Australian Government

MEM14085A Apply mechanical engineering analysis techniques

Release: 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MEM14085A Apply mechanical engineering analysis techniques

Modification History

Release 1 - New unit Replaces MEM14061A, but not equivalent.

Unit Descriptor

This unit of competency covers the skills needed to undertake a range of mechanical engineering-related analyses. The analyses may relate to design, fitness for purpose evaluations, installation and commissioning, and other mechanical engineering-related tasks. Documentation of the design process includes calculations, specifications, computer-aided design (CAD) files, risk analysis, sustainability and life cycle assessments.

Application of the Unit

This unit applies to mechanical engineering analyses undertaken as part of a mechanical design or mechanical assessment of plant, products, projects, system changes or improvements. It is suitable for people working as mechanical designers and draftspersons and those pursuing careers and qualifications in mechanical engineering or related disciplines. The work may be undertaken individually or as part of a team.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A	Apply technical mathematics
MEM23109A	Apply engineering mechanic principles

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 mechanical analysis context and need	1.1	Review the context and negotiate parameters of the mechanical design or task in consultation with stakeholders
		1.2	Identify relevant engineering scientific principles and required analysis techniques
		1.3	Investigate life cycle design and sustainability implications of mechanical design or existing plant or equipment
		1.4	Determine specification, documentation and graphical techniques required for analysis
		1.5	Confirm work health and safety (WHS) and regulatory requirements, codes of practice, standards, and risk management relevant to mechanical analysis task
		1.6	Determine available sources for any required technical and professional assistance
2	Apply mechanical analysis techniques	2.1	Plan, schedule and coordinate the analysis task
		2.2	Create adequate and accurate calculations, preliminary graphics and maintain analysis process records
		2.3	Evaluate multiple solutions against analysis criteria
		2.4	Apply systems thinking to problem solving and decision making
		2.5	Incorporate professional and technical assistance, as

			required
		2.6	Apply specification, documentation and graphical techniques modelling, mock-up or prototyping techniques, where required, to achieve or test solution
3	Report results	3.1	Record results of analysis
		3.2	Provide 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:

- communicating and negotiating with stakeholders and team
- determining or confirming relevance of mechanical engineering scientific principles and analysis techniques, including principles of:
  - mechanics
  - fluid power
  - fluid dynamics
  - thermodynamics
  - electrical fundamentals
  - engineering materials, properties and processes
- evaluating WHS and regulatory requirements, standards and codes of practice for relevance to analysis tasks
- evaluating multiple solutions against analysis criteria, risk, sustainability and cost factors
- applying life cycle design and sustainability parameters to analysis task
- planning, scheduling and coordinating the analysis task
- applying problem solving and decision making with systems thinking for contingencies and constraints and continuous improvement
- specifying, documenting and applying graphical techniques, including modelling
- undertaking or supervising mock-up or prototyping techniques, where required, to achieve solution
- creating and maintaining adequate and accurate calculations and analysis 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:

- implications of life cycle design, fitness for purpose evaluation and sustainability for mechanical analysis process
- mechanical engineering-related analysis processes and techniques to investigate, synthesise and develop proposals, evaluate feasibility against analysis criteria, and review and revise in consultation with stakeholders and team or support functional group
- common model, mock-up and prototyping techniques relevant to mechanical engineering

- systems thinking, problem solving and decision making, and continuous improvement methods
- WHS and regulatory requirements, codes of practice, standards, risk management and registration requirements
- sources of professional and technical assistance
- procedures for planning, scheduling and coordination of analysis
- hardware requirements of typical mechanical, fluid power, hydrodynamic and thermal applications
- engineering scientific principles required for design analysis:
  - mechanical
  - fluid power
  - fluid dynamics
  - thermodynamics
  - electrical fundamentals
  - engineering materials, properties and processes
- mechanical analysis calculation techniques
- software for product planning and analysis, such as CAD, stress analysis and mould design, and project management
- documentation and required information
- prototyping options, including mock-ups, physical and virtual modelling, and rapid 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 mechanical analysis techniques consistent with an analysis 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 analysis brief and specification requirements with stakeholders • determine or confirm relevant scientific principles and analysis techniques, WHS and regulatory requirements • evaluate multiple solutions • investigate life cycle analysis and sustainability • plan, schedule and coordinate the analysis task • solve problems and make decisions with systems thinking for

	contingencies and constraints and continuous improvement • define analysis, specify and document and apply graphical techniques, modelling, mock-up or prototyping techniques • create and maintain adequate and accurate calculations and analysis 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 a simulated working environment 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. • Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability. • Access must be provided to appropriate learning and/or assessment support when required. Where applicable, physical resources should include equipment modified for people with disabilities.
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 for assessment	Assessment processes and techniques must be culturally 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.

Mechanical engineering analysis	Mechanical engineering analysis may be required for a variety of reasons, including: • design of mechanical devices and plant • design or evaluation of significant modifications, process changes or improvements • sustainability issues relevant to plant, equipment or processes • static and dynamic analysis of loads, including the resulting stresses and deformations • fitness for purpose evaluation • installation and commissioning of plant and equipment
Planning processes	Planning processes may include: • establishing analysis parameters and criteria • contributing to the negotiation and advice process • preliminary planning, analysis investigations and costing • identifying analysis, development, prototyping activities and skills requirements • planning and scheduling analysis activities • improving, adjusting and rescheduling as required by emergency contingencies and constraints
Analysis process	Analysis as a systematic process includes: • establish analysis 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 • evaluating solutions against analysis criteria • consultation, adjustments and agreement • finalise analysis and sign-off
Analysis criteria	Analysis includes relevant technical criteria and may also include criteria relating to: • function • manufacturability and maintainability • marketability

	• sustainability • cost constraints • ergonomics and anthropometrics and physiology • facilities, plant and skills available • contingencies and constraints minimisation • safety 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 analysis	Life cycle analysis can be used to improve sustainability of products and services. It may be 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
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
Appropriate licensed technical and professional	Appropriate licensed technical and professional assistance may include:

assistance	• technical support and advice relating to elements which have intrinsic danger, 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
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to the mechanical engineering analysis task

Unit Sector(s)

Competency field

Unit sector Planning

Custom Content Section

Not applicable.