



Australian Government

UEEEEC0021 Diagnose and rectify faults in air navigation circuits and systems

Release: 1

UEEEEC0021 Diagnose and rectify faults in air navigation circuits and systems

Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

Application

This unit involves the skills and knowledge required to diagnose and rectify faults in aviation navigation circuits and systems in compliance with relevant regulatory requirements of the Civil Aviation Safety Authority (CASA) and national operating standards.

It includes diagnosing aviation navigation circuits and system faults, interpreting circuit diagrams, rectifying faults, conducting safety inspections and functional testing, and completing the necessary service documentation.

Permits may be required for some work environments, such as confined spaces, working aloft, near live electrical apparatus and site rehabilitation.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

UEEEEC0061 Set up and adjust commercial radio frequency (RF) transmission and reception systems

UEEEEC0068 Troubleshoot communication systems

UEEEEC0053 Provide engineering solutions to air traffic control system problems

Competency Field

Electronics and Communications

Unit Sector

Electrotechnology

Elements and Performance Criteria

ELEMENTS

PERFORMANCE CRITERIA

Elements describe the essential Performance criteria describe the performance needed to

outcomes.

demonstrate achievement of the element.

1 Prepare to diagnose aviation navigation circuits and system faults

- 1.1** Work health and safety (WHS)/occupational health and safety (OHS) requirements and workplace procedures for a given work area are identified and applied
- 1.2** Aviation operational safety procedures for a given work area are obtained and applied
- 1.3** WHS/OHS risk control measures and workplace procedures are followed in preparation for aviation work activity
- 1.4** Safety hazards that have not previously been identified are documented on job safety assessments, risks assessed and control measures implemented in consultation with appropriate person/s
- 1.5** Extent of faults is determined from reports, circuit diagrams and other relevant documentation, and discussions with appropriate person/s
- 1.6** Appropriate person/s is consulted to ensure the work is coordinated effectively with others involved on the work site
- 1.7** Tools, equipment and testing devices needed to diagnose faults are obtained in accordance with workplace procedures and checked for correct operation and safety

2 Diagnose and rectify aviation navigation system faults

- 2.1** WHS/OHS risk control measures and workplace procedures for carrying out work activities are followed
- 2.2** Need to inspect, test or measure live work is determined in accordance with WHS/OHS requirements and, as required, conducted in accordance with workplace safety procedures
- 2.3** Circuits, machines and plant are checked and isolated in accordance with WHS/OHS requirements and workplace procedures
- 2.4** Logical diagnostic methods are applied to diagnose aviation navigation system faults, employing measurements and estimations of system operating parameters in accordance with system operational requirements

- 2.5 Suspected fault scenarios are tested as being the source of navigation system problems
 - 2.6 Source of the fault is identified and competent person/s engaged to rectify the fault in accordance with workplace procedures
 - 2.7 Faults in the electronic components of the system are rectified in accordance with navigation system operation standards
 - 2.8 Aviation navigation system is inspected and tested to verify the system operates as intended and to specified requirements
 - 2.9 Decisions for dealing with unplanned situations are made from discussions with appropriate person/s and job specifications and requirements
 - 2.10 Unplanned situations are responded to in accordance with workplace procedures in a manner that minimises risk to personnel and equipment
 - 2.11 Diagnosis and rectification activities are carried out efficiently without waste of materials or damage to apparatus, the surrounding environment or services using sustainable energy practices
- 3 Commission aviation navigation system**
- 3.1 WHS/OHS risk control measures and procedures for carrying out the work are followed
 - 3.2 Testing and measuring devices are connected and set up in accordance with job requirements and the particular air navigational system
 - 3.3 Measuring instruments are set up and adjusted in accordance with transmission/reception requirements and equipment manufacturer instructions
 - 3.4 Adjustments are made to provide optimum transmission/reception performance within regulatory requirements
 - 3.5 Decisions for dealing with unplanned situations are made from discussions with appropriate person/s and job specifications and requirements
 - 3.6 Unplanned situations are responded to in accordance with workplace procedures in a manner that minimises

		risk to personnel and equipment
	3.7	Setting up is carried out efficiently without waste of materials or damage to apparatus, the surrounding environment or services using sustainable energy principles
4 Complete and report fault diagnosis and rectification activities	4.1	WHS/OHS work completion risk control measures and workplace procedures are followed
	4.2	Worksite is made safe in accordance with workplace safety procedures
	4.3	Rectification of faults is documented in accordance with workplace procedures
	4.4	Appropriate person/s is notified in accordance with workplace procedures that the aviation navigation system faults have been rectified and recommission

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the UEE Electrotechnology Training Package Companion Volume Implementation Guide.

Diagnosing and rectifying system faults in electronic air navigation systems must include at least the following:

- four system faults in four of the following systems:
 - non-directional beacon (NDB)
 - very high frequency (VHF) omni directional radio range (VOR)
 - distance measuring equipment (DME)
 - instrument landing system (ILS)
 - global navigation satellite system (GNSS)

Unit Mapping Information

This unit replaces and is equivalent to UEENEEH191A Diagnose and rectify faults in air

navigation circuits and systems.

Links

Companion Volume implementation guides are found in VETNet - -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>

Assessment Requirements for UEEEC0021 Diagnose and rectify faults in air navigation circuits and systems

Modification History

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasion and include:

- applying logical diagnostic methods
- using fault scenarios to test the source of system faults
- identifying faults and competency needed to rectify them
- rectifying faults in system electronics
- verifying that the system operates correctly
- documenting fault rectification
- dealing with unplanned events
- applying sustainable energy principles and practices
- commissioning of air navigational system
- completing and reporting fault diagnosis and rectification activities
- implementing relevant work health and safety (WHS)/occupational health and safety (OHS) requirements and workplace procedures and practices, including the use of risk control measures.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- electronic communications - air navigation systems, including:
 - aviation navigation services and principles encompassing:
 - role of navigation aids in providing air traffic control (ATC) services
 - functions provided by navigational aids
 - Rho Theta concept in context of navigational aids used within aviation
 - relevant International Civil Aviation Organisation (ICAO) (Annex 10) specifications
 - monitoring – equipment, status and pilot
 - principle of operation of the non-directional beacon (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 used by pilots and ATC
- principle of operation of the CVOR/DVOR encompassing:
 - simple block diagram of a CVOR labelling each part
 - basic principles of variable and reference information
 - radio frequency (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
- principle of operation of the distance measuring equipment (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
- principle of operation of the instrument landing system (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 far field radiation patterns
 - far field phasing and space modulation
 - terms DDM and SDM
 - performance requirements for CAT I, CAT II and CAT III ILS
- 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)
- 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)
- mandated flight check of an NDB
- 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
 - definition of “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 and 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
 - process for returning the aid to service
 - location and identification of appropriate DME documentation (AEIs)

- 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 and antenna
 - typical monitored parameters for a CVOR
 - purpose of monitor bypass
 - correct use of test equipment and interpretation of results
 - measurement of performance parameters using the correct test equipment
 - correct use of test equipment
 - correlate the measurements to the 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
- 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 and CMP), timing signals generation (TSD), reference phase generator (RPG), antenna switching (ASD and ADS), sideband generator (SGN, SMA and SCU), control unit (CTU), monitor unit (MRF, MSC, MFI, MBD and MSD)
 - typical monitored parameters for a DVOR
 - correct use of test equipment and interpretation of results
 - measurement of performance parameters using the correct test equipment
 - correct use of test equipment
 - correlate the measurements to the 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
- 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 and power
 - block diagram illustration 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
- measurement of performance parameters using the correct test equipment
- correct use of test equipment
- correlate the measurements to the 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
- relevant Civil Aviation Safety Authority (CASA) national operating standards, workplace policies and procedures
- relevant job safety assessments or risk mitigation processes
- relevant WHS/OHS and CASA legislated requirements
- relevant workplace documentation.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment

Assessment must occur in suitable workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated suitable workplace operational situations that replicate workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or simulations
- relevant and appropriate materials, tools, equipment and personal protective equipment (PPE) currently used in industry
- resources that reflect current industry practices in relation to diagnosing and rectifying faults in air navigation systems

- applicable documentation, including workplace procedures, equipment specifications, regulations, codes of practice and operation manuals.

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