Australian Government

MEM14088A Apply maintenance engineering techniques to equipment and component repairs and modifications

Release: 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MEM14088A Apply maintenance engineering techniques to equipment and component repairs and modifications

Modification History

Release 1 (MEM05v9).

Unit Descriptor

This unit of competency covers the skills needed to apply maintenance engineering techniques to equipment or component modification or repair. It includes decision making on the need for repair, replacement or modification and design of any repair or modification. The unit covers maintenance techniques for repair and modification of mechanical, fluid and electrical plant, and facilities in accordance with procedures, work health and safety (WHS) and legislative requirements, and risk management procedures. Documentation of the repair or modification process includes calculations, specifications, computer-aided design (CAD) files, risk analysis, sustainability and life cycle assessments.

Application of the Unit

This unit applies to maintenance-related work where a technical evaluation must occur on whether to repair, replace or modify equipment or components and where engineering design techniques are applied where repair or modification is required. The unit applies across all engineering disciplines and would normally be selected in conjunction with appropriate technical units for the equipment or components being considered for maintenance.
The unit includes reviewing condition analysis and non-destructive test (NDT) reports. However, the conduct of condition analysis and NDT tests is covered by the relevant specialist technical units.
Where an organisation or whole of plant maintenance management systems is being reviewed or considered for change the unit MEM23125A Evaluate maintenance systems, should be selected.
The unit is suitable for people working at a technician level in maintenance-related design drafting or in maintenance-related supervision or management.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM14092A Integrate maintenance fundamentals into an engineering task

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element.

Elements and Performance Criteria

1	Investigate requirements of equipment or component maintenance task	1.1	Review the context and parameters of the maintenance task in consultation with stakeholders
		1.2	Review equipment or component original design and any subsequent modifications and repairs
		1.3	Review current performance specifications
		1.4	Determine engineering scientific principles and design techniques required for equipment or component maintenance
2	Investigate alternatives of repair, replacement or modification	2.1	Review preventative maintenance system requirements or defect/failure details to determine if replacement is required
		2.2	Review equipment or component condition analysis reports, including the results of any required NDT
		2.3	Review maintenance repair techniques and processes, standard parts, labour and skill requirements
		2.4	Consider life cycle design and sustainability implications of maintenance design and maintenance activities

		2.5	Determine specification, documentation and graphical techniques required to define designs
		2.6	Confirm WHS and regulatory requirements, codes of practice, standards, risk management and registration requirements relevant to repair and modification design projects
		2.7	Assess the need for technical and professional assistance
		2.8	Consider software options for repair and modification design, such as computer-aided design (CAD), stress analysis and project management software
		2.9	Decide if repair, replacement or modification is appropriate and seek any necessary approvals
3	Apply repair and modification design techniques	3.1	Plan, schedule and coordinate the repair or modification design task
		3.2	Apply the design process and scientific principles to repair and modification design proposals
		3.3	Determine materials, components, maintenance processes, equipment and tools required to implement design
		3.4	Create adequate and accurate calculations, preliminary graphics and maintain design process records, including use of software, as appropriate
		3.5	Assess repair and modification designs against design criteria
		3.6	Apply systems thinking to problem solving and decision making techniques in dealing with contingencies and constraints for continuous improvement and development of design options
		3.7	Incorporate professional and technical assistance, as required
		3.8	Use specification, documentation and graphical techniques, modelling, mock-up or prototyping techniques, as appropriate, to define repair or modification

4	Report results	4.1	Record results of investigations, application and development of repair and modification design
		4.2	Provide appropriate documentation, such as calculations, specifications, diagrams, CAD files, mock-ups or prototypes

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required skills

Required skills include:

- determining or confirming scientific principles and maintenance design techniques, WHS and regulatory requirements, and design specification requirements required to meet maintenance brief
- evaluating multiple solutions, materials and components, maintenance repair processes and techniques, standard parts, skill requirements, equipment and tools
- investigating life cycle design and sustainability, technical and professional assistance alternatives for repair, replacement or improvement, and software options for maintenance planning and design
- planning, scheduling and coordinating the maintenance task
- applying design process and scientific principles to component and hardware selection and design proposals
- solving problems and making decisions with systems thinking for contingencies and constraints, and continuous improvement
- defining designs, specifying and documenting and applying graphical techniques, modelling, mock-up or prototyping techniques
- creating and maintaining adequate and accurate calculations and design process records
- reporting and documenting results of investigations, application of principles and techniques, calculations, specifications, diagrams, CAD files, mock-ups or prototypes of designs

Required knowledge

Required knowledge includes:

- sustainability implications of maintenance processes, materials and products, including consideration of life cycle analysis
- design processes and techniques
- concurrent engineering techniques, systems thinking, problem solving and decision making, and continuous improvement methods
- WHS Acts and regulations, codes of practice, standards, registration and risk assessment for design, maintenance and prototyping activities
- procedures for planning, scheduling and coordination of maintenance design
- typical maintenance criteria, such as:
  - strength and servicability of repairs compared to original
  - function and aesthetics

  - maintainability and manufacturability
  - preventative maintenance evaluatuion criteria, such as mean time between failure (MBTF) and failure mode effects analysis (FMEA)
  - required quality, cost and sustainability
- design calculations techniques
- typical maintenance design requirements of various industries
- typical repairs, parts, skills and maintenance processes
- hardware specifications and catalogues
- typical maintenance plant, equipment and tools
- plant condition and maintenance assessment techniques
- typical maintenance techniques and technologies for monitoring, preventative maintenance, online and breakdown maintenance, disassembly, repair, reassembly and recommission
- design calculations layout and documentation for design checking and maintenance records
- design process documentation and reports, including specifications and CAD graphics
- software for maintenance planning and repair and modification design, including CAD and stress analysis software
- software and systems, such as system control and data acquisition (SCADA) and distributed control systems (DCS) for maintenance control and information distribution
- developments in repair and modification design
- options for mock-up, modelling and prototyping

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Overview of assessment	A person who demonstrates competency in this unit must be able to apply repair and modification techniques consistent with a design brief information, relevant standards and conventions.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • communicate, negotiate and review maintenance brief with stakeholders • determine or confirm scientific principles and design techniques, WHS and regulatory requirements, and design

	specification requirements • evaluate multiple solutions • investigate life cycle design, sustainability, technical and professional assistance required, and maintenance alternatives for repairs and modifications • plan, schedule and coordinate the maintenance task • solve problems and make decisions with systems thinking for contingencies and constraints, and continuous improvement • define designs, specify and document and apply graphical techniques, modelling, mock-up or prototyping techniques • select components and hardware • create and maintain adequate and accurate calculations and design process records • report and document results and processes.
Context of and specific resources for assessment	• This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
Method of assessment	• Assessment must satisfy the endorsed Assessment Guidelines of the MEM05 Metal and Engineering Training Package. • Assessment methods must confirm consistency and accuracy of performance (over time and in a range of workplace relevant contexts) together with application of underpinning knowledge. • Assessment methods must be by direct observation of tasks and include questioning on underpinning knowledge to ensure correct interpretation and application. • Assessment may be applied under project-related conditions (real or simulated) and require evidence of process. • Assessment must confirm a reasonable inference that competency is not only able to be satisfied under the particular circumstance, but is able to be transferred to other circumstances. • Assessment may be in conjunction with assessment of other units of competency where required.
Guidance information	Assessment processes and techniques must be culturally

for assessment	appropriate and appropriate to the language and literacy capacity of the candidate and the work being performed.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Maintenance repair and modification requirements	Maintenance repair and modification requirements may include: • scheduled maintenance required under the maintenance management system • unscheduled maintenance as a result of system/component failure • repairs to restore systems/components to operation • modifications to improve system/component reliability or maintainability • maintenance schedule change or equipment or component modification required because of a change in equipment performance requirements (e.g. changed production or product design) • competitive market pressure and 'lean maintenance' • changes in available maintenance technology • resources supply (e.g. materials, labour and skills) • introduction or changes to asset technologies (e.g. mechanical, fluid, electrical, electronic and system control) • sustainability relevant to repair and modification design tasks • WHS, risk and applicable standards and code requirements
Planning processes	Planning processes may include: • establishing maintenance parameters and design criteria • contributing to the negotiation and advice process • preliminary planning, investigations and costing • identifying design, development, prototyping activities and skills requirements • planning and scheduling design activities • improving, adjusting and rescheduling as required by emergency contingencies and constraints

Design process	Where equipment or component repair or modification design is required the design process includes: • establish design parameters and criteria • research, measurement, experimentation and investigation • generating ideas • synthesis, problem solving and decision making, and addressing constraints • apply scientific principles, calculation and graphics, prototyping and mock-up techniques if required • selection of components and hardware • evaluating solutions against design criteria • consultation, adjustments and agreement • finalise design and sign-off
Design criteria	Design criteria may include: • function and fit for purpose • aesthetics • manufacturability and maintainability • sustainability • cost constraints • ergonomics and anthropometrics and physiology • facilities, plant, services and skills available • WHS and risk
Sustainability	Sustainability is used to mean the entire sustainable performance of the organisation/plant, including: • meeting all regulatory requirements • conforming to all industry covenants, protocols and best practice guides • minimising ecological and environmental footprint of process, plant and product • maximising economic benefit of process plant and product to the organisation and the community • minimising the negative WHS impact on employees, community and customer
Life cycle	Life cycle analysis can be used to improve sustainability of repaired or modified equipment or components. It may be applied to all aspects of

assessment	the repair or modification process

Appropriate licensed technical and professional assistance	Appropriate licensed technical and professional assistance may include:
	• technical support and advice relating to elements which have intrinsic dangers, such as:
	  • high pressure
	  • energised fluid vessels
	  • high temperatures and heat energy capacity
	  • wiring with high current control voltages above extra low voltage
	• professional support for technologies, such as:
	  • specialist electric motor drives and controllers
	  • specialist materials, plastics, metal alloys and nano materials
	  • special processes, foundry, alloy welding, heat treatment, sealing and fastening

WHS, regulatory requirements and enterprise procedures	WHS, regulatory requirements and enterprise procedures may include: • WHS Acts and regulations • relevant standards • codes of practice from Australian and overseas engineering and technical associations and societies • risk assessments • registration requirements • safe work practices • state and territory regulatory requirements applying to electrical work
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular maintenance repair and modification design task
Prototyping	Prototyping may include: • mock-ups, physical and virtual modelling with post-processing for computer numeric control (CNC) and rapid prototyping
Systems thinking	Systems thinking refers to the conduct of engineering work in a

	manner that demonstrates knowledge of how the interaction of different technical systems on equipment, machinery or structures, as well as the skills and techniques of personnel, combine to perform or support engineering-related operations, processes or projects. It embraces determining or establishing how the function of each technical system or component, as well as the skills and techniques of personnel, effects or potentially may effect, outcomes. Systems should be interpreted broadly within the context of the organisation and depending on the project or operation can include equipment, related facilities, material, software, internal services and personnel, and other organisations in the value chain

Unit Sector(s)

Competency field

Unit sector Planning

Custom Content Section

Not applicable.