Australian Government

UEENEEG180A Develop detailed and complex drawings for electrical systems using CAD systems

Release: 2

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

UEENEEG180A Develop detailed and complex drawings for electrical systems using CAD systems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor **1) Scope:**

1.1) Descriptor

Develop detailed and complex drawings for electrical systems using computer aided design (CAD) systems to meet design specification. It includes 2D and 3D drawing formats covering a representative range of electrical systems such as installations with alternative supplies, installations over 400 A per phase at low voltage and/or high voltage, single or multi tenancies, heavy plant, switchgear, protection systems, earthing, power factor correction, control equipment, and energy monitoring and management.

Application of the Unit

Application of the Unit **2)**

This unit is intended for competency development entry-level employment based programs incorporated in approved contracts of training.

Licensing/Regulatory Information

License to practice **3)**

The skills and knowledge described in this unit do not require a license to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where

License to practice **3)**

applicable contracts of training such as apprenticeships.

Pre-Requisites

Prerequisite Unit(s) **4)**

Competencies **4.1)**

Granting competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed.

UEENEED104A	Use software for engineering applications
UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace
UEENEEE102A	Fabricate, dismantle, assemble of utilities industry components
UEENEEE104A	Solve problems in d.c. circuits
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications
UEENEEG179A	Develop detailed electrical drawings
UEENEEE190A	Prepare engineering drawings using manual drafting and CAD for electrotechnology/utilities applications
UEENEEE191A	Prepare electrotechnology/utilities drawings using manual drafting and CAD equipment and software
UEENEEE192A	Produce detailed electrotechnology/utilities drawings using computer aided design equipment and software.

Literacy and numeracy skills **4.2)**

Participants are best equipped to achieve competency in this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 'Literacy and Numeracy'

Reading 5 Writing 5 Numeracy 5

Employability Skills Information

Employability Skills **5)**

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.

Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a competency standard unit

Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Prepare to develop detailed and complex drawings for electrical systems	1.1 OHS procedures for a given work area are identified, obtained and understood
	1.2 Established OHS risk control measures and procedures in preparation for the work are followed
	1.3 The need for detailed and complex electrical

ELEMENT	PERFORMANCE CRITERIA	
		drawings is determined from the nature of the work to be undertaken.
	1.4	Established routines and procedures are followed to obtain electrical drawings details required for the work to be undertaken from project specifications.
	1.5	Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved on the work site
	1.6	Software tools and equipment a needed for the work are obtained in accordance with established procedures
2 Develop detailed and complex drawings for electrical systems.	2.1	OHS risk control measures and procedures for carrying out the work are followed
	2.2	The types of design detailed complex electrical drawings and layouts required are determined from project specifications for the electrical systems.
	2.3	Technical data of electrical system components is interpreted to determine parameters that are to be included in the detailed electrical drawings
	2.4	Appropriate software tools are used to produce detailed electrical drawings based on standard protocols
	2.5	Detailed complex electrical drawings are checked for accuracy are compliance with project specifications
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3 Complete detailed and complex drawings for electrical systems	3.1	Completed detailed complex electrical drawings are submitted to an appropriate person to be checked for accuracy and compliance with project specifications.
	3.2	Any alterations, additions or correction instructions are followed and detailed complex electrical drawings are re-submitted for final approval

ELEMENT	PERFORMANCE CRITERIA
	3.3 Copies of completed detailed complex electrical drawings are filed securely in accordance with established procedures

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

8) This describes the essential skills and knowledge and their level, required for this unit.

Evidence shall show that knowledge has been acquired of safe working practices and development of detailed and complex drawings for electrical systems

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

KS01-EG180A Electrical Detailed/Complex Drawings

Evidence shall show an understanding of electrical detailed/complex drawings to an extent indicated by the following aspects:

T1 Advanced computer-aided drawing design (CAD) systems encompassing:

- principles, terms, symbols and conventions usage in deploying advanced commands using computer-aided drawing design, and application of related skills
- internet and/or network within CAD (e.g. team projects) usage
- 3-D assemblies creation
- solid model creation and editing
- usage of various software programs to produce a drafting product
- models demonstration an interpretation
- usage of geometry in parametric programs
- 2-D geometry form 3-D models creation
- surface and mass properties (e.g. area and perimeter) extraction
- importation and exportation of various file formats (e.g. BXF,IGES, and rost)
- customization to improve productivity
- multiple three dimensional views – encompassing setup environment on screen; top view; front and side views; three dimensional views
- movement through space – encompassing created views drawing; various planes; coordinate system relocation
- views creation – encompassing three dimensional geometric shapes; three dimensional complex views by manipulation of drawing planes and location of geometric shapes
- editor modification functions – encompassing facilitating modifications of geometric shapes to complete three dimensional complex views
- three dimensional view display – encompassing wire line; solid face – isometric, perspective, orthographic
- views storage – encompassing variety of views in assembly drawing files for plotting

T2 Computer based modelling and application systems encompassing:

- different types of 3 dimensional computer aided modelling techniques encompassing concepts, systems types, applications complexities and currency, enhanced features, and functionality; 3 dimensional wire frame modellers; surface

REQUIRED SKILLS AND KNOWLEDGE

modellers; solids modellers; parametric modellers; feature based modellers

- software applications used in engineering design (e.g. Finite Element Analysis[FEA]), kinematics; manufacturing (e.g. numerical controlled machining, robotics, rheology); marketing (e.g. visualisation, animation); product design (e.g. visualisation, rapid prototyping); simulation (e.g. kinematics, production systems simulators); productivity enhancement tools, applications integration and commands (e.g. hot keys, macros, programming)

T3 Computer based modelling, design and drafting systems encompassing:

- 3 dimensional models creation - encompassing aspects of modelling such as model origin; direction of axes; scaling; construction methods; planning use of layers; planning detailing preparation; planning model visualisation; productivity enhancing tools; programming, macros, hot keys, advanced commands
- 3 dimensional assembly models creation – encompassing features such as item origins; direction of axes; planning standards use; library parts and user defined internal library parts; scaling; planning detailed views – sections; planning assembly visualisation
- detailed 3 dimensional models to Australian/New Zealand standards (dimensioned and annotated) drawings production and plotting from
- detailed 3 dimensional models to Australian/New Zealand standards assembly drawings production and plotting – including sectional views
- created data storage and retrieval from off-line storage media

T4 CAD modelling techniques encompassing:

- principles, terms, symbols and conventions usage in modelling encompassing: region modelling; solids modelling; wire frame as opposed to solids
- modelling types and usage
- region modelling techniques encompassing: region primitive; regions editor
- solid modelling techniques encompassing: solid primitives; solid primitives editor; region models to solid models conversions
- composite models production encompassing: composite regions; composite solids
- sectioned models production encompassing: cutting plane; cross hatching
- pre-drawn library files and primitives to produce 3D models
- third level software to produce 3D models
- mass and area properties extraction encompassing: area properties from region models
- 3D model rendering techniques encompassing: rendering types and preferences; rendering techniques such as lights, views, scenes
- various materials and surface finish options
- 3D models hard copy production
- 3D models storage in various file formats for retrieval into CAD drawings or other application software
- principles, terms, symbols and conventions usage in modelling techniques encompassing: 3 dimensional wire frame modellers; surface modellers; solids

REQUIRED SKILLS AND KNOWLEDGE

modellers; parametric modellers; feature based modellers

- types and usage of modelling techniques
- applications software encompassing: engineering design, e.g. Finite Element Analysis (FEA), kinematics manufacturing, e.g. numerical controlled; machining, robotics, rheology; marketing, e.g. visualisation, animation product design, e.g. visualisation, rapid prototyping; simulation, e.g. kinematics, production, systems simulators

T5 Graphical engineering design techniques for products, processes, systems or services representation encompassing:

- principles, concepts and conventions of graphical design techniques for representing products, processes, systems or services
- functional operation of components/assemblies to be drawn
- surface contact or separation encompassing: type of fit; performance/operation on finish
- datum points and tolerances
- design functional specifications
- components, materials, methods and processes encompassing: range of options; choice; satisfying design specification
- graphical methods of representation encompassing: options
- graphical representation procedures for the preparation of production drawings, specifications and operating and maintenance instructions/manuals
- design impact and feedback encompassing: clients; stakeholders

T6 Managing resources - CAD encompassing:

- production related processes – encompassing costing of estimates, budget planning, labour - cost of time, subsequent cost for a given project; material cost for a given project; staff/skills selection; quality control methods
- Human Resource Management (HRM) – encompassing; HRM definition and aims, changing social environments; changing legal environments - Occupational Health and Safety (OHS); influence of changing technology - nature of work, quality of work; principles and concepts - motivational theories, human relations approach to productivity improvements, work design, industrial relations
- decision making activities – encompassing setting objectives; organising resources; achieving predetermined goals; evaluating results; the organising process - fragmentation of work processes, coordination of work processes; controlling - relationship with other management functions; resolution of problems; approaches and aids to decision making; functional solution methods – brainstorming, lateral thinking, synectics (creative thinking), group participant techniques
- decisions evaluation

T7 Managing CAD Systems encompassing:

- configuring computer systems - encompassing types of CPU and operating systems; peripheral input and output devices; importing/exporting drawing files;

REQUIRED SKILLS AND KNOWLEDGE

communication protocol standards – hardware, software, installing with a CAD package; backup storage devices; cabling and communication for specific hardware

- management of CAD system variables and layers
- Local Area Networks (LAN) – encompassing LAN concepts and functions; hardware and software requirements; CAD for networks configuration; layout planning; software storage requirements; network to user configuration; applications operations - input and output devices; file management; security operations
- operations, coordination and control – encompassing storage devices; plotting mediums; plotter and consumables
- techniques for efficient system management – encompassing drawing project file management procedures, drawings files maintenance and recording; adoption of drawing standards; procedures for achieving and backing up; internal security system establishment

T8 Managing CAD utilities encompassing:

- text editing software – encompassing commands; menus; keystrokes; special software function keys; read; modification of help; modification of assistance screens
- procedures for creation of complex CAD menus – encompassing screen and digitising tablet menus; compile files to operate screen and tablet menus
- macro and icon files– encompassing techniques for creation; techniques for customisation
- file transfer procedures

Evidence Guide

EVIDENCE GUIDE

9) This provides essential advice for assessment of the unit. It must be read in conjunction with the performance criteria and the range statement of the unit and the Training Package Assessment Guidelines.

The Evidence Guide forms an integral part of this unit. It must be used in conjunction with all parts of the unit and performed in accordance with the Assessment Guidelines of this Training Package.

Overview of Assessment **9.1)**

Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that

can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the industry-preferred model for apprenticeships. However, where summative (or final) assessment is used it 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. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accordance with industry and regulatory policy.

Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being assessed.

The critical safety nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Sources of evidence need to be 'rich' in nature to minimise error in judgment.

Activities associated with normal everyday work have a bearing on the decision as to how much and how detailed the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practised. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

Critical aspects of evidence required to demonstrate competency in this unit

9.2)

Before the critical aspects of evidence are considered all prerequisites must 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 – UEE11'. Evidence shall also comprise:

- A representative body of work performance 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 statement
- Apply sustainable energy principles and practices as specified in the performance criteria and range statement
- Demonstrate an understanding of the essential knowledge and associated skills as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements.
- Demonstrate an appropriate level of skills enabling employment
- Conduct work observing the relevant Anti Discrimination legislation, regulations, polices and workplace procedures

- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Develop detailed and complex drawings for electrical systems as described in 8) Range and including:

A Developing a variety of detailed and complex electrical drawings

B Producing drawing sets

C Producing drafting documentation

D Interpreting and using technical data and specifications

E Selecting components and materials

F Developing 2D and 3D computer based models using computer based modelling, design and drafting systems

G Applying graphical techniques to produce products, processes, systems or services designs representations

H Presenting designs of electrical engineering products, processes, systems or services

I Incorporating feedback into final products

J Verifying and presenting final drafts

K Managing, processing, storing and retrieving drafting data

L Using advanced computer-aided systems and commands

M Using relevant drafting peripheral systems, equipment and tools encompassing digitising and scanning equipment to develop detailed and complex drawings

N Managing CAD systems and utilities

O Applying knowledge of complex electrical equipment design drawing methods, techniques, procedures and protocols and documenting design

P Applying knowledge related to resource requirements in CAD for electrical engineering briefs and/or specifications

Q Applying knowledge related to storing and retrieving data, and producing related documentation for presentations

Context of and specific resources for assessment

9.3)

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

OHS policy and work procedures and instructions.

Suitable work environment, facilities, equipment and materials to undertake actual work as prescribed in this unit.

These should be used in the formal learning/assessment environment.

Note:

Where simulation is considered a suitable strategy for assessment, conditions for assessment must be authentic and as far as possible reproduce and replicate the workplace and be consistent with the approved industry simulation policy.

The resources used for assessment should reflect current industry practices in relation to developing detailed and complex drawings for electrical systems

Method of assessment

9.4)

This unit shall be assessed by methods given in Volume 1, Part 3 'Assessment Guidelines'.

Note:

Competent performance with inherent safe working practices is expected in the Industry to which this unit applies. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended

for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

Concurrent assessment and relationship with other units

9.5)

For optimisation of training and assessment effort, competency development in this unit may be arranged concurrently with units covering the development of detailed and complex drawings for electrical systems.

Range Statement

RANGE STATEMENT

10) This relates to the unit as a whole providing the range of contexts and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

This unit shall be demonstrated in relation to development of detailed and complex drawings for electrical systems

- Covers detailed and complex drawings for electrical systems encompassing 2D and 3D drawing formats and products covering a representative range of electrical systems such as installations with alternative supplies, installations over 400 A per phase at low voltage and/or high voltage, single or multi tenancies, heavy plant, switchgear, protection systems, earthing, power factor correction, control equipment, and energy monitoring and management.
- Australian/New Zealand standards and enterprise standards related to electrical drafting
- Components and materials from supplier/manufacturers' catalogues
- Detailed and complex electrical drawings
- Drawing sets
- Drafting documentation
- Dimensions, limits and fits, tolerances and surface textures, datum references and geometry tolerances
- Electrical specifications, layouts, sketches or verbal instructions in conformance with Australian Standards, enterprise standards and/or design brief
- Master sketches methods, techniques, procedures and devices encompassing freehand sketching
- Type, form and size of materials from information, abbreviations and symbols supplied on electrical engineering drawings, briefs and/or specifications
- Specifications may be obtained from design information, customer requirements, sketches, preliminary layouts and/or field investigations
- Feedback procedures for incorporating client feedback from implementation, installation to commissioning stages into final product and selection of preferred option
- Materials and equipment used in electrical engineering applications by selecting the correct type, form and size of materials and equipment from information, abbreviations and symbols supplied on detailed electrical engineering drawings, briefs and/or specifications
- Resources required in CAD for electrical engineering briefs and/or specifications
- CAD modelling systems and techniques

RANGE STATEMENT

- Graphical engineering design techniques for products, processes, systems or services representation
- Production processes and procedures for presentations of related design documentation, products, processes, systems or services
- Organisational procedures for preparation and production of drawings, drawing sets, specifications, drafting documentation and operating and maintenance instructions/manuals for products and systems
- Organisational procedures for processing, filing and saving all graphics, specifications, instructions and related documentation in correct format and location in accordance with work site procedures
- Organisational procedures for collaborating with the client, stakeholders and other staff in the selection of the preferred option
- Verification and production of final drafts processes and procedures
- Computer aided design systems, management, resources, utilities, advanced commands, drafting peripheral systems, equipment and tools encompassing digitising and scanning equipment
- Integrated and complex electrical equipment design drawing methods, techniques, procedures and protocols and documenting design
- Drafting data
- Management, storage and retrieval of drafting data.

Generic terms used throughout this Vocational Standard shall be regarded as part of the Range Statement in which competency is demonstrated. The definition of these and other terms that apply are given in Volume 2, Part 2.1.

Unit Sector(s)

Not applicable.

Competency Field

Competency Field **11)**

Electrical