



Australian Government

UEENEEG144A Develop engineering solutions for d.c. machine and control problems

Release 2

UEENEEG144A Develop engineering solutions for d.c. machine and control problems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This unit covers developing engineering solutions to resolve problems with d.c. machines and their controls. 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.

Typical machine problems are those encountered in meeting performance requirements and compliance standards, revising machine operating parameters and dealing with machine malfunctions.

Application of the Unit

Application of the Unit 2)

This unit applies to any recognised development program that leads to the acquisition of a formal award at AQF level 6

Licensing/Regulatory Information

License to practice 3)

The skills and knowledge described in this unit require a license to practice in the workplace for work involving

License to practice

3)

direct access to plant and equipment connected to installation wiring at voltage above 50 V a.c. or 120 V d.c. However other conditions may apply in some jurisdictions subject to regulations related to electrical work. Practice in the workplace and during training is also subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Note:

1. Compliance with permits may be required in various jurisdictions and typically relates to the operation of plant, machinery and equipment such as elevating work platforms, powder operated fixing tools, power operated tools, vehicles, road signage and traffic control and lifting equipment. Permits may also be required for some work environments such as confined spaces, working aloft, near live electrical apparatus and site rehabilitation.

2. Compliance may be required in various jurisdictions relating to currency in First Aid, confined space, lifting and risk safety measures.

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.

UEENEEE1 25A Provide engineering solutions for problems in complex multiple path circuit

UEENEEE1 26A Provide solutions to basic engineering computational problems

AND

UEENEEE1 29A Solve electrotechnical engineering problems

OR

Prerequisite Unit(s)

4)

UEENEEE1
01A Apply Occupational Health and Safety regulations, codes and practices in the workplace

UEENEEE1
04A Solve problems in d.c. circuits

UEENEEG1
01A Solve problems in electromagnetic devices and related circuits

OR

UEENEEH1
14A Troubleshoot resonance circuits in an electronic apparatus

UEENEEE1
01A Apply Occupational Health and Safety regulations, codes and practices in the workplace

AND

UEENEEE1
04A Solve problems in d.c. circuits

OR

UEENEEH1
69A Solve problems in basic electronic circuits

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)

This unit contains Employability Skills

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 engineering solution for d.c. machine problems.	1.1 OHS processes and 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 extent of the machine problem is determined from performance specifications and situation reports and in consultations with relevant persons.
	1.4 Activities are planned to meet scheduled timelines in consultation with others involved in the work.
	1.5 Effective strategies are formed to ensure solution development and implementation is carried out efficiently.

ELEMENT	PERFORMANCE CRITERIA
2 Develop engineering solution for d.c. machine problems.	2.1 OHS risk control measures and procedures for carrying out the work are followed.
	2.2 Knowledge of d.c machine construction, operation, characteristics and applications are applied to developing solutions to d.c machine problems.
	2.3 Parameters, specifications and performance requirements in relation to each machine problem are obtained in accordance with established procedures.
	2.4 Approaches to resolving d.c. machine problems are analysed to provide most effective solutions.
	2.5 Unplanned events are dealt with safely and effectively consistent with regulatory requirements and enterprise policy.
	2.6 Quality of work is monitored against personal performance agreement and/or established organizational or professional standards.
3 Test, document and implement engineering solution for d.c. machine problems.	3.1 Solutions to machine problems are tested to determine their effectiveness and modified where necessary.
	3.2 Adopted solutions are documented including instruction for their implementation that incorporates risk control measure to be followed.
	3.3 Appropriately competent and qualified person(s) required to implement solutions to d.c machine problems are coordinated in accordance with regulatory requirements and enterprise policy. (Note)
	3.4 Justification for solutions used to solve d.c. machine problems is documented for inclusion in work/project development records in accordance with professional standards.

Note:

A license to practice in the workplace is required for work involving

ELEMENT

PERFORMANCE CRITERIA

direct access to plant and equipment connected to installation wiring at voltages above 50 V a.c. or 120 V d.c.

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 developing engineering solutions for d.c. machine problems.

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

KS01-EG144A

Direct current machine diagnostics

Evidence shall show an understanding of developing engineering solutions for d.c. machine problems to an extent indicated by the following aspects:

T1 Basic d.c. machine construction and operation encompassing:

- General principles of operation
- Applications of d.c. machines
- Construction of d.c. machines
- d.c. machine configurations; series, shunt, compound long shunt and compound short shunt
- Armature and field currents
- Insulation
- Ratings
- Cooling paths
- Bearings
- General maintenance of d.c. machines

T2 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

T3 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:

REQUIRED SKILLS AND KNOWLEDGE

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

T4 Armature reaction in d.c. machines encompassing:

- effect of armature reaction on d.c. machine characteristics
- use of compensating winding

T5 d.c. generators encompassing:

- relative advantages and disadvantages of the various dc generator configurations and their performance under various load conditions
- voltage regulation as a percentage or per unit value
- operation in parallel

T6 d.c. motors encompassing:

- relative advantages and disadvantages of the various dc motor configurations and their performance under various load conditions

REQUIRED SKILLS AND KNOWLEDGE

- shape of motor speed/torque curves
- reversal of rotation

T7 Starting and protection of d.c. motors encompassing:

- types of d.c. motor starters in use
- d.c. motor protection

T8 Speed regulation and speed control of d.c. motors encompassing:

- methods in use
- effect on motor design and operation caused by the use of SCR
- speed control equipment

T9 Braking of d.c. motors encompassing:

- Plugging
- Dynamic
- Regenerative
- Mechanical

T10 Losses, heating and efficiency encompassing:

- Copper losses
- Iron losses
- Mechanical losses
- Efficiency

T11 Acceleration of d.c. motors and loads encompassing:

- characteristics of typical loads
- matching a suitable motor to a given load
- heating of windings
- derating of motors

T12 Special d.c. motors construction, operation and applications encompassing:

- permanent-magnet motors
- brushless motors (e.c. motors)
- coreless and moving coil motors
- linear motors
- printed circuit motor
- stepping motors
- voice-coil motors

T13 Maintenance of d.c. machines encompassing:

- routine maintenance
- breakdown repairs

T14 types of faults encompassing:

REQUIRED SKILLS AND KNOWLEDGE

- 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

T15 adjustment of machines encompassing:

- correct brush position
- machining and finishing of commutators

Evidence Guide

EVIDENCE GUIDE

9) The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

The Evidence Guide forms an integral part of this unit. It must be used in conjunction with all parts of this 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's 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 every day 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 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 – 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, policies and workplace procedures
- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
 - Develop engineering solutions for d.c. machine problems as described in 8) and including:

A Understanding the extent of the machine problem.

B Forming effective strategies for solution development and implementation.

C Obtaining machine parameters, specifications and performance requirements appropriate to each problem.

D Testing and solutions to machine problems.

E Documenting instruction for implementation of solutions that incorporate risk control measure to be followed.

F Documenting justification of solutions implemented in accordance with professional standards.

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.

Note:

Successful completion of relevant vendor training may be used to contribute to evidence on which competency is deemed. In these cases the alignment of outcomes of vendor training with performance criteria and critical aspects of evidence shall be clearly identified.

**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 by this unit.

These should be part of the formal learning/assessment

environment.

Note:

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.

The resources used for assessment should reflect current industry practices in relation to developing engineering solutions for d.c. machine problems.

**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 assessment 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 unit:

UEENEEE12 Provide engineering solutions for problems in
5A complex multiple path circuit

The critical aspects of occupational health and safety covered in unit UEENEEE101A and other discipline specific occupational health and safety units shall be incorporated in relation to this unit.

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 developing engineering solution for at least four d.c. machine problems.

Note.

Typical machine problems are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions

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