



Australian Government

MEM14087A Apply manufactured product design techniques

Release: 1

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Modification History

Release 1 - New unit. Replaces MEM14063A, but not equivalent.

Unit Descriptor

This unit of competency covers the application of engineering design techniques to manufactured products. It includes documentation of the design process, calculations, specifications, computer-aided design (CAD) files, risk analysis, sustainability and life cycle assessments.

Application of the Unit

This unit applies to where engineering and related skills and knowledge are required for the design of manufactured products or components. The unit applies to people working individually or as part of a team. It is suitable for individuals working alone as designers on simpler manufactured product and component design or as part of a design team consisting of other paraprofessional and professional engineering designers. The unit is also suitable for design draftspersons undertaking design tasks.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM14089A Integrate mechanical fundamentals into an engineering task

MEM23004A Apply technical mathematics

MEM23063A Select and test mechanical engineering materials

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 manufactured product design requirements	1.1	Review product design brief
		1.2	Determine engineering and scientific principles and design techniques required for product design process
		1.3	Investigate life cycle design and sustainability implications of design requirement
		1.4	Determine required specification, documentation and graphical techniques to define design
		1.5	Confirm work health and safety (WHS) and other regulatory requirements
		1.6	Identify codes, standards and risk management requirements
		1.7	Investigate software requirements for product design process

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| 2 | Apply manufactured product design techniques | 2.1 | Plan, schedule and coordinate the design task |
| | | 2.2 | Analyse available materials, components, manufacturing processes, tooling and suppliers against design requirements |
| | | 2.3 | Create adequate and accurate calculations, preliminary graphics and maintain design process records |
| | | 2.4 | Evaluate multiple solutions against design criteria, risk, failure mode, sustainability and cost |
| | | 2.5 | Apply systems thinking, problem solving and decision making techniques in dealing with contingencies and constraints, continuous improvement and development of design options |
| | | 2.6 | Incorporate professional and technical assistance, as required |
| | | 2.7 | Finalise specification and documentation, modelling, mock-up or prototyping |
| 3 | Report results | 3.1 | Record results of investigations, application and development of design |
| | | 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
- determining or confirming appropriate engineering and scientific principles for product or component design task
- determining sustainability, WHS, regulatory and risk management requirements
- evaluating multiple solutions for materials and components, manufacturing processes, tooling and component supply for product
- investigating life cycle and sustainability of a design
- evaluating requirement for technical and professional assistance
- planning, scheduling and coordinating a design task
- solving problems and making decisions with systems thinking for contingencies and constraints, and continuous improvement
- specifying and documenting designs, including 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 materials, product and processes, including consideration of life cycle analysis
- manufactured product design processes and techniques
- systems thinking, problem solving and decision making, and continuous improvement methods
- WHS and regulatory requirements, standards and risk assessment for design, and prototyping activities
- sources of professional and technical assistance procedures for planning, scheduling and coordination of design
- typical product design criteria
- design calculation techniques
- product planning and design software, such as for CAD, stress analysis and project management

- design process documentation, records and reports, including specifications and CAD graphics
- typical materials and components used in manufacturing
- tooling, plant and processes for particular products and materials
- characteristics of cast, forged, machined and sheet metal components, moulded and extruded plastic components, and components made from other materials or by other processes
- professional and technical assistance for product development

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 manufactured product design techniques consistent with a design brief, relevant standards and conventions. It includes working individually and as part of a team in accordance with organisational procedures.
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 design brief with stakeholders • determine or confirm scientific principles and design techniques, WHS and regulatory requirements, and design specification requirements • evaluate multiple solutions, materials and components, manufacturing processes, tooling and component supply chain for product • investigate life cycle design and sustainability, technical and professional assistance required • plan, schedule and coordinate the design task • select design components using design process and scientific principles • 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 • 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 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.

Context of manufactured product design	The context for product design activity may include: • budget and market considerations • technological advantages/disadvantages of materials, equipment and suppliers • resources supply (e.g. materials, labour and skills) • sustainability issues relevant to design task (e.g. WHS, risk management, standards and codes of practice)
Planning processes	Planning processes may 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 and rescheduling as required by emergency contingencies and constraints
Design process	Designing as a systematic process includes: • establish design parameters and criteria • research, measurement, experimentation and investigation • generate ideas and develop proposals • synthesis, problem solving and decision making, and addressing constraints • apply scientific principles, calculation and graphics, prototyping and mock-up techniques • evaluate solutions against design criteria • review and revision of design in consultation with stakeholders • finalise design and sign-off
Design criteria	Design criteria include: • function • aesthetics • manufacturability and maintainability • marketability • sustainability, including life cycle analysis • cost constraints on costs of design, development, tooling up, manufacture, marketing and distribution • ergonomics and anthropometrics and physiology • facilities, plant and skills available • safety and risk
Analysis	Analysis may include: • product and component performance requirements • assessment against manufacturing capability of organisation • failure mode effects and risk • static and dynamic analysis of loads • the stresses and deformations resulting • graphical and mathematical methods and software options • suitability of materials for purpose and manufacturing process
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 assessment	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
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 • industry codes of practice • 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 design task

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
Product manufacturability	Design for manufacture includes consideration of manufacturing processes and plant, such as the use of group technologies. Manufacturability may be enhanced by concurrent product and process design.
Prototyping	Prototyping may include: • mock-ups, physical and virtual modelling with post-processing for computer numeric control (CNC) and rapid prototyping

Unit Sector(s)

Competency field

Unit sector Planning

Custom Content Section

Not applicable.