18 Hazardous areas close inspection requirements	M042A; M042A;
2.22.19 Hazardous areas management	M047A; M048A; M049A; M050A; M078A;
2.22.20 Explosion-protected electrical systems design	M057A; M058A; M059A;; ;
2.22.21 Explosion-protected equipment conformity assessment	M035A; M036A; M037A;
2.22.22 Hazardous areas installation testing	M038A; M039A; M040A; M041A;
2.22.23 Explosion-protection visual checks	M080A;
2.22.24 Gas detection—portable devices	M076A;
2.22.25 Gas detection—fixed equipment	M077A; M057A; M058A; M059A;;
2.22.26 Evaluation and selection of gas detection equipment (portable and fixed)	M079A;
2.22.27 Basic properties, behaviour and detection of gases and vapours	M017A; M076A; M077A
2.22.28 Gas detection—Instructions in the use of portable devices	M076A
2.22.29 Gas detection selection and installation design	M079A; P001B
2.22.30.1 Conformity assessment of explosion-protected equipment, documentation	M035A; M036A; M037A; M067A; M068A; M069A
2.22.30.2 Conformity assessment processes	M035A; M036A; M037A; M067A; M068A; M069A
2.22.31 Fitness-for-purpose of equipment for use in a hazardous area	M067A; M068A; M069A
2.22.32 Hazardous areas auditing processes	M064A; M065A; M066A M067A; M068A; M069A

Essential knowledge and associated skills	Competency Standard Units
2.22.33 Reeling, trailing and flexible cables and repair techniques	M070A; M071A; M073A
2.22.34 Electrical fundamentals and cables testing techniques	M071A; M073A
2.22.35 Reeling, trailing and flexible cable plug and coupler inspection and fitting techniques	M072A; M073A

T 2.4 - HV Switching

Essential knowledge and associated skills	Competency Standard Units
T2.4.3 High voltage switching principles	G034B;
T2.4.4 High voltage fault switching principles	G034B;
T2.4.5 High voltage distribution transformer principles	G034B;
T2.4.6 High voltage SWER system	G034B;
T2.4.7 Feeder automation system	G034B;

2 Preliminary Information and Glossaries

Electrotechnology Industry Standards UEE07

Volume 2 Part 1

Preliminary Information

This Volume (Vol 2 Part 1) contains the Definitions/Glossary of Electrotechnology Terms. In addition, the National Occupational Health and Safety Commission Glossary of Terms have been included. Users will find definitions here that clarify any Occupational Health and Safety specific terms. Where a term in the glossary is followed by a number, e.g. *Tools and equipment* (2), the number indicates the AQF level.

Volume 2, Part 2 contains competency standard units and the Essential Knowledge and Associated Skills (EKAS). Each competency standard unit has a reference to the relevant Knowledge and Associated Skills, which are detailed separately from the competency standard units. This is designed to make the package easier to interpret and apply. In the Essential Knowledge and Associated Skills section of each unit there is reference to the relevant EKAS, identified by a unique clause number and title. This separate Essential Knowledge and Associated Skills forms an integral part of each competency standard unit, and all assessment evidence activities and reporting processes are to incorporate this specification.

Training Package Layout

This revised Electrotechnology Industry Training Package has been developed, reviewed and validated through extensive industry consultation. It reflects the views of a wide cross-section of the industry and its key stakeholders/practitioners throughout Australia.

The Training Package has been constructed as a two volume set. Volume 1 covers the overall Package framework and completion requirements for qualifications. Volume 2 includes the content details of parts and sub-sections of Volume 1. The two volumes form an integrated whole and are not to be used independently of each other.

Volume 1

Preliminary Information

Current Membership of the National Steering Group

The Electrotechnology Industry

Part 1 Qualifications Framework

Part 2 Competency Standards Overview and Index

Part 3 Assessment Guidelines

Appendix A — Australian Apprenticeships

Appendix B — Sample Assessment Instruments

Enclosures

- **Enclosure A: List of Sample Assessment Instruments**
- **Enclosure B: Administrative Forms**
- Enclosure C: Glossary of Terms

Volume 2

Preliminary Information

Part 1 Definitions/Glossary

Part 2 Competency Standards

2.1 Competency Standard Units

- A – Assembly
- B – Broadcast
- C – Commercial
- D – Computer systems
- E – Cross discipline
- F – Data and voice communications
- G – Electrical
- H – Electronic
- I – Instrument and control
- J – Refrigeration and air conditioning
- K – Renewable and sustainable energy
- L – Imported
- M – Hazardous areas
- N – Rail systems
- P – Restricted and specialist
- R – Research

2.2 Essential Knowledge and Associated Skills (EKAS)

Part 3 Literacy and Numeracy Skills

Volume 1: Structure and Overview

Part 1 – Qualification Framework

Information in Part 1 outlines how the qualifications are structured, along with their scope/descriptions, composition and content. Completion and issuance requirements are provided as well as advice on flexibility arrangements, with entry and exit pathways and articulation arrangements. Titles and codes of the list of qualifications to be issued are also included.

Part 2 – Competency standards

Information in Part 2 outlines how the competency standards were developed (in broad terms). The industry coverage they apply to, as well as the format and construction of the individual competency standard units is provided. The index of Competency Standard Units and their scope/description is included in this part. Matters related to language, literacy and numeracy, access, equity and cultural diversity, and any regulatory arrangements, for which the competency standard units may apply is also included. Importantly, each competency standard unit is interrelated and linked with the Definitions/Glossary and Essential Knowledge and Associated Skills sections of the Volume. No competency standard unit is to be used in isolation or exported without these interrelated components.

There are nearly 500 competency standard units included in Volume 2, each listed according to their respective industry discipline area.

Part 3 – Assessment guidelines

Information in Part 3 outlines how the assessment guidelines inform RTOs about the infrastructure requirements they will need to enable them to carry out training delivery assessment activities related to the Training Package. This includes assessment systems, the role of the RTO, assessment pathways, recognition arrangements, assessor qualifications and sources of information.

Included in Part 3 are: Appendix A Australian Apprenticeships Application and Appendix B Sample Assessment Instruments. Appendix B also contains Enclosures A, B and C: A – a List of Sample Assessment Instruments, B – Administrative Forms and C – Glossary of Terms.

Volume 2: Competency standard unit's content and scope

Volume 2 Part 1 contains the competency standards units in their respective disciplines: Assembly; Broadcast; Commercial; Computer systems; Cross discipline; Data and voice communications; Electrical; Electronic; Instrument and Control; Refrigeration and air conditioning; Renewable and sustainable energy; Imported; Hazardous areas; Rail systems; Restricted and specialist; Research

Volume 2 Part 2.2 contains the Essential Knowledge and Associated Skills and an Essential Knowledge Matrix mapping the essential knowledge and associated skills to each Unit.

Volume 2 Part 3 contains information and definitions relating to literacy and numeracy skills. Users should refer to this section when developing learning and assessment resources.

Important Note to Users

Training Packages are dynamic documents. They are amended periodically to reflect the latest industry practices and are version controlled. It is essential that the latest version is always used.

Check the version number before commencing training or assessment

This Training Package is Version 1 – check whether this is the latest version by going to the National Training Information Service (www.ntis.gov.au) and locating information about the Training Package. Alternatively, contact the Training Package developer and technical content custodian ElectroComms and EnergyUtilities Industry Skills Council Ltd trading as EE-Oz Training Standards <http://www.eeoz.com.au/> to obtain relevant content advice and confirm the latest version number.

Explanation of version number conventions

The primary release of a Training Package is Version 1. Sometimes when changes are made to a Training Package the version number is changed and sometimes it is not, depending on the extent of the change. When a Training Package is reviewed, it is considered to be a new Training Package and has a new Training Package number rather than a version change. Do not confuse the version number with the Training Package's national code (which remains the same during its period of endorsement).

Note the change of National Code from UTE99 to UEE07 for this Training Package.

In Volume 2, Part 2 the competency standard units and the Essential Knowledge and Associated Skills (EKAS) are found. The competency standard units refer to the Knowledge and Associated Skills in the relevant section of each competency standard unit. Just as the Definitions/Glossary section clarifies the Training Package use of terms the EKAS provides clarification as to the range and depth of coverage more briefly expressed elsewhere in the unit. Users should refer to these important requirements. The competency standard units themselves only refer to the clause number and reference title of the Essential Knowledge and Associated Skill the content of these clauses is found in Volume 2, Part 2.2.1. The separation of the essential knowledge and associated skills from the competency standard units has occurred to facilitate user friendliness for interpretation, applicability and future maintenance. This essential knowledge and associated skills forms an integral part of each competency standard unit and all assessment evidence activities and reporting processes are to incorporate this specification.

Definitions and OHS Glossary

The definitions and glossary in this Part are included to provide further elaboration of the meaning of particular words, phrases and terms used in the Training Package, especially in the competency standards units.

Scope

The Competency Standard Units in this Part of the Training Package cover the Electrotechnology Industry. The definitions provided in the Definitions/ Glossary are those that are to apply to the use of those terms within the Training Package. They are included to provide added clarity of the term and are the meanings generally understood and used by Industry; the regulators, and the community of practitioners.

Application

The information contained in each competency standard unit includes the intended use of the unit for assessment and a training program(s).

References

Regulations

The work functions described by competency standard units in this Training Package may be subject to statutory regulations. Where this is the case the particular regulations will depend on local jurisdictions and knowledge and application of such regulations within the scope of the unit shall be an aspect of evidence in deeming a person competent. Refer to in 1.4 Definitions

Reference documents

Each part of the Training Package will include a list of reference documents. These are a component of competency which assist in developing training programs and assessing competency, which include relevant legislation, regulation, industrial instruments, codes of practice, guidelines and advisory standards and policies. Examples may include industry preferred training and assessment models, anti-discrimination and equal employment opportunity statutes encompassing application of access, equity and cultural diversity principles associated with under-represented groups. They should be used wherever required and currency is to be assured in their application.

Definitions – Electrotechnology

The definition of terms used in this Part 2 of the Training Package form an integral part of the Training Package.

1.4.1 Access permits

A form type document giving formal permission to enter a specified work area when it is safe to do so and is part of the risk control measures for the area.

1.4.2 Accessories

Devices forming part of an electrotechnology system or installation but not including those defined as apparatus

1.4.3 Apparatus

Any device used to convert energy from one form to another and any device used for control or protection of a person, environment or a system.

1.4.4 Appliance

An energy using device, other than a lamp, in which electricity and/or gas is converted to any other form of energy.

1.4.5 Appropriate person

Individuals with responsibilities for design, installation, maintenance, production or servicing activities or a customer or a person of higher authority.

Note:

Examples of an appropriate person is a site manager, a project manager, a line manager, a supervisor a team leader and a customer's representative.

1.4.6 Approved

Acceptable to an authority having jurisdiction

1.4.7 Assessment of competence

The process of checking and confirming demonstrated performance in carrying out specified work activities and/or functions based on evidence that shows a person has carried out such work safely and to requirements.

1.4.8 Australian Qualifications Framework (AQF)

Australian Qualifications Framework Qualifications described in terms of levels characterised by the outcomes of vocational education and training. The Australian Qualifications Framework is intended to provide a comprehensive, nationally consistent, flexible framework for all qualifications in post-compulsory education and training.

1.4.9 Australian Quality Training Framework (AQTF)

A set of nationally agreed Standards to ensure the quality of vocational education and training services throughout Australia. The AQTF includes two sets of Standards:

Standards for Registered Training Organisation

Standards for State and Territory Registering/Course Accrediting Bodies

1.4.10 Authorised

Permission granted by a relevant higher authority to use particular equipment or to carry out specified work.

1.4.11 Authority

Agency representing the interest of another party and with the responsibility to make decisions on their behalf.

Note.

Examples are a customer's representative and agencies responsible for implementation of legislation

1.4.12 Cardiopulmonary Resuscitation (CPR)

An emergency life-support procedure using a combination of expired air resuscitation and external cardiac compression.

1.4.13 Checks, functional

The process of verifying that items of equipment operate as intended. Functional checking is used confined to basic systems.

1.4.14 Checks, visual

The process of identifying defects that is apparent to the eye. Visual checking is used confined to basic systems.

1.4.15 Competency

Competency comprises the specification of knowledge and skills and the application of that knowledge and skill to the standards of performance required in the workplace.

Competency includes all aspects of work performance and not only narrow skills. The four components of competency are: task skills; task management skills; contingency management skills and job/role environment skills.

1.4.16 Competency Standard Unit(s) See also units of competency

A competency standard unit is the group of skills and knowledge required by an individual to carry out a useful work function. Description of Units of Competency is given in Section 2 of this Standard.

A single Competency Standard Unit is not to be confused with a job description that will invariably comprise of a number of competency standard units.

Competency standards are made up of a number of Competency Standard Units. These units describe a key function or role in a particular job function or occupation. Each unit identifies a discrete workplace requirement and includes the knowledge and skills that underpin competency, as well as language, literacy and numeracy and Occupational Health and Safety requirements. A competency standard unit is usually linked to one or more AQF qualifications.

The fields in each competency standard unit and the types of information they contain are given in Table 1.1 below.

TABLE 1.1 Field Titles in a Competency Standard Unit and the types of information they contain

Field Title	Type of information
Unit code	Unit title
Unit Descriptor	1.1) Scope General description of the scope of the work function to which the competency applies and the general abilities needed. 1.2) License to Practice Indicates how technical standards, codes of practice and regulatory requirements apply to the Unit and whether a licence to practise is required.
Prerequisite Units	2) Prerequisites 2.1) Competency Standard units Specific and general competencies expected to have been achieved prior to undertaking training in the unit. 2.2) Literacy and numeracy skills

Field Title	Type of information
	Informs the reading, writing and maths skill level needed to achieve competence in the unit. (see Volume 2 Part 3).
Employability Skills	3) Generic competencies related to enabling skills for workplace employment activities
Application of the unit	4) Application The way in which the Unit is intended to be used in a learning program or qualification
Competency field	5) Discipline The sector of the electrotechnology industry to which the unit mainly applies.
Elements and Performance Criteria	6) Elements Outcomes that contribute to a unit. Performance Criteria Specify the required levels of performance for each Element.
Required skills and knowledge	7) Essential knowledge and associated skills Knowledge that is either explicit or implicit for effective performance.
Range Statement	8) Range Range of context and conditions to which performance criteria apply.
Evidence Guide	9) Evidence guide Assists with the interpretation and assessment of the unit
Overview of assessment	9.1) Overview Provides a summary of appropriate assessment methods and what they encompass.
Critical aspects of evidence required to demonstrate competency in this unit	9.2) Critical Aspects of Evidence Particular knowledge and skills essential to effective performance.

Field Title	Type of information
Context and specific resources for assessment	9.3) Context Environment and resources acceptable for assessing achievement of competency. Informs of the resources needed when simulating real the work place is considered and indicates when simulation of the workplace may be a viable or necessary.
Methods of assessment	9.4) Assessment Methods Indicates the acceptable methods of assessment which are specified in Section 3 of this document.
Concurrent assessment and relationship with other units	9.5) Concurrency Identifies where benefits may be derived by assessing two or more units concurrently or sequentially.

- **1.4.17 Competency Standards**

Competency Standards are the collection of competency standard units for a particular industry sector and are an integral part of a Training Package.

The competency standard units described in this document are part of the Electrotechnology Industry Training Package UEE07.

- **1.4.18 Complex**

Made up of many interrelated parts the behaviour or performance of which affect the behaviour or performance of the whole.

Note.

Examples in the context of electrotechnology are systems with many interworking subsystems, complex work activities such as some testing procedures and aspects of some essential knowledge.

- **1.4.19 Compliance**

An installation or equipment that conforms to relevant regulations which may include technical standards, codes or practice and the like.

- **1.4.20 Computer system**

Computer hardware, software and connectivity components that make up a system to operate, control or analysis a process.

- **1.4.21 Consistent performance**

Relates to sufficient evidence being present. This requires evidence that competence has been demonstrated for each element of each unit having been achieved at least twice; autonomously and to requirements.

- **1.4.22 Defects**

Physical or performance aspects of an installation or equipment that do not comply with the relevant regulations, standards or job specifications.

- **1.4.23 Documentation**

Written information, either hard or soft copy, related to a work function.

Note.

Examples of documentation are forms, work instructions, specifications, drawings, reports

- **1.4.24 Electrical installation, general**

All parts of an electrical installation in a building, structure and premises that are not designated as special electrical installations or those related to hazardous areas.

- **1.4.25 Electrical installation, special**

Electrical installation related to moveable premises and caravan parks, shows and carnivals, boating marinas, medical treatment areas, cranes and hoists, lifts, electric fences and construction and demolition sites.

- **1.4.26 Electronic sub assemblies**

An assembly of connected electronic components designed for a particular function that forms part of an electronic apparatus or system.

- **1.4.27 Enterprise standards**

Standards of management, performance, service or product established by an enterprise.

- **1.4.28 Endorsement**

The variations in equipment or function in which an individual demonstrates competence relevant to a competency standard unit. An endorsement applies to competency standard unit in the disciplines of 'Hazardous areas' and 'Restricted and special electrical work' and is shown by a suffix to the unit title. Details of endorsements are given in the competency standard units where they apply

- **1.4.29 Equipment**

Any component part or apparatus accessory of an electrotechnology system or installation

- **1.4.30 Established procedures**

Formal arrangements of an organization, enterprise or statutory authority of how work is to be done and by whom.

Note.

Examples of established procedures are documented in quality management systems, safety management systems, work clearance systems, work instructions, work procedures, standard operating procedures, reporting systems and arrangements for dealing with emergencies.

- **1.4.31 Essential knowledge and associated skills (EKAS) knowledge and skills specification (KKS)**

Provide specific advice in facilitating consistency and reliability in resource development and delivery. The knowledge and skills specifications are premised on the separate content of the essential knowledge and associated skills section of the expanded Volume 2 - Essential Knowledge and Associated Skills clauses, which are referred to in each competency standard unit.

The specifications are designed to:

- provide the depth and breadth of essential knowledge and associated skills to be learned
- ensure they support the needs of the workplace
- contain assessment strategies, including a table of specifications to increase validity, reliability and fairness
- detail the resources required for satisfactory delivery in the learning environment
- provide clarification regarding the type and quantity of evidence needed for assessment purposes
- support a variety of delivery modes, e.g. face-to-face, distance or computer- assisted learning
- provide content and structure that maximises learning retention
- provide a clear purpose statement about their relationship to the overall educational program.
- **1.4.32 Established routines**
Strict procedures for carrying out a work activity or task often formalised in the form of work instructions.
- **1.4.33 Explosion protection**
Techniques applied to the design of electrical equipment, components and systems to prevent the electrical energy from becoming an ignition source in the presence of flammable vapours and gases or combustible dusts in hazardous areas.
- **1.4.34 Fall prevention**
Safe working practices intended to prevent persons or objects from falling from a height regarded as hazardous.
- **1.4.35 Hazard**
Something with the potential to cause injury or disease to persons, damage property or disrupt productivity.
- **1.4.36 Hazardous area**
Area in which an explosive atmosphere is present or may be expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical equipment. Hazardous areas may include a variety of adverse environmental conditions such as those encountered in coal mines, shipping, oil/gas platforms and the like, which commonly require further specifications stated in legislation or regulatory requirements.
- **1.4.37 Hazardous area records**
Records that show a hazardous area has been appropriately classified and the electrical equipment complies with the appropriate certification and other relevant requirements specific to the site. Generally referred to as a 'Verification Dossier'
- **1.4.38 Industry standards**
Standards of management, performance, service or product established by a representative Industry Body. This Training Package is an example of an industry standard.
- **1.4.39 Inspection, actions taken**
Actions taken by an inspector in relation to defects in an installation

Note:

Examples of such actions are disconnection or non-connection of supply until a defect is rectified, notice of the period in which it has to be rectified, other actions within the scope of inspection authority.

- **1.4.40 Inspection, audit**

An inspection that reviews the regulatory obligations of enterprise. Audit inspections may involve reviewing records of work, inspection of safety equipment and inspection of recently completed work.

- **1.4.41 Inspection, close**

An inspection which encompasses those aspects covered by a visual inspection and, in addition, identifies those defects, e.g. loose fasteners, which will become apparent when access equipment, e.g. steps, and tools are used. Close inspections do not normally require an enclosure to be opened or equipment de-energised.

- **1.4.42 Inspection, detailed**

An inspection that encompasses those aspects covered by a close inspection and, in addition, identifies those defects that only become apparent when an enclosure is opened up, or by use of tools and test equipment.

- **1.4.43 Inspection, visual**

An inspection that identifies, without the use of access equipment or tools, those defects that are apparent to the eye.

- **1.4.44 Install**

1. The act of placing and permanently fixing equipment in place in a building or premises.
2. Placing and setting up an operating system and application software on a computer or network.

- **1.4.45 Installation**

Installation includes all equipment and component parts or a system as they are fixed in place and connected as necessary, to operate as intended.

Note.

Examples of installations are antenna installations, electrical installation, home entertainment installations and refrigeration installation.

- **1.4.46 Key competencies**

Generic competencies enabling effective participation in work and their incorporation in the Units of Competency (see Appendix A).

- **1.4.47 Knowledge and Skills Specification (KKS)**

See Essential Knowledge and Associated Skills (EKAS).

- **1.4.48 Maintain**

Ensuring systems, equipment or apparatus continue to work properly by checking, repairing faults, rectifying malfunction and making adjustments as required.

- **1.4.49 Maintenance, scheduled**

A formal process of periodically checking, overhauling and replacing equipment and/or components based on the assessment of risk associated with their failure during operation.

- **1.4.50 Non-compliance**

Aspects of an installation or equipment that do not satisfy the applicable regulations, standards or requirements.

- **1.4.51 OHS policies and procedures**

Arrangements of an organization or enterprise to meet its legal and ethical obligations of ensuring the workplace is safe and without risk to health. (See also Glossary of OHS Terms)

Note:

Ensuring a workplace is safe will include hazards identification and risk assessment mechanisms, implementation of safety regulations, safety training, safety systems incorporating work clearance procedures, isolation procedures, use of protective equipment and clothing and use of codes of practice.

- **1.4.52 Permit, clearance to work**

A system that authorises, in writing, specified work activities to be carried out in a specified work location at a specified time as part of the risk control measures. The system includes safety procedures that shall be followed before authorisation is given.

Note.

Examples include work permit systems operate in the electricity supply sector, in petrochemical plants, in refineries, in heavy manufacturing and in rail networks

- **1.4.53 Process control**

Control of actions used in the manufacture, analysis and modification of materials.

- **1.4.54 Process control system**

System used to control processes

- **1.4.55 Regulated environment**

Are those requirements that are to be met for regulated purposes including but not limited to licensing regimes; registration regimes; industrial instruments and/or arrangements; standards; codes of practice; industry wide preferred approaches encompassing industry policies and guidelines advised for respective Training Package non-endorsed implementation.

- **1.4.56 Reporting**

Formally written or computer entered and stored document detailing the outcomes of a work activity. (See 1.4.15 Documentation)

- **1.4.57 Requirements**

That to which equipment and procedures and their outcomes shall conform and includes statutory obligations and regulations and Standards called-up by legislation or regulations; or manufacturers', regulatory or industry requirements

Requirements may include codes of practice, industry policies, job specifications, Australian/New Zealand or International Standards called up in specifications be they - conformity notices, procedures and work instructions, and quality management systems, as well as transport documentation, manufacturers' specifications, maintenance manuals, schedules and specifications/standards, circuit/cable schedules, design specifications, customer/client requirements and specifications and national and state guidelines, policies and imperatives relating to the environment

- **1.4.58 Representative range**

That which requires a sufficient body of evidence undertaken across a range of activities and work functions to be present in order that a valid, reliable, fair and timely judgement about an individual's performance for attributing competence can be made. The range of systems, apparatus, equipment, accessories, applications, processes, and/or techniques referred to in the unit should be such that a peer group of industry practitioners would readily conclude that competency has been demonstrated. See competency standard unit for more information and in relation to the body of evidence required refer to the Assessment Guidelines of this Training Package.

- **1.4.59 Risk assessment**

Process of evaluating the likelihood and consequences of occurrences that would have an adverse affect on safety, health and the environment of a work area and the operation and viability of an enterprise.

- **1.4.60 Risk control measures**

Methods and equipment for preventing risk of injury or damage from a hazard. Many risk control measures have been established and formalised in standards and codes of practice.

- **1.4.61 Safe design principles**

Principles applied in the design of a product that take into account means to reduce harmful affects to both persons and the environment during its manufacture, its use and its disposal at the end of the life of the product.

- **1.4.62 Safe working**

System of procedures used to ensure safety in work and operation related to rail systems.

- **1.4.63 Servicing**

Maintaining, fault finding / troubleshooting and repair of equipment, plant machinery and/or installations.

- **1.4.64 Set-up**

Place in operation equipment that requires certain procedures to be followed before it can be used. Typical items of equipment that require setting up are appliance, computers and home entertainment equipment.

- **1.4.65 Simulation**

Where simulation is considered a suitable strategy for assessment, conditions must be authentic and as far as possible reproduce and replicate the workplace and be consistent with the approved industry simulation policy.

Note:

Six principles have been developed to govern the conduct of assessment in simulated environments; however, the underpinning principle in relation to off-the-job workplace simulation is that "actual tasks, activities and conditions are as close as possible to real life situations": 1. Reflect workplace conditions, 2. Reflect the intent of the Electrotechnology Training Package, 3. Involve Realistic and Authentic Activities, 4. Facilitate Profiling, 5. Support Holistic Judgements, and 6. Undergo Quality Assurance Processes.

- **1.4.66 Skills enabling employment**

A range of generic employment based skills that are expected of individuals in a workplace. (See Volume 2 Part 5)

- **1.4.67 Specifications**

All those attributes that define accurately the nature of the involved hazards, materials/products, processes, equipment and installation design.

Note:

Examples of specifications are design and manufacturer specifications defining all the necessary parameters and tolerances, process flow diagrams, explosive characteristics and technical data sheets for hazardous materials and products.

- **1.4.68 Standard, deemed to comply**

A guide setting out methods and materials that if applied in the prescribed way will satisfy the requirements of a performance-based technical standard.

- **1.4.69 Standards, technical**

Technical documents which set out specifications and other criteria for equipment, materials and methods, to ensure they consistently perform as intended. The Standards referred to are **those published by Standards Australia or an industry association.**

- **1.4.70 Sustainable energy, practices**

Working in a way that eliminates unnecessary energy use and material waste and disposes of the necessary waste with minimal effect on the environment and in compliance with regulation.

- **1.4.71 Training Package**

A Training Package is a set of nationally endorsed Standards and qualification for recognising and assessing people's skills. A training package specifies the outcome of training and is not a prescription of how an individual should be trained.

- **1.4.72 Unit of competency**

See competency standard unit.

- **1.4.73 Vocational standard**

See competency standard unit.

- **1.4.74 Voltage, extra-low**

Not exceeding 50 V a.c. or 120 V d.c.

- **1.4.75 Voltage, high**

Exceeding low voltage

- **1.4.76 Voltage, low**

Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

- **1.4.77 Work instructions**

Strict and formal instructions on how a work activity or task is to be carried out.

- **1.4.78 Work platform**

Equipment specifically designed to access a work area out of normal reach above the ground or floor level.

Note.

Examples are step ladders, extension ladders, scaffolding, pole platforms, 'cherry pickers' and the like.

- **1.4.79 Workplace procedures**

See 1.4.29 Established procedures

- **1.4.80 Work site protection**

Processes and procedure to manage or prevent the passage of trains over a section of (rail) track for which possession has been acquired so that maintenance or repair work can be carried out.

Additional Glossary terms for Occupational Health and Safety

Introduction

This Glossary of Occupational Health and Safety (OHS) Terms has been developed to assist competency developers and writers, reviewers of training packages and those developing any training specification or learning materials for the Vocational Education and Training Environment.

In Australia we consider that the rate of workplace fatality, injury and ill-health is far too high. To reduce this toll we need to make some changes in the workplace and this requires training to enable enterprises and workers to effectively manage safety.

We must ensure that OHS is clear in the competency so that the resultant learning contributes to improving the capacity of those in the workplace to manage safety. This applies not only to the ‘designated’ OHS units but to the integration of OHS, as appropriate, into all competencies, learning programs and learning resources.

The competency, TAADES505A *Research and develop competency standards*, specifies the outcomes and the knowledge and skills required to research and develop documents which outline competency requirements for a particular job function, work process, work role or specific vocational outcome. This competency cites four phases in developing a competency:

1. Research the competency area
2. Formulate competency specifications
3. Validate competency specifications
4. Finalise competency specifications.

OHS is a critical aspect of research into the competency area, and also an important aspect of work performance to be integrated within a competency.

To some extent OHS has its own language. OHS is ‘owned’ by many people as it impacts on all of us, however key words and terms are not always used in a consistent manner and this can lead to confusion. To maximise the effectiveness of our training and education we need to ensure that our use of the OHS language is as consistent and clear as possible.

This glossary is not intended as a definitive dictionary of OHS terms but is designed to be used in the second phase of competency development which is to formulate the competency specifications. It is also an invaluable tool for those involved in the design and development of learning resources.

Further information on OHS hazards, practical guidance material, standards and codes of practice is available at the National Occupational Health and Safety Commission website at www.nohsc.gov.au

The glossary is intended to be an evolving and dynamic document and those wishing to comment on the terms or suggest additions or modifications should email the Team Leader of the OHS Skills Development Team at NOHSC.

GLOSSARY OF OHS TERMS

NOHSC Glossary	Explanation
Accident	A term that is now considered out of date. Preferred term is 'incident'.
Accountability	The process by which a person with OHS responsibilities is answerable to a higher authority.
Action level	The level at which a risk is considered to be unacceptable and action is required to reduce the level of risk. May be specific such as a noise level at which hearing protection must be worn, a concentration of chemical or more generic.
(OHS) Action plans	Documented plans developed within the workplace to implement OHS management, which include allocated responsibilities and time frames.
Administrative controls	Management practices that aim to control employees' exposure to specific hazards, and generally improve health and safety – examples include the use of job rotation, job enlargement
ALARA (As Low As Reasonably Achievable)	A basic concept where risks are kept as low as is reasonably achievable. ALARA is determined by reference to established codes and standards and consultation with groups impacted by the decision outcomes including those exposed to the risk.
Anthropometry	The science dealing with the comparative measurement of the size and proportions of the human body, the range of

NOHSC Glossary	Explanation
	movement of limbs, as used in ergonomics.
(OHS) Audit	A systematic examination against an agreed benchmark of the approach to managing safety to evaluate an organisation's arrangements for identifying hazards, assessing and controlling risks, and monitoring and improving the effectiveness of the management of OHS and compliance. (Note a workplace inspection is NOT an audit.)
Audit tools	The instruments for collecting evidence and conducting the analysis and evaluation (they are not the same as the audit criteria or benchmark), they may be: • developed specifically for the purpose • adapted from existing tools • purchased or accessed from existing tools • and include: • performance checklists • sets of questions to be asked • descriptions of required characteristics to be checked • limitations for and instructions for use
Authorisation of permit	Signing of permit by competent person.
Biomechanics	The application of mechanics (forces and motion) to analyse body movement and the stresses involved in body posture during movement.
Causative event	Key event that resulted in the particular outcome(s) of injury or damage.
Circumstance	Short-term situation that is relatively unusual, such as a storm or when a key person is absent.
Certification	Refer 'operator certification.
Common law	Law that is derived from the English legal system and has evolved through judicial decision and practice (case law) that establishes and follows precedent. Note difference to 'statute law'.
Condition	Permanent situation such as type of equipment, work practice, design of work environment (often different to detect or identify) that may contribute to risk.
Consequence	The injury or damage outcome of an event, which may be expressed quantitatively or qualitatively; there may be a range

NOHSC Glossary	Explanation
	of possible outcomes for a specific event or scenario.
Confined space	An enclosed or partially enclosed space which- • is at atmospheric pressure during occupancy • is not intended or designed primarily as a place of work, and is liable at any time to - • have an atmosphere which contains potentially harmful levels of contaminant • not have a safe oxygen level or • cause engulfment, and • may have restricted means for entry and exit. A confined space is determined in part by the hazards associated with a defined set of circumstances (restricted entry or hazardous atmosphere, risk of engulfment) and not just with work performed in a restricted space. Examples include but may not be limited to: storage tanks, tank cars, process vessels, boilers, pressure vessels, silos and other tank-like compartments open-topped spaces such as pits or degreasers pipes, sewers, shafts, ducts and similar structures shipboard spaces entered through a small hatchway or access point, cargo tanks, cellular double bottom tanks, duct keels, ballast and oil tanks and void spaces (but not including dry cargo holds). A person is deemed to have entered a confined space when their head (i.e. the breathing zone) or upper part of the body is within the boundary of the confined space. (Note that inserting an arm for atmospheric testing is not considered an entry to a confined space). References: • AS/NZS 2865:2001 Safe working in a confined space • Handbook - HB 213:2003 Guidelines for safe working in a confined space
Consultative arrangements	State and territory OHS legislation specifies obligations for workplace consultation. The workplace arrangements to meet these obligations may include: • OHS and other consultative and planning committees • health and safety and other employee representatives • employee and supervisor involvement in OHS activities

NOHSC Glossary	Explanation
	such as inspections and audits • procedures for reporting hazards, and raising and addressing OHS issues • employee and workgroup meetings. Factors that should be considered when developing consultative arrangements include: • language • shift work and rostering arrangements • timing of information and data provision • literacy and numeracy levels • workers with special needs • workplace organisational structures (for example, size of organisation, geographic, hierarchical) • cultural diversity • management approach • workplace culture and approach to OHS by managers, supervisors and employees.
Controls	The devices and methods of controlling the effect of the hazard so that the risk of injury is minimised. The ‘quality’ of the control is the level and reliability of the control compared with the level of risk. The quality of the controls is determined by: • the best available technology or approach should be applied when the most probable outcome is death or serious injury • the best practical technology or approach may be applied where the most probable outcome is less serious Refer also ‘Hierarchy of control’. Workplace factors that impact on the controls selected and the implementation include: • language • shift work and rostering arrangements • literacy and numeracy • workplace organisational structures (e.g. geographic, hierarchical) • cultural diversity • training required • workplace culture related to OHS, including commitment by managers and supervisors and compliance with procedures and training.

NOHSC Glossary	Explanation
Control measures	Devices, systems (including work methods) or approaches that reduce exposure to workplace hazards

Crisis management plan A flexible document that can cope with a broad range of crisis types and:

- is approved at the highest levels of the organisation
- focuses on management control
- identifies responsibilities for decision making
- details communication processes and psychological support
- addresses arrangements with any contractors or shared tenancy
- integrates the emergency response plans as well as recovery
- incorporates dealing with external agencies and support
- addresses planning for recovery before crisis occur.

Documentation for crisis management plan may include

- policy, emergency response structure, initial response instructions for various roles/areas, responsibility and authority of individual roles, warning systems, training requirements, resource inventory for response and recovery, program review and monitoring processes; and
- crisis risk management documentation, such as risk management team lists, communications strategies, identification of issues, risk assessments/evaluations, vulnerability profiles, risk registers and treatment strategies.

The term ‘emergency management’ may also apply but ‘crisis management’ infers a more holistic approach encompassing the full range of business affairs.

Dangerous Goods (DG) Those gases, liquids and solids identified and classified under the internationally agreed system which is followed in Australia and that are subject of so called ‘dangerous goods’ standards and legislation.

The objective of the Dangerous Goods legislation is to control the storage, handling and transport of DGs to protect the safety of workers, the public, property and the environment. While dangerous goods may also be hazardous the terms should not be confused.

Dangerous parts of plant Potential contact or entrapment points to which the operator

NOHSC Glossary	Explanation
	may be exposed during: • operation • examination • lubrication • adjustment • maintenance.
Design	The process of bringing together innovation, aesthetics, and functionality to plan and create a product, processor system to meet the artistic, industrial or performance requirement of an individual or group. The Design Process involves a series of activities where an idea is conceived, shaped, developed, produced and then acted upon to produce a designed-product. It also includes any subsequent alteration of a designed-product (redesign or retrofit).
Design process	The stages of the design process include: The concept design phase considers preliminary design options, which are assessed against product specifications to determine the best preliminary design to be developed. This phase includes concept design, research and development, feasibility and risk management (including OHS risks). The detailed design phase develops the selected design to its final state. It includes research and development, feasibility studies, concept and detail design, technical and functional specifications, plans and drawings, operational systems, construct/manufacture options and detailed quantities, cost and risk analysis (including analysis of OHS risks).
Designed-product	The item to be designed, including a built environment, structure, an item of plant or equipment, chemical, work system or process; or any other physical attribute or system associated with either the work or its interface with people.
Duty of care	Arises from common law but is enshrined in OHS statute law and / that places into a legal form a moral duty to anticipate possible causes of injury and illness and to do everything reasonably practicable to remove or minimise these possible causes of harm. The key factors relating to duty of care are that: • duty of care applies wherever there is special relationship (employer – employee, employer-contractor, supervisor – work team member, tradesperson-apprentice) • duty of care applies to all circumstances of the

NOHSC Glossary	Explanation
	relationship - individual duty of care cannot be delegated (but roles and functions may be delegated) - applies personally to individuals - applies to all risks that are foreseeable and preventable - includes the concept of ‘reasonable’.
Elements of systematic approaches to managing OHS including OHSMSs	A list of key requirements or major principles that are combined in a methodical and ordered manner to minimise the risk of injury or ill health in the workplace; and may include processes of OHS planning, allocation of resources, communication and consultation, hazard management, record keeping and reporting, training and competency, and review and evaluation for ongoing improvement of OHS.
Emergency	Events such as: - serious injury events - emergencies requiring evacuation - fires and explosions - hazardous substance and chemical spills - explosion and bomb alerts - security emergencies, such as armed robberies, intruders and disturbed persons - internal emergencies, such as loss of power or water supply and structural collapse - external emergencies and natural disasters, such as flood, storm and traffic accident impacting on the organisation. May also be referred to ‘hazardous event’.
Emergency agency	Includes fire, police, ambulance, relevant government departments, hazardous materials response teams (HAZMAT) and OHS authorities
Emergency control organisation (ECO) is:	Structured group within the organisation that includes roles such as emergency controller, communications recorder, media liaison and employee support.
Emergency equipment	Includes: - first aid equipment - eye wash shower or portable eye washes - fire extinguishers and equipment - communication equipment - evacuation alarms

NOHSC Glossary	Explanation
	• evacuation equipment, especially that for disabled persons • torches • clothing items such as coloured hats and vests.
Emergency stops and warning devices	Are fitted to plant and equipment that have a risk of entrapment or other hazard and must be: • prominently, clearly and durably marked • coloured red (push buttons, bars or handles) • unable to be affected by electrical or electronic circuit malfunction • fitted where risk assessment identifies a need.
Enforcement	Processes and instruments available to the OHS regulator under legislation may include: • prosecution • prohibition notices • improvement notices • on-the-spot fines • provisional improvement notices.
Epidemiology	The study of the distribution and determinants of disease within human populations. Patterns of injury or illness in groups of people are studied to determine causes, identify groups at risk and to identify and evaluate methods of treatment and prevention.
Ergonomics	The study of the relationship between people, the equipment they use and their physical and social work environment.
Ergonomic interventions	Includes: • design of tools • design of workplaces • design of products • design of equipment • design of work systems, processes or organisation including work flow, planning and control • job design • development of new decision making processes • new forms and organisations of work
Ergonomic tools and databases	May include: • engineering models • Australian and International Standards

NOHSC Glossary	Explanation
	Australian and International anthropometric databases
Explosive substance	Substance that explodes if it comes into contact with heat, flame, an ignition source or incompatible substance.
Fail-to-safe	Design feature of equipment that ensures if there is a failure or defect in the product, or another factor such as loss of power, then the product is left in a safe condition.
Functional areas and management systems	Other than OHS but that impact on the management of OHS may include: strategic planning purchasing, procurement and contracting logistics HR, IR and personnel management, including payroll engineering and maintenance information, data and records management finance and auditing environmental management quality management.
Guarding	Devices fitted to machinery to separate the operator from dangerous parts of the machine. Devices may include: - permanently fixed physical barriers where no access of any part of a person is required - interlocking physical barriers where access to dangerous areas is required during operation - physical barriers securely fixed by means of fasteners or devices - presence-sensing safeguarding systems.
Hazard	A source or a situation with a potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these.
Hazards of long latency	Conditions, illnesses and other health risks that result from longer term exposure to specific triggers such as chemicals, noise, radiation and psychosocial factors.
Hazards of low frequency/high	High impact events that occur rarely such as explosions, fires and building collapses but may result in very serious injury,

NOHSC Glossary	Explanation
consequence	death or multiple death situations.
Hazard identification	The process of identifying sources of harm. Hazard identification may be required: • at design or pre purchase of buildings, equipment and materials • at commissioning or pre-implementation of new processes or practices • before new forms of work and organisation of work are implemented • before changes are made to workplace, equipment, work processes or work arrangements • as part of planning major tasks or activities, such as equipment shutdowns • following an incident report • when new knowledge becomes available • at regular intervals during normal operations • prior to disposal of equipment, buildings or materials. Different methods may be used to identify hazards including observation; consultation with workers, clients or other users; trial of models or prototypes; review of technical standards and other information sources; monitoring and measurement.
Hazard identification tools and processes	Include: • analysis of incident investigations • analysis of incident, injury and claims statistics • workplace inspections • job safety analysis (JSA) • audits • cause and effect diagrams • surveys • review of research and industry literature
Hazardous event	Includes incidents with the potential to seriously harm life, health, property, the environment or a combination. May also be referred to as ‘emergencies’.
Hazardous substance	A substance that is listed on the National Commission’s <i>List of Designated Hazardous Substances</i> (NOHSC:10005) or has been classified as a hazardous substance by the manufacturer or importer in accordance with the National Commission’s <i>Approved Criteria for Classifying Hazardous Substances</i> (NOHSC:1008).

NOHSC Glossary	Explanation
Hazardous substance register	Listing of all the hazardous substances that are used or produced in a workplace together with a current Material Safety Data Sheet for each substance. May also contain risk assessments for individual hazardous substances.
HAZCHEM	An initial response emergency action code that provides information vital to emergency services to enable them to stabilise the incident scene during the early stages of a HAZMAT incident. The Code is displayed on emergency information panels on transport vehicles and on signs on buildings. HAZCHEM codes are assigned to chemicals on the basis of their flammability, toxicity, reactivity and other relevant chemical and physical properties.
HAZMAT	A contraction of the words 'hazardous materials' and may be used in a range of circumstances including HAZMAT emergency response units, HAMAT emergency response equipment and HAZMAT registers of hazardous substances.
HAZOP (Hazard and Operability Study)	An advanced risk analysis technique that involves a systematic review of a process to determine risks and risk minimisation strategies.
Health and safety representative	An employee, elected by the workgroup, who represents the OHS interests of the people with whom they work. The function is carried out in addition to the normal work role. Processes for election of health and safety representatives, their role and rights are specified in state and territory legislation.
Health promotion	The promotion of health, especially as a workplace program, designed to improve and enhance employee health undertaken as a complementary activity to the prevention of work-related injury and disease. Also called wellness.
Health surveillance	Monitoring or checking individuals for the purpose of identifying changes due to exposure to hazards in the workplace. May include biological monitoring.
Hierarchy of control	The priority order in which hazard and risk controls should be considered with the eventual outcome often being a combination of measures. The prime emphasis is on: • elimination, and where this is not practicable, minimisation of risk by: • substitution

NOHSC Glossary	Explanation
	• isolating the hazard from personnel • engineering controls • administrative controls (e.g. procedures, training) • personal protective equipment (PPE).
Hot work	Involves using equipment that generates heat, sparks, flames or any other sources of ignition in an atmosphere that may be flammable. Includes work with welders, cutters including oxygen cutters, power tools, grinding, mobile phones. Hot work can also include breaking into ‘live’ equipment or performing work on live equipment that has the potential to release its contents (e.g. hot tap in chemical plants).
Housekeeping	Describes workplace and personal routines designed to improve hygiene and safety, for example, cleaning up spills and keeping walkways, exits and traffic areas clear.
Incident	An event that has caused or has the potential for injury, ill-health or damage. (‘Incident’ is the preferred term rather than ‘accident’)
(Sources of OHS) Information:	May be internal and include: • hazard, incident and investigation reports • workplace inspections • incident investigations • minutes of meetings • Job Safety Analyses (JSA’s) and risk assessments • organisational data such as insurance records, enforcement notices and actions, workers compensation data, OHS performance data • reports and audits • material safety data sheets (MSDSs) and registers • employees handbooks • employees including questionnaire results • OHS advisors • manufacturers’ manuals and specifications. Or external, including: • regulatory bodies and OHS Acts regulations, codes and guidance material • other relevant legislation • National Occupational Health and Safety Commission (NOHSC) and Australian Bureau of Statistics • databases such as national and state injury data and

NOHSC Glossary	Explanation
	NICNAS (National Industrial Chemicals Notification and Assessment Scheme) • OHS specialists and consultants • newspapers and journals, trade/industry publications • internet sites • industry networks and associations including unions and employer groups • OHS professional bodies • research information.
Isolation	A safety device system that includes devices such as isolating switches, locks, safety bars, shields, full pressure blanks, spectacle blanks to lock controls, especially moving parts, equipment, systems or devices with stored energy, to an 'off' position while a worker is in a vulnerable position such as carrying out maintenance on rotating equipment, and electrical and hydraulic systems. Isolation systems generally use locking switches that need keys to open the lock and are used in conjunction with a danger tag system that promotes greater safety consciousness amongst the workforce for all situations in which danger to persons could arise from: • the operation of machinery, plant or equipment • the flow of steam, electricity, gases or liquids • the use of faulty or unsafe plant and equipment • include multiple locking systems and involve written authorisation by a competent person Also called 'lock-out' and 'tag-out'.
Job Safety Analysis (JSA)	Process of examining all aspects of a task to identify hazards and conditions with a potential for injury or ill health with the objective of developing risk controls including written job instructions.
Legislation relevant to OHS	Includes Commonwealth and relevant State / Territory OHS specific acts and regulations as well as: • workers compensation • privacy legislation • contract law • trade practices • criminal law • common law • industrial relations law

NOHSC Glossary	Explanation
	equal employment opportunity and anti- discrimination law
Life-cycle	All phases in the life of a product. Specific phases depend on the type of product but may include design, development, manufacture, construction, assembly, import, supply, distribution, sale, hire, lease, storage, transport, installation, erection, commissioning, use or operation, consumption, maintenance, servicing, cleaning, adjustment, inspection, repair, modification, refurbishment, renovation, recycling, resale, decommissioning, dismantling, demolition, discontinuance, disposal.
Likelihood	The likelihood of the occurrence of the consequence, not the likelihood of the hazard or the particular scenario.
Locked out	Equipment, which is not to be operated for any reason, may be pad-locked or otherwise prevented from operation using a keyed lock. A lockout may be accompanied by a tag out, or a lock out system may incorporate a tag. Lockout means the isolation by a mechanical device, generally a lock, which, when applied at the source, physically prevents the control to any electrical or mechanical equipment being turned on. Refer also to 'Isolation'.
Manual handling	The use of force applied by a person to lift, move, carry, push, pull or otherwise move or restrains an animate inanimate object.
Material Safety Data Sheet (MSDS)	Document describing the properties and hazards of a material or substance including statements about its chemical and physical properties, health hazards, precautions for use and safe handling instructions. All manufacturers and suppliers of chemicals are obliged to produce an MSDS for each hazardous chemical.
Monitoring	Involves the use of valid and suitable techniques to estimate the exposure of employees to a hazard.
Musculoskeletal disorder (MSD)	An injury, illness or disease that arises in whole or part from manual handling in the workplace, whether occurring suddenly or over a prolonged period of time. (Does not include injuries caused by crushing, entrapment or cut resulting primarily from the mechanical operation of plant.
Occupational Overuse	Previously called RSI and refers to arrange of conditions

NOHSC Glossary	Explanation
Syndrome (OOS)	characterised by persistent discomfort and pain in and around joints and associated with repeated movement of the joint. Recent state and territory legislation tends to group these conditions with those arising from manual handling as Musculoskeletal Disorders.
OHS inspection	The process of physically examining and evaluating the extent to which hazards and risks exist, and /or particular OHS requirements, procedures or standards are being met. Refer also to 'workplace inspection'.
OHS specialists	Include: • safety professionals • ergonomists • occupational hygienists • safety engineers • injury management advisors • health professionals.
Operator certification	The process by which a certificate to use or operate industrial equipment is issued by a certifying authority.
OHS management system (OHSMS)	That part of the organisation's overall management system that covers developing, implementing, reviewing and maintaining the activities for managing OHS. It is NOT a standard, a commercial package or folders on the shelf; however it may involve use of OHS management systems developed in the workplace to meet the OHS situation in that particular workplace. Also referred to in broader context as systematic approaches to managing OHS.
Operational controls for plant and equipment	Should: • be suitability identified • have nature and function clearly indicated • be readily and conveniently located • be guarded to prevent unintentional activation • be capable of locking in 'off' position to enable disconnection of all motive power and forces • be of 'fail safe' type.
Participative arrangements	Are those arrangements that inform employees and other stakeholders of OHS matters, seek their input and offer opportunity for stakeholders to participate in decisions that

NOHSC Glossary	Explanation
	may impact on their OHS. May also be referred to as 'consultative arrangements', however 'participation' implies a higher level of involvement.
Permit to work	A written authority document such as hot work and confined space entry that: • includes approval to undertake work and activities including tests, measurements and monitoring • is authorised by a responsible or designated person directly in control of the work • certifies appropriate precautions and controls to be followed • incorporates checklists, conditions and actions such as the frequency and duration of the work and atmospheric tests • follows recognised industry standard recording practices.
Plant	As defined in National Standard for Plant includes: • machinery, equipment (including scaffolding), appliance, implement or tool and any other component, fitting or accessory • fixed and or specified plant as cited in commonwealth, state and territory OHS legislation • mobile plant and load shifting equipment • pressure equipment such as boilers, pressure vessels and pressure piping • electrical installation and plant such as wiring, accessories, fittings, consuming devices, control and protective gear, converters and generators.
Plant Registration	The administrative process by which a certifying authority or state OHS regulator requires an organisation or industry to register plant, machinery and equipment.
Personal protective equipment (PPE)	Equipment designed to be worn by a person to provide protection from hazards, and may include: • head protection • face and eye protection • respiratory protection • hearing protection • hand protection • clothing and footwear. Personal protective equipment is considered the least satisfactory control measure.

NOHSC Glossary	Explanation
Policies and procedures	Relevant to OHS include: • policies and procedures underpinning OHS including those for hazard and incident reporting, OHS communication, consultation, issue resolution and risk management • quality system documentation • purchasing and contracting procedures • documents describing how tasks, projects, inspections, jobs and processes are to be undertaken • standard operating procedures, work instructions • job or batch sheets, recipes • operators manuals • employee and contractor handbooks • job/task statements.
Positive performance indicators	Focus on assessing how successfully a workplace is performing through measuring OHS processes.
(OHS) Records	Requirements for OHS record keeping may be defined in: • OHS legislation and regulations governing reporting of incidents and maintenance of records related to specific hazards, including chemical registers and material safety data sheets (MSDSs) • privacy legislation • organisational procedures. OHS records may include: • hazard and incident reports, first aid records • risk assessments • hazardous substances and dangerous good registers, MSDSs • risk registers • OHS audit and inspection reports • maintenance and testing records • OHS training records • outcomes of health surveillance and environmental monitoring • workers compensation claims and return to work records. OHS records must be stored taking account of: • privacy

NOHSC Glossary	Explanation
	• confidentiality • enabling access to personal records, within legislative requirements • commercial in confidence issues as appropriate.
(OHS) Reporting requirements	Under legislation include serious injury and serious incident reporting to OHS authorities.
(OHS) Responsibilities	Those with legislated OHS responsibilities include: • company director • manager • supervisors • OHS representatives • employees and contractors • designers, manufacturers, installers, suppliers.
Residual risk	That risk that is unable to be designed out of a product or process.
Risk	The chance of something occurring that will result in injury or damage. It is measured in terms of consequences (injury or damage) and likelihood of the consequence. Refer also to ‘Consequence’ and ‘Likelihood’.
Risk analysis	Analysing the risk to: • identify factors influencing the risk and the range of potential consequences • effectiveness of existing controls • likelihood of each consequence considering exposure and hazard level • combining these in some way to obtain a level of risk. Factors influencing the risk may be associated with • equipment • work environment • work organisation • task • the individual/operator • frequency and duration of exposure • number of people exposed/ involved.
Risk assessment	Risk assessment is a two-step process that involves risk analysis and risk evaluation. Risk assessment as required under various OHS legislation

NOHSC Glossary	Explanation
	does not necessarily require this second step of evaluation. Refer also to 'Risk Analysis' and 'Risk evaluation'.
Risk evaluation	Comparison of risk with pre-established criteria for tolerance (or as low as reasonably achievable) and the subsequent ranking of risks requiring control. This activity will usually be carried out by or in conjunction with others with advanced OHS skills and knowledge.
Risk management	The whole systematic process directed towards identifying hazards, assessing the risk and developing controls to minimise the risk and monitoring the effectiveness of the controls (and taking further action as required).
Risk ranking	A process of rating risks according to their severity and likelihood. Common systems are based on matrices or nomograms but are usually highly subjective.
Risk register	Includes: • a list of hazards, their location and people exposed • a range of possible scenarios or circumstances under which these hazards may cause injury or damage • the results of the risk assessment, and may also include; • possible control measures and dates for implementation. May also be referred to as Hazard Register.
Safe Design	A design process that generates options to eliminate hazards, or minimise potential risk to health and safety of those who make the product and those that use it by involving decision makers and considering OHS risks throughout the life cycle of the designed product.
Stakeholders	In workplace OHS include: • managers • supervisors • health and safety and other employee representatives • OHS committees • employees and contractors • the community.
Standards	Relevant to OHS include: • OHS regulations and standards developed by OHS regulators • national standards (NOHSC)

NOHSC Glossary	Explanation
	• Australian standards • International national standards • industry standards • codes of practice • exposure standards • guidance notes.
Statute Law	Law created by legislation passed by government (acts and regulations) as distinct from common law.
(OHS) plan:	A document that: • is usually developed annually but may be developed for a shorter or longer period • reviewed regularly • has OHS performance indicators (i.e. objectives and targets that are achievable and practical) reflecting systematic approaches to managing OHS.
System of work	The overall process of work including: • method by which the work is carried out • organisation of the work • selection and maintenance of tools and equipment • supervision and training • selection of workers • allocation of tasks and responsibilities.
Systemic approach to managing OHS	Requires: • comprehensive processes that are combined in a methodical and ordered manner to minimise the risk of injury or ill health in the workplace • processes of planning, allocation of resources, communication and consultation, hazard management, record keeping and reporting, training and competency, and review and evaluation for ongoing improvement. Factors that may impact on the implementation of a systematic approach to managing OHS may include: • barriers to communication, such as language/literacy • workplace culture issues, such as management commitment, supervisors' approach to compliance and general acceptance of the priority of safety • diversity of workers • structural factors, such as multiple locations, shift work and supervisory arrangements.

NOHSC Glossary	Explanation
Tag out	Refer to 'Isolation'.
Technical advisors	To the OHS function may include: • legal practitioners • engineers (such as design, acoustic, mechanical, civil) • security and emergency response personnel • workplace trainers and assessors • maintenance and trade persons.
Wellness	Refer to 'Health promotion'.
Workplace policies	Comprise written statements of employer's intentions and how the employers will action those intentions in the workplace. For example: OHS, access and equity, discrimination and manual handling.
Workplace inspection	Process of examining the workplace, usually with the aid of a checklist, to identify hazards and level of compliance with workplace procedures.

Some terms in the glossary have been taken from, or modified from the CCH Occupational Health and Safety Glossary, 1992 and National Guidelines for Integrating OHS Competencies into National Industry Competency Standards [NOHSC: 7025 (1998)] 2nd edition.

Volume 2 Part 2

Competency Standard Units

In this Electrotechnology Training Package (UEE07) there are approximately 500 competency standard units, arranged into sixteen (16) disciplines for ease of presentation and to facilitate quick access and referencing for users.

Disciplines

A – Assembly

B – Broadcast

C – Commercial

D – Computer systems

E – Cross discipline

J – Refrigeration and air conditioning

K – Renewable and sustainable energy

L – Imported

M – Hazardous areas

N – Rail systems

F – Data and voice communications

P – Restricted and specialist

G – Electrical

R – Research

H – Electronic

I – Instrument and control

All of the competency standard units have been developed in accordance with DEEWR minimum requirements and include minor enhancements. All Parts in Volume 2 of this Training Package form an integrated component of each competency standard unit and must be included when developing learning strategies and assessment processes. Importantly, competency standard units interrelate and are linked with both the Definitions/Glossary and an Essential Knowledge and Associated Skills (EKAS) sections of the Volume. Each competency standard unit includes its unique combination of EKAS by clause number and title

EKAS have been separated from the competency standard units to facilitate user friendliness for interpretation, applicability and future maintenance, however the EKAS section forms an integral part of each competency standard unit and all assessment and reporting processes require the confirmation of the achievement of the relevant EKAS specifications.

No competency standard unit is to be used in isolation or exported without these interrelated components.

For detailed information on competency standard units, including their structure, refer to *Volume 1, Part 1 Qualifications* and *Volume 1, Part 2 Competency Standards*.

Coding Structure

The competency standard units have been coded with a Discipline code. Units in any one Discipline may range across a number of AQF levels. Refer to the section covering the Qualification Structure of Volume 1 Part 1 Qualification Framework to determine the relevant unit(s) pertaining to the qualification(s) required.

Unit Number										
U	E	E	N	E	E	H	0	2	4	A
Industry - EE-Oz Training Standards identifier			Training Package identifier			Discipline ← letters→	Unit Numbers 001 to 999			Version
← 12 Characters Maximum →										

U = Utilities – DEEWR Identifier

EE = EE-Oz Training Standards – ElectroComms and EnergyUtilities Industry Skills Council Identifier

N = National – Training Package identifier

EE = Electrical and Electronics

H = Discipline (e.g. H = Electronic)

Number = unit number identifier

A = Version

Possible Skills Set CSUs

Some competency standard units (CSUs) may appear within this section and/or within a qualification of this Training Package but they can be delivered and assessed independently of any qualification.

Typically, these CSUs relate to work functions associated with regulatory or specialised functions. They may augment or be incidental to existing competencies held by individuals or be required for workplace entry associated with OHS issues.

All identified prerequisite requirements must be met for each competency standard unit.

The independent competency standard units are listed in Volume1 Part 1 – Qualifications Framework. For the complete competency standard unit refer to the respective Discipline sections.

Essential Knowledge and Associated Skills

Introduction

The Essential Knowledge and Associated Skills (EKAS) are an integral part of each unit of competence and must be taken into account when developing learning strategies and assessment tools. The EKAS inform delivery to assure consistency, reliability and validity of outcomes. Following are the EKAS industry has determined as necessary for the development and deeming of competence.

Outline of Essential Knowledge and Associated Skills construction

As particular EKAS can be common across several units the Electrotechnology Industry has adopted a system of Clause Numbering and has allocated Clause Titles, these are mapped into each unit of competence in Section 7.1. The numbers and titles have been grouped into Topics that are indicative of the EKAS content for ease of use. Clause Numbers for this Training Package begin with 2 followed by a decimal that refers to the Topic area as shown below.

Clause number	Topic areas
2.1	Cables, conductors and terminations

- 2.2 Common, commercial, processes and enterprise specific knowledge and skills
- 2.3 Control technologies
- 2.4 Communications and computer technologies
- 2.5 Drawings, diagrams, schedules, manuals, standards and regulations
- 2.6 Electrical applications and apparatus
- 2.7 Electrical installations and systems
- 2.8 Electrical principles
- 2.9 Electronic principles and applications
- 2.10 Electronic communications technology
- 2.11 Equipment and tools
- 2.12 Instrumentation
- 2.13 Maintenance and repair
- 2.14 Rail signalling
- 2.15 Refrigeration and air conditioning apparatus
- 2.16 Refrigeration and air conditioning installations
- 2.17 Refrigeration and air conditioning principles and applications
- 2.18 Safety
- 2.19 Special requirements
- 2.20 Sustainable energy and environment
- 2.21 System, control and automated
- 2.22 Hazardous areas

ESI-Transmission Distribution and Rail Training Package

- T2.4 HV Switching

Refer Volume 2 - Part 2.2 Essential Knowledge and Associated Skills (EKAS)**Essential Knowledge and associated Skills to Unit Maps**

The following appendices of the Electrotechnology Training Package consist of two mappings of the Essential Knowledge and Associated Skills:

- Appendix 1 - Competency Standard Units to Essential Knowledge and Associated Skills Relationship
- Appendix 2 - Essential Knowledge and Associated Skills to Competency Standard Units Relationship

This information is provided to assist users in developing holistic training support materials for respective qualifications and/or competency standard units.

Appendix 1 and 2

Refer to Appendix 1 - Unit to Essential Knowledge and Associated Skills Relationship and Appendix 2 - Essential Knowledge and Associated Skills to Unit Relationship

2.3.1 Reading, Writing and Numeracy**VOLUME 2 PART 3****3.1 LANGUAGE, LITERACY AND NUMERACY**

The reading, writing and numeracy skills/competencies in each competency standard unit describe the recommended prerequisite entry requirements typically needed to successfully achieve competence in the unit. A nationally-recognised language, literacy and numeracy framework has been used to provide advice as to the relevant entry level required.

The information has been derived from the '*National Reporting System*' report, '*A mechanism for reporting outcomes of adult English language, literacy and numeracy programs*'. The Australian National Training Authority (ANTA) and the Department of Employment Education and Training (DEET), 1994-5, jointly funded the report. Australian Training Products Ltd (ATP) distributes it for and on behalf of Language Australia Victorian Office. Stock code 3010A, ISBN: 0 7306 7493 2, April 1999.

The report:

- identifies adult English language, literacy and numeracy competencies in industry
- facilitates student pathways
- generates ideas for curriculum and assessment

The report identifies a national framework of five vertical levels of competence related to complexity of language, literacy and numeracy competence. Six interrelated horizontal aspects of communication were found to apply in relation to differing orientations of social activity involving reading, writing, speaking, listening and/or numeracy. These were categorised as follows: Procedural Communication for performing tasks; Technical Communication for using technology; Personal Communication for expressing identity; Cooperative Communication for interacting in groups; Systems Communication for interacting in organisations; and Public Communication for interacting in the wider community.

The National Reporting System Report: A mechanism for reporting outcomes of adult English language, literacy and numeracy, should be referred to at all times for clarification, more detailed information and advice.

For the purposes of providing relevant entry-level advice, specific features of writing, reading and numeracy competencies have been selected from the five-level competence structure using the Technical Communication aspect of the national framework, these are outlined in the Table below. Registered Training Organisations should use this information to assist them in developing appropriate entry-level learning strategies, to assist learners meet the entry-level requirements of specific competency standard units.

Table 1 – Reading, Writing and Numeracy \— Indicators of Competence

These five levels of competence are interrelated with six aspects of communication of the National Reporting System (NRS). The NRS suggests that the *‘report of a person’s competence derives from the interplay between the chosen activity, the features of the text/task, and the context and level of support under which the activity is performed’*.

Note: These indicators of competency are not an assessment system and not a recruitment instrument for employers. They are not a curriculum; not a model of language acquisition; not a means for categorising students in terms of a simple ‘level’; not a set of ‘broad’ competency statements, but specific to reading writing and numeracy.

Reading

Scale	IoC*	Indicators of Competence	Technical Communication
5	5.1	Reads and interprets structurally intricate texts in chosen fields of knowledge and across a number of genres, which involve complex relationship between pieces of information and/or propositions.	Defines the purpose and objectives for the use of a particular technology, e.g. writes a report, which includes a detailed analysis of technology as, applied in a particular workplace or environment.
	5.2	Interprets subtle nuances, infers purpose of author and makes judgements about the quality of an argument.	Draws on prior knowledge of the application of technology in researching the capacity of a new system, e.g. writes a briefing and recommends purchase or use of a particular system.
	5.3	Reads and critically evaluates texts	Uses technological principles to reduce

Scale	IoC*	Indicators of Competence	Technical Communication
		containing data which includes some abstraction, symbolism, and technicality presented in graphic, diagrammatic, formatted or visual form.	constraints presented by environmental or physical capacity, e.g. writes a report, which compares the effectiveness and efficiency of manual and computerised record management systems. Prepares a written or oral report, which critically evaluates the content, structure, and purpose of technical texts including graphic, diagrammatic or numerical information. Adapts task instructions to suit changes in technology, e.g. writes plain English instructions for the operation of a new machine based on the manufacturer's instructions. Draws from a number of sources and uses computer skills to prepare a report, e.g. CV and job application letter.
4	4.1 4.2	Reads and interprets structurally intricate texts in chosen fields of knowledge which require integration of several pieces of information for generating meaning. Interprets texts, which include ambiguity, and inexplicitness where reader needs to distinguish fact from opinion and infer purpose. Interprets and extrapolates from texts containing data which includes some abstraction, symbolism, and technicality presented in graphic, diagrammatic, formatted or visual form.	Compares and contrasts views on technology in newspaper articles. Interprets the purposes and objectives for the use of technology after the reading a brochure or manual. Selects technological practices to conform to the guidelines for health and safety, environmental impact and ethical practice, and uses them within those guidelines. Uses guidelines to ensure technological equipment is used to its full capacity. Uses a computer to prepare a typed report from a hand-drafted report. Compares and contrasts different technologies and their impact, e.g. argues the case for new practices when using new technologies, reports on the effects of installation of new machinery. Writes a report on the impact of a particular technology for a specific audience, e.g. management committees, tri-partite committees. Reads a complex diagram to identify

Scale	IoC*	Indicators of Competence	Technical Communication
			components and procedures for dealing with a technical fault or breakdown.

Reading – continued

3	3.1 3.2 3.3	Reads and interprets texts of some complexity, integrating (where relevant) a number of pieces of information in order to generate meaning. Displays awareness of purpose of text, including unstated meaning. Interprets and extrapolates from texts containing data which is unambiguously presented in graphic, diagrammatic, formatted or visual form.	Reads a technical manual where the information is supported by diagrams, sufficiently well to be able to locate and comprehend particular information required, e.g. programs a VCR to record two programs in advance. Uses the author, title, key word and other search indexes of a library computer. Comprehends short summary information on computer-managed learning packages to choose a relevant package to suit own needs. Uses the word processing program on a computer to produce texts. Writes simple instructions for using familiar technology, e.g. how to use an automatic teller machine. Completes a formatted workplace test, e.g. damage or breakdown report. Writes a brief report on uses of technology, e.g. for classroom, workplace, domestic or community purposes.
2	2.1 2.2	Reads and interprets short simple texts on a personally relevant topic. Locates specific information relating to familiar contexts in a text which may contain data in simple graphic, diagrammatic, formatted or visual form.	Reads short, relevant, explicit, clearly formatted texts related to technology, e.g. the author and title index of a library computer. Chooses a computer assisted learning package, having read short descriptions of one or two programs, to acquire a defined skill or area of knowledge. Writes a short description, e.g. describes a damaged part of a machine to facilitate repair. Extracts information from a list with language and numeracy components, e.g. price lists of components for computer systems. Records simple and routine information using

			the telephone, e.g. takes a phone message, on a form designed for this purpose. Interprets instructions, which combine pictorial and written information, e.g. directions on how to operate a piece of machinery safely.
1	1.1 1.2	Reads and identifies letter of the alphabet in the context of whole words, numbers, signs and symbols relating to personal details and immediate environment. Identifies specific information in a personally relevant text with familiar content, which may include personal details, location or calendar information in simple graphic, diagrammatic, formatted or visual form.	Recognises very short, explicit, pictorial texts, e.g. understands logos related to worker safety before using a piece of machinery, reads letters on a keyboard. Reads graphic instructions accompanying a new piece of technology to learn new information or skills about a technology or medium, e.g. uses an automatic teller machine by following instructions given graphically on the screen. Types own name or single words into a computer-assisted learning program.

Note: IoC* - Indicators of Competency sub-level

Writing

Scale	IoC*	Indicators of Competence	Technical Communication
5	5.4 5.5	Demonstrates well-developed writing skills by selecting stylistic devices to express complex relationships between ideas and purposes. Generates complex written texts with control over generic structure.	Defines the purpose and objectives for the use of a particular technology, e.g. writes a report, which includes a detailed analysis of technology as, applied in a particular workplace or environment. Draws on prior knowledge of the application of technology in researching the capacity of a new system, e.g. writes a briefing and recommends purchase or use of a particular system. Uses technological principles to reduce constraints presented by environmental or physical capacity, e.g. writes a report, which compares the effectiveness and efficiency of manual and computerised record management systems. Prepares a written or oral report, which

Scale	IoC*	Indicators of Competence	Technical Communication
			critically evaluates the content, structure, and purpose of technical texts including graphic, diagrammatic or numerical information. Adapts task instructions to suit changes in technology, e.g. writes plain English instructions for the operation of a new machine based on the manufacturer's instructions. Draws from a number of sources and uses computer skills to prepare a report, e.g. CV and job application letter.
4	4.4 4.5	Communicates complex relationships between ideas by matching style of writing to purpose and audience. Generates written texts reflecting a range of genres and using appropriate structure and layout.	Compares and contrasts views on technology in newspaper articles. Interprets the purposes and objectives for the use of technology after the reading a brochure or manual. Selects technological practices to conform to the guidelines for health and safety, environmental impact and ethical practice, and uses them within those guidelines. Uses guidelines to ensure technological equipment is used to its full capacity. Uses a computer to prepare a typed report from a hand-drafted report. Compares and contrasts different technologies and their impact, e.g. argues the case for new practices when using new technologies, reports on the effects of installation of new machinery. Writes a report on the impact of a particular technology for a specific audience, e.g. management committees, tri-partite committees. Reads a complex diagram to identify components and procedures for dealing with a technical fault or breakdown.

Note: IoC* - Indicators of Competency sub-level

Writing – continued

Scale	IoC*	Indicators of Competence	Technical Communication
3	3.4 3.5	Communicates relationships between ideas through selecting and using grammatical structures and notations, which are appropriate to the purpose. Produces and sequences paragraphs according to purpose of text.	Reads a technical manual where the information is supported by diagrams, sufficiently well to be able to locate and comprehend particular information required, e.g. programs a VCR to record two programs in advance. Uses the author, title, key-word and other search indexes of a library computer. Comprehends short summary information on computer-managed learning packages to choose a relevant package to suit own needs. Uses the word processing program on a computer to produce texts. Writes simple instructions for using familiar technology, e.g. how to use an automatic teller machine. Completes a formatted workplace test, e.g. damage or breakdown report. Writes a brief report on uses of technology, e.g. for classroom, workplace, domestic or community purposes.
2	2.3 2.4	Writes about a familiar topic using simple sentence structure and joining ideas through conjunctive links where appropriate. Completes forms or writes notes using factual or personal information relating to familiar contexts.	Reads short, relevant, explicit, clearly formatted texts related to technology, e.g. the author and title index of a library computer. Chooses a computer assisted learning package, having read short descriptions of one or two programs, to acquire a defined skill or area of knowledge. Writes a short description, e.g. describes a damaged part of a machine to facilitate repair. Extracts information from a list with language and numeracy components, e.g. price lists of components for computer systems. Records simple and routine information using the telephone, e.g. takes a phone message, on a form designed for this purpose. Interprets instructions, which combine pictorial and written information, e.g. directions on how to operate a piece of machinery safely.

Scale	IoC*	Indicators of Competence	Technical Communication
1	1.3	Copies letters of the alphabet, numbers, and dates in order to convey personal details such as name, address, telephone number.	Recognises very short, explicit, pictorial texts, e.g. understands logos related to worker safety before using a piece of machinery, reads letters on a keyboard.
	1.4		
	1.5	Writes basic personal details about self or others such as name, address, and signature. Writes one or two phrases/simple sentences conveying an idea, message or opinion drawing from a modelled text.	Reads graphic instructions accompanying a new piece of technology to learn new information or skills about a technology or medium, e.g. uses an automatic teller machine by following instructions given graphically on the screen. Types own name or single words into a computer-assisted learning program.

Note: IoC* - Indicators of Competency sub-level

Numeracy

Scale	IoC*	Indicators of Competence	Technical Communication
5	5.10	Interprets, selects and investigates appropriate mathematical information and relationships highly embedded in an activity, item or text.	Calculates distance, length and location using the trigonometry and geometry of triangles in relevant situations, e.g. locates grid reference on a map for a boat travelling on an given bearing with time and speed specified; uses dimensions provided on a scaled plan of a roof to find the pitch or slope of the roof. Calculates quantities of materials to tile the roof applying a 4% allowance for wastage.
	5.11		
	5.12	Selects and applies a wide range of mathematical strategies flexibly to generate solutions to problems across a broad range of contexts. Uses a wide range of oral and written informal and formal language and representation including symbols, diagrams and charts to communicate mathematically.	Plans and gathers information on a negotiated topic from a variety of sources including government, industry and media about relevant community or workplace issues. Organises information by grouping. Graphically represents and analyses information for a particular purpose. Presents, individually or in a team, a report expressing a viewpoint, which is substantiated by discussion of supporting statistical evidence. Interprets and applies metric quantities and numbers in scientific notation, e.g. calculates the

Scale	IoC*	Indicators of Competence	Technical Communication
			amount of oil in litres spilled from a tanker if it covers a surface area of water of approximately 1200 hectares ($1.2 \times 10^7 \text{m}^2$) to a thickness of $6 \times 10^3 \text{mm}$. Uses financial formulae, e.g. simple and compound interest to calculate and contrast the interest incurred in borrowing money from financial institutions.
4	4.10 4.11 4.12 4.13	Selects and investigates appropriate mathematical information and relationships embedded in an activity, item or text. Selects and applies an expanding range of mathematical strategies flexibly to solve problems in a variety of contexts. Examines and questions the appropriateness, possible interpretations and implications of aspects of a mathematical activity. Uses a range of oral and written informal and formal language and representation including symbols, diagrams and charts to communicate mathematically.	Uses ratio and scale to interpret dimensions on a basic plan. Applies similarity and ratio to estimate and calculate lengths, e.g. finds height of a building, a tree. Compares quality and costs of using imported vs. Australian tiles, discount vs. brand name paints. Presents information in appropriate graphical format to show different interpretations and influences, e.g. analysis of government spending on education. Applies formulae and interprets results relevant to a familiar practical situation, measuring the dimensions needed and substituting them into the formula, adjusting units where necessary, e.g. length of edging for circular garden or pond, capacity of a water tank or bath. Uses area and perimeter to calculate a range of options, e.g. given a certain length of fencing, plan a range of options for paddock dimensions, which meet specific area requirements. Calculates and contrasts monthly income from average sales, given a variety of salary options involving retainers and commission rates.

Note: IoC* - Indicators of Competency sub-level

Numeracy – continued

Scale	IoC*	Indicators of Competence	Technical Communication

Scale	IoC*	Indicators of Competence	Technical Communication
3	3.10 3.11 3.12 3.13	Selects appropriate mathematical information embedded in a real life activity, item or text. Selects and applies a range of mathematical strategies to solve problems in a number of contexts which are familiar and may be interrelated. Reflects on and questions reasonableness and appropriateness of the purpose, process and outcomes of a mathematical activity. Uses oral and written informal and formal language and representation including symbols and diagrams to communicate mathematically.	Uses a distance scale to find the shortest route between two locations on a map and considers road terrain conditions in deciding preferred route. Expresses and calculates with metric quantities, eg interprets and costs quantities of cheese given different forms such as 350g, 0.35kg. Measures common three-dimensional shapes, eg room, and represents the information on an appropriate diagram drawn to scale. Calculates with common, fractions and metric measurements, eg adjusts the quantities in a recipe by halving or doubling to obtain the required amount. Uses a variety of methods to analyse advertising by comparing savings on a number of different items, eg at 12% off, 15% off, 1/3 off, price reduced by \$10. Compares casual and permanent rates of pay over a given time span for work of the same nature.
2	2.9 2.10 2.11 2.12	Locates relevant mathematical information in a familiar real life activity text. Selects and uses straightforward mathematical actions in familiar and predictable contexts. Uses estimation and prior experience to examine purpose and check reasonableness of the process and outcomes of a mathematical activity. Uses oral and written informal and formal language and representation some symbols and diagrams to communicate mathematically.	Compares measurements taken with estimated lengths of familiar objects, eg estimates and measures storeroom dimensions.
1	1.10 1.11	Locates simple key mathematical information in a familiar real life activity text.	Estimates lengths of familiar objects using metric units, eg a person's height, height of doorway.

Scale	IoC*	Indicators of Competence	Technical Communication
	1.12	Recognises and uses straightforward mathematical actions which relate to immediate contexts.	
	1.13	Uses rough estimation and prior experience to identify purpose and check reasonableness of the process and outcomes of a mathematical activity.	
		Uses everyday informal oral language and representation including familiar symbols and diagrams to communicate mathematically.	