



Australian Government

MEM09155A Prepare mechanical models for computer-aided engineering (CAE)

Release 1

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Modification History

Release 1 - New unit. Replaces MEM09151A but not equivalent

Unit Descriptor

This unit of competency covers the application of mechanical modelling techniques for computer-aided engineering (CAE) purposes. It includes model creation for purposes such as computer-aided manufacturing (CAM) and computer numerical control (CNC) applications, rapid prototyping and stress analysis, and as a basis for generating orthogonal drawings.

Application of the Unit

This unit applies to modelling of mechanical, maintenance and manufacturing engineering products, plant and system for CAE applications. It is suitable for people working in design drafting and those pursuing technical qualifications and careers at engineering technician level.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A Apply technical mathematics

MEM23109A Apply engineering mechanics 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

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|---|---------------------------|--|
| 1 | Identify model parameters | 1.1 Identify the engineering context of computer modelling |
| | | 1.2 Identify sustainability issues related to required models |
| | | 1.3 Identify work health and safety (WHS) and regulatory requirements related to modelling processes and materials |
| | | 1.4 Identify the virtual or physical model parameters, form, function and features |
| | | 1.5 Identify required model generation processes, including any required graphics generation, post-processing and physical modelling |
| | | 1.6 Identify licensed technical and professional assistance for advice, as required |
| | | |
| 2 | Develop model | 2.1 Generate initial graphical model |
| | | 2.2 Undertake initial consultation on model with stakeholders and adjust, as required |
| | | 2.3 Prepare model for intended purpose |
| | | 2.4 Trial model for purpose and complete investigative analysis or produce physical model |
| | | 2.5 Evaluate model against design criteria with stakeholders and make adjustments, as required |
| | | 2.6 Engage appropriate licensed technical and professional assistance for advice, as required |

- 3 Finalise modelling
 - 3.1 Prepare final model
 - 3.2 Report and demonstrate results
 - 3.3 Provide documentation, instructions, models and files, as required
 - 3.4 Obtain sign-off

Required Skills and Knowledge

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

Required skills

Required skills include:

- reviewing features, functions and context of engineering modelling, including imminent future developments
- comparing available software, functions and features
- communicating, participating and negotiating with:
 - stakeholders, team, cross-function support groups and experts
 - appropriate licensed technicians and professionals
- modelling using a comprehensive range of techniques, such as:
 - creating and manipulating 3-D entities
 - using library files and adaptations
 - accessing supplier catalogues and databases
- creating dimensioned orthographic projections from model
- extracting dimensional properties from model:
 - post-processing model for analysis or physical modelling
- finalising modelling by:
 - completing work
 - gaining approval and commissioning work
 - providing documentation and reports, as required
 - obtaining sign-off

Required knowledge

Required knowledge includes:

- advantages and disadvantages of CAM using modelling compared to traditional manufacturing methods
- implications to be taken into account when modelling (e.g. efficiency of production, generation of waste and life cycle considerations)
- typical mechanical components, assemblies and layouts suitable for modelling
- software functions and features
- model creation techniques, including:
 - using and manipulating coordinate systems
 - creating 3-D entities, ruled and revolved surfaces

- creating solids, editing and combining solids
- manipulating entities and solids
- library files
- manipulations of solids and library files
- 3-D graphics from models, including rotated views and sections
- dimensioned orthographic representations from models
- typical modelling processes, including:
 - computer modelling
 - post-processing
 - prototyping and model manufacture
- mathematical model analysis options, such as:
 - finite analysis of heat flows
 - finite analysis of stresses and deflections
- physical modelling options
- traditional, current and emerging modelling methods
- WHS and regulatory requirements, codes of practice, risk assessment and registration requirements relevant to modelling task
- job requirements that may create a need for licensed technical and professional services assistance
- modelling compared to traditional representation methods, including:
 - pen and pencil graphics compared to wire frame, surface and solid models
 - computer animations compared to transparent overlay mobiles to test clearances and motions
 - solid models compared to isometric representations
 - computer library files compared to the use of reference charts and catalogue information

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 produce a variety of mechanical, manufacturing and maintenance-related models that are consistent with design information and relevant standards and conventions.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	<p>Assessors must be satisfied that the candidate can competently and consistently:</p> <ul style="list-style-type: none"> • review features, functions and context of engineering modelling • compare available software, functions and features • communicate, participate and negotiate with stakeholders, team, cross-function support groups and experts, appropriate licensed technicians and professionals • model using a comprehensive range of techniques • create dimensioned orthographic projections from model • extract dimensional properties from model • post-process model for analysis or physical modelling • complete work, commission and gain approval, document and report, and obtain sign-off • identify future developments in modelling.
Context of and specific resources for assessment	<ul style="list-style-type: none"> • Assessment may occur on the job or in an appropriately simulated environment. Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and WHS practices. • 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	<ul style="list-style-type: none"> • Assessment must satisfy the endorsed Assessment Guidelines of the MEM05 Metal and Engineering Training Package.

	<ul style="list-style-type: none"> • 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.

Models	<p>Models may be:</p> <ul style="list-style-type: none"> • virtual, such as computer generated solids models • physical models developed from the virtual model data
Model purpose	<p>Models covered by this unit include mechanical, maintenance and manufacturing engineering products, plant and system models. Examples of models include:</p> <ul style="list-style-type: none"> • computer model of a cavity mould for finite analysis of heat flows

	<ul style="list-style-type: none"> • computer model of a container, vehicle or frame for finite analysis of stresses and deflections • physical models of components produced for form, fit or aesthetic purposes • physical models, such as a once-off vehicle body panel, produced ready and fit for purpose • physical models, such as a sintered metal moulds or die capable of producing a limited run of production components
Features, functions and context of engineering modelling	<p>Features, functions and context of mechanical modelling include:</p> <ul style="list-style-type: none"> • techniques used for mechanical modelling • sustainability implications of modelling • WHS and regulatory requirements related to modelling processes and materials • model parameters, form, function and features, virtual or physical • processes required which may include those for generating graphics, post-processing and physical modelling • required licensed technical and professional assistance
Post-processor	<p>A post-processor or code generator converts programmed instructions generated by CAM software or CAD package into CNC program code to control a machine tool</p>
Post-processing model for analysis or physical modelling	<p>Examples of post-processing model for analysis or physical modelling include:</p> <ul style="list-style-type: none"> • setting up model with physical properties, mesh and nodes for finite element analysis (FEA) • processing dimensional data to create 3-D code for CAM operations • post-processing to create CNC data files to control CNC devices, including mills, lathes, machining centres, lasers, ultrasonic cutters and routers • modelling for rapid prototyping
Rapid prototyping	<p>A variety of rapid prototyping processes are available, including:</p> <ul style="list-style-type: none"> • selective laser sintering (SLS) which uses thermoplastics

	<p>and metal powders</p> <ul style="list-style-type: none"> • fused deposition modelling (FDM) which uses thermoplastics and eutectic metals • stereolithography (SLS) which uses a photopolymer • laminated paper manufacturing (LPM) which uses paper • electron beam melting (EBM) which uses titanium alloys • 3-D printing (3-DP) which uses a variety of materials
Criteria for mechanical designs	<p>Criteria for mechanical designs may include:</p> <ul style="list-style-type: none"> • function • aesthetics • manufacturability and maintainability • marketability • sustainability • cost constraints • ergonomics, anthropometrics and physiology • facilities, plant and skills available • safety and risk
Mechanical components, assemblies and layouts	<p>Mechanical assemblies may include:</p> <ul style="list-style-type: none"> • chain drives, gear sets, pulley and belt drives • threads, fasteners and springs • shafts, keyways and splines • structural sections • machines, drives and transmissions • materials handling equipment, including belt conveyors, augers and pneumatic conveyors • guards, handrails and platforms • structures, vessels and tanks • fan, ventilation, air conditioning service and ducting • production process layouts
Appropriate licensed technical and professional assistance	<p>Appropriate licensed technical and professional assistance may include:</p> <ul style="list-style-type: none"> • technical support and advice relating to elements which have intrinsic dangers, such as: <ul style="list-style-type: none"> • high pressure • energised fluid vessels • high temperatures and heat energy capacity

	<ul style="list-style-type: none"> wiring with high current control voltages above extra low voltage professional support for technologies, such as: <ul style="list-style-type: none"> 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	<p>WHS, regulatory requirements and enterprise procedures may include:</p> <ul style="list-style-type: none"> WHS Acts and regulations other relevant regulations and standards industry codes of practice risk assessments registration requirements safe work practices
Standards and codes	<p>Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular design task</p>
Modelling and related software	<p>Modelling and related software may include:</p> <ul style="list-style-type: none"> lumped parameter model empirical, random data tested model FEA software model-based design

Unit Sector(s)

Competency field

Unit sector Drawing, drafting and design

Custom Content Section

Not applicable.