Australian Government

UEENEEH191A Diagnose and rectify faults in air navigation circuits and systems

Release 2

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

UEENEEH191A Diagnose and rectify faults in air navigation circuits and systems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor **1) Scope:**

1.1) Descriptor

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.

Application of the Unit

Application of the Unit **2)**

This unit is intended as an additional competency to relevant competencies previously acquired. It is suitable for employment-based programs under an approved contract of training at the aligned AQF 5 level or higher.

Licensing/Regulatory Information

License to practice **3)**

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 traineeship.

License to practice **3)**

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, lifting equipment and the like. 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.

The skills and knowledge described in this unit may require a license to practice in the workplace where plant and equipment operate at voltage above 50 V a.c. or 120 V d.c.

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.

UEENEEH127A	Set up and adjust commercial radio frequency (RF) transmission and reception systems
UEENEEH172A	Troubleshoot communication systems
UEENEEH190A	Provide engineering solutions to air traffic control system problems

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 diagnose and rectify faults	1.1 OHS procedures for a given work area are obtained and understood.
	1.2 Operational safety procedures for a given work area are obtained and understood

ELEMENT	PERFORMANCE CRITERIA	
	1.3	Established OHS risk control measures and procedures are followed in preparation for the work.
	1.4	Safety hazards that have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel.
	1.5	The extent of faults is determined from reports and other documentation and fro discussion with appropriate personnel.
	1.6	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.
	1.7	Tools, equipment and testing devices needed to diagnose faults are obtained in accordance with established procedures and checked for correct operation and safety.
2 Diagnose and rectify faults	2.1	OHS risk control measures and procedures for carrying out the work are followed.
	2.2	The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures.
	2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures.
	2.4	Logical diagnostic methods are applied to diagnose navigation system faults employing measurements and estimations of system operating parameters referenced to system operational requirements.
	2.5	Suspected fault scenarios are tested as being the source of system problems.
	2.6	Source of the fault is identified and appropriately competent persons are engaged to rectify the fault where it is outside the scope of electronics.

ELEMENT	PERFORMANCE CRITERIA	
	2.7	Faults in the electronic components of the system are rectified to raise navigation system to its operation standard.
	2.8	System is tested to verify that the system operates as intended and to specified requirements.
	2.9	Decisions for dealing with unexpected situations are made from discussions with appropriate persons and job specifications and requirements.
	2.10	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
	2.11	Diagnosis and rectification activities are carried out efficiently without waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3 Commissioning of navigational systems	3.1	OHS risk control measures and procedures for carrying out the work are followed.
	3.2	Testing/measuring devices are connected and set up in accordance with requirements for a particular air navigational system.
	3.3	Measuring instruments are set up and adjusted in accordance with transmission/reception requirements and equipment manufacturer's instructions.
	3.4	Adjustments are made to provide optimum transmission/reception performance within regulatory requirements.
	3.5	Decisions for dealing with unexpected situations are made from discussions with appropriate persons and job specifications and requirements.
	3.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
	3.7	Setting-up is carried out efficiently without

ELEMENT	PERFORMANCE CRITERIA	
		waste of materials or damage to apparatus, the surrounding environment or services and using sustainable energy principles.
4 Complete and report fault diagnosis and rectification activities	4.1	OHS work completion risk control measures and procedures are followed.
	4.2	Work site is made safe in accordance with established safety procedures.
	4.3	Rectification of faults is documented in accordance with established procedures.
	4.4	Appropriate person or persons notified, in accordance with established procedures, that the system faults have been rectified and re commission

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 diagnosing, rectifying faults and commissioning air navigation systems.

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

KS01-EH191A 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

REQUIRED SKILLS AND KNOWLEDGE

- 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.

REQUIRED SKILLS AND KNOWLEDGE

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, 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

REQUIRED SKILLS AND KNOWLEDGE

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, 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
- 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

REQUIRED SKILLS AND KNOWLEDGE

- 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

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 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 must 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 accord 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 influence decisions about how/how much 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, polices and workplace procedures

- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Diagnose and rectify faults in air navigation systems as described in 8) and including:
  a. Applying logical diagnostic methods.
  b. Using fault scenarios to test the source of system faults.
  c. Identifying faults and competency needed to rectify them.
  d. Rectifying faults in system electronics.
  e. Verifying that the system operates correctly.
  f. Documenting fault rectification.
  g. Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a 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 diagnosing and rectifying faults in air navigation 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)**

There are no concurrent assessment recommendations for this unit.

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 by diagnosing and rectifying at least four system faults across a representative range of electronic air navigation systems.

NDB, VOR, DME, ILS. GNSS

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)**

Electronics