Australian Government

MEA726 Apply aircraft electrical system design techniques

Release: 1

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Modification History

Release 1 - New unit of competency

Application

This unit of competency applies to design of aircraft electrical systems and components for aircraft, design of modifications and development, and update of test procedures and of repair requirements. It includes electrical design techniques and performance of the design process within the requirements of airworthiness regulators and documentation of the design process within management systems, such as configuration management (CM) and integrated logistic support (ILS).

It is suitable for people working as members of design teams and for those employed within maintenance engineering support departments or pursuing careers and qualifications as paraprofessionals in avionic engineering.

This unit is used in workplaces that operate under the airworthiness regulatory systems of the Australian Defence Force (ADF) and the Civil Aviation Safety Authority (CASA).

Pre-requisite Unit

MEA702	Produce avionic engineering related graphics
MEA706	Apply basic scientific principles and techniques in avionic engineering situations
MEA708	Select and test avionic engineering materials
MEA714	Integrate avionic fundamentals into an engineering task
MEA725	Apply advanced scientific principles and techniques in avionic engineering situations

Competency Field

Avionic engineering

Unit Sector

Elements and Performance Criteria

Elements describe the essential Performance criteria describe the performance needed to

outcomes.		demonstrate achievement of the element.	
1.	Investigate requirements of aircraft electrical system design projects	1.1	Review the context and negotiate parameters of the engineering design brief in consultation with stakeholders
		1.2	Determine engineering scientific principles and design techniques required for design process
		1.3	Investigate life-cycle design and sustainability implications of avionic design
		1.4	Determine specification, documentation and graphical techniques required to define designs
		1.5	Confirm work health and safety (WHS) and regulatory requirements, codes of practice, standards, risk management and registration requirements relevant to avionic design project
		1.6	Investigate the need for technical and professional assistance
2.	Apply aircraft electrical system design techniques	2.1	Plan, schedule and coordinate the design task
		2.2	Apply the design process and avionic scientific principles to component selection and design proposals
		2.3	Create adequate and accurate calculations, preliminary graphics and maintain design process records
		2.4	Evaluate multiple solutions against design criteria, risk, sustainability and cost
		2.5	Integrate avionic analogue techniques, hardware and software, including mechanical, fluid, electrical, electronic, controller and networking
		2.6	Apply systems thinking, problem solving and decision making in dealing with contingencies and constraints for continuous improvement and development of design options
		2.7	Incorporate professional and technical assistance as required
		2.8	Apply specification, documentation and graphical techniques modelling, mock-up or prototyping

			techniques to define designs
3.	Report results	3.1	Report results of investigations, application and development of avionic design
		3.2	Provide documentation, such as calculations, specifications, diagrams, computer-aided design (CAD) files, control circuits and controller programs, mock-ups or prototypes
		3.3	Draft documentation required by CM plan and/or ILS process

Foundation Skills

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

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Avionic engineering refers to:	• The engineering discipline concerned with the conceptual development, research, design, manufacture, implementation, installation, commissioning and maintenance of aerospace electrical, instrument, radio and electronic systems and components and related test equipment for civil and military applications
Aircraft electrical systems include:	• Electrical power generation • Control and distribution • Interface with aircraft systems, including hydraulic, pneumatic, power plant and flight controls • Interface with avionic analogue systems • Interface with avionic digital systems
Context of engineering design activity includes:	• Competitive market • Geo political factors, such as access to materials and markets • Technological advantage/disadvantage • Resources supply: materials, labour and skills • Sustainability issues relevant to design task, including • social, economic and environmental considerations

- material and energy resources
- WHS, risk, and applicable standards and code requirements

Planning processes include:

- Establishing design parameters and design criteria
- Contributing to the negotiation and advice process
- Preliminary planning, design investigations and costing
- Identifying design, development, prototyping activities and skills requirements
- Planning and scheduling design activities
- Improving, adjusting, rescheduling as required by emergency contingencies and constraints

Design process includes:

- Establishing design parameters and criteria
- Researching, measuring, experimenting and investigating
- Generating ideas
- Synthesis, problem solving and decision making, addressing constraints
- Applying scientific principles, calculation and graphics, prototyping and mock-up techniques
- Evaluating solutions against design criteria
- Consultation, adjustments and agreement
- Finalising design and sign-off

Design criteria include:

- Function
- Aesthetics
- Manufacturability and maintainability
- Marketability
- Sustainability:
  - social, economic and environmental
  - material and energy resources
- Cost constraints
- Ergonomics and anthropometrics and physiology
- Facilities, plant and skills available
- Safety and risk

Design analysis includes:

- Graphical and mathematical methods and software options associated with mechanical, electrical and electronic aspects of aircraft electrical systems

Sustainability considerations include:

- Resources and energy required for design
- Environmental considerations in manufacturing and operation of design:
  - raw material, solids and hazardous waste, and production by-products
  - potential contamination of land, air and stormwater pollutants, and discharge to sewerage

	• carbon pollution and reduction effects
Configuration management (CM)	• CM is a process for control and documentation of the design and development process and for the management of system, component and software throughout the service life
Integrated logistic support (ILS)	• ILS is an integrated approach to the management of logistic disciplines originally developed for the management of military systems from design concept to final disposal at life-of-type. It covers: • reliability engineering, maintainability engineering and maintenance planning • supply and support • support and test equipment • manpower and personnel • training and training support • technical data and publications • computer resources support • facilities • packaging, handling, storage and transportation • design interface
Life-cycle assessment is applied to:	• All aspects of manufacture of a single product • The entire operations of an organisation • A particular aspect of operations, such as environmental implications • As part of the ILS process
Prototyping includes:	• Mock-ups • Physical and virtual modelling with post-processing for computer-numerically controlled (CNC) and rapid prototyping
Appropriate technical and professional assistance includes:	• Assistance from individuals with CASA maintenance certification licenses or those with supervisory authorisations in the ADF regulatory system • Professional support from engineers employed within: • organisations with CASA design approvals, continuing airworthiness management or maintenance approvals • approved engineering organisations under the ADF regulatory system • Engineers employed within organisations recognised by overseas airworthiness organisations
WHS, regulatory requirements and enterprise	• WHS Acts and regulations • Relevant standards

procedures include:

- Industry codes of practice
- Risk assessments
- Registration requirements
- Safe work practices
- State and territory regulatory requirements applying to electrical work
- Civil Aviation Safety Regulations (CASRs)
- AAP7001.053 ADF Technical Airworthiness Management Manual
- Overseas airworthiness authorities where applicable e.g. Federal Aviation Administration, Transport Canada, European Aviation Safety Agency

Relevant standards include:

- AS 1100.101-1992 Technical drawing – General principles
- AS 1102.101-1989 Graphical symbols for electrotechnical documentation - General information and general index
- AS/NZS ISO 31000 Set:2013 Risk Management Set
- NOHSC:1014 National standard for the control of major hazard facilities
- AS/NZS ISO 14000 Basic Set:2007 Environmental Management Basic Set
- ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework
- AS 61508.1-2011 Functional safety of electrical/ electronic/ programmable electronic safety related systems – General requirements
- AS 62061-2006 Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
- MIL-STD 785 Reliability program for systems and equipment development and production
- MIL-STD 1388-1A Logistic Support Analysis (LSA)
- MIL-STD 1388-2B Requirements for a LSA record
- MIL-STD 1629A Procedures for performing a failure mode, effects and criticality analysis (FMECA)
- MIL-STD 1629B FMECA
- MIL-STD 2173 Reliability centred maintenance requirements (superseded by NAVAIR 00-25-403
- OPNAVINST 4130.2A

Relevant handbooks include:

- Integrated Logistic Support Handbook, third edition – James V Jones
- MIL-HDBK-217 Reliability prediction of electronic equipment

- MIL-HDBK-338B Electronic reliability design handbook
- MIL-HDBK-781A Reliability test methods, plans and environments for engineering development, qualification and production
- NASA PRA Probabilistic risk assessment handbook
- NASA Fault tree assessment handbook

Systems thinking includes:

- The process of developing solutions within the context of an entire system
- Recognising that an improvement in one subsystem can adversely affect another subsystem

Unit Mapping Information

Release 1 - new unit based on MEM14066A Plan and design avionic engineering projects – units not equivalent

Links

Companion Volume implementation guides are found in VETNet - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=ce216c9c-04d5-4b3b-9bcf-4e81d0950371