Australian Government

Department of Education, Employment and Workplace Relations

MEM234003A Design machines and ancillary equipment

Release: 1

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Modification History

New unit

Unit Descriptor

This unit of competency covers the design of machines and ancillary equipment. It includes sustainability implications, occupational health and safety (OHS), modelling and calculations, use of software, product analysis and product life cycle design, investigating, generating ideas, synthesis, prototype completion and manufacture and evaluation.

Application of the Unit

This unit applies to the design of any significant machinery and ancillary equipment for domestic, commercial, industrial, medical, military or entertainment purposes. Design activities may also include reverse engineering, design rectification or modifications of an existing design. Activities include the design of specific machine elements, such as shafts, bearings, brakes, clutches, springs, pressure vessels, flywheels, and may also include selection of ancillary equipment, such as motors, pumps and valves.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

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. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

1	Clarify the design task and elaborate the specification	1.1	Establish, in consultation with client, required features of machine and ancillary equipment
		1.2	Determine parameters to the brief or contract
		1.3	Determine stakeholders to be consulted in design process
		1.4	Assess OHS, regulatory, sustainability or environmental issues relevant to design task
		1.5	Confirm design brief, including budget and schedule, and provide preliminary advice on feasibility
2	Perform design analysis and prepare concept proposals	2.1	Carry out initial investigations and measurements
		2.2	Using current industrial design techniques carry out required modelling and calculations using appropriate software
		2.3	Generate a range of solutions to the design brief
		2.4	Check feasibility and evaluate solutions against design criteria ensuring conformity to standards and codes, technical, economic and OHS requirements
		2.5	Determine, social and sustainability implications of solutions
		2.6	Review concept proposals with client and identify preferred solution
3	Design machines or equipment	3.1	Finalise selected machine or equipment design, including ensuring preparation of all required documentation, drawings, specifications and instructions
		3.2	Consult with client and stakeholders to obtain sign-off on design
		3.3	Monitor installation and commissioning with stakeholders and make any necessary adjustments to design

Required Skills and Knowledge

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

Required skills

Required knowledge includes:

- determining features of machines or equipment, including OHS, regulatory and risk management requirements
- interpreting parameters to the brief or contract
- researching latest trends and techniques in:
  - machine and equipment design
  - reverse engineering
  - sustainability issues and implications for machine and equipment design
  - materials
  - assembly, fabrication and construction techniques
  - lean and other quality techniques
  - latest relevant modelling and other software
- investigating and presenting options
- investigating faults in existing designs and proposing solutions
- selecting and using software and validation techniques, including 2-D and 3-D modelling
- creating design solutions to match client expectations of innovation as well as fitness for purpose
- designing for servicing, maintainability, cost, manufacturability and assembly, and ease of operation
- applying calculus to engineering design solutions requiring computations, such as rate of change, moments of inertia and friction forces
- evaluating solutions for feasibility against design criteria, including relevant engineering and financial calculations and analysis
- selecting materials, equipment and sub-assemblies based on availability, price and performance characteristics
- applying graphical techniques, such as those required by dynamic balancing diagrams
- communicating, negotiating and reviewing with stakeholders and client throughout process to obtain agreement of proposal and sign-off on design
- documenting design with drawings, specifications and instructions

Required knowledge

Required knowledge includes:

- contemporary engineering design methods
- research and investigations methods
- techniques for:
  - continuous improvement
  - problem solving and decision making
  - root cause analysis (RCA) or failure mode and effects analysis (FMEA) or design review based on failure mode (DRBFM), and Pareto analysis
- engineering design software options
- software validation processes
- documentation, drawings, specifications and instructions
- OHS and regulatory requirements, codes of practice, standards, risk minimisation and registration requirements.
- machine element assembly arrangements and methods
- fastening and sealing methods
- gear design standards and techniques
- strength and stress analysis
- shaft design
- forces, stresses and deflections of coil springs
- stresses in thick-walled pressurise vessels and cylinders subject to shrink and press fitting
- disk, hydraulic and cone clutches
- velocity and acceleration analysis of mechanisms
- ergonomics principles
- materials selection
- failure modes

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.

Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • determine features of machines or equipment, OHS, regulatory and risk management requirements • generate design solutions • interpret parameters to the brief or contract • research current design trends and sustainability implications • investigate options for machine and equipment design • measure, model, calculate and analyse using software and validation techniques • innovate and create solutions • evaluate solutions for feasibility against design criteria • communicate, negotiate and review with stakeholders and client throughout process to obtain agreement of proposal and sign-off on design.
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, that is, the candidate is not in productive work, 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 its 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 able not only 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.

Client	Client may be: • internal or external to the designer's organisation
Parameters to the design brief	The design brief may include the design of new equipment or fault analysis, rectification or modification to an existing design. Parameters to the design brief may include: • determination of the degree of innovation and creativity expected by the client • design process limits and budgets • product cost limits and budgets • performance specifications • equipment availability, capacities and restrictions • specified administrative, communication and approval procedures • other special features and limits in the design brief
OHS, regulatory, sustainability and environmental issues	OHS, regulatory, sustainability and environmental issues may include: • OHS Acts and regulations • relevant standards • industry codes of practice • risk assessments • registration requirements • safe work practices • 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 OHS impact on employees, community and customer

	• state and territory regulatory requirements
Range of solutions	Range of solutions may include those that: • satisfy the technical requirements of the design brief • are within budget • are able to be manufactured • meet any regulatory requirements • minimise environmental and sustainability impacts
Current industrial design techniques	Current industrial design techniques may relate to: • sustainability and energy conservation • life cycle design and recyclable components • maintainability, manufacturability and reliability • use of current codes and standards and risk minimisation • developments in design techniques and design software along with software validation techniques
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular design task

Unit Sector(s)

Engineering practice

Custom Content Section

Not applicable.