



Australian Government

MEM23109A Apply engineering mechanics principles

Release 1

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Modification History

Release 1 (MEM05v9).

Unit Descriptor

This unit of competency covers the application of mechanics and strength of materials principles to devices, machines and systems and their components in order to identify key mechanical properties. It includes a range of basic analyses of static and dynamic loads and moments, stresses and deflections, velocities and accelerations.

Application of the Unit

This unit applies to analysis of mechanical devices, machines and systems and their components to determine a range of mechanical related properties. It covers the analysis of 2-D forces and moments, stresses and deflections on bodies, frames and beams. It is suitable for people working as technicians in engineering or related fields using basic mechanics principles and those pursuing careers and qualifications in engineering or related disciplines.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A Apply technical mathematics

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	Identify scope of required analysis	1.1	Identify device, machine or system and component parts for analysis
		1.2	Assess engineering mechanics principles, skills and techniques required by tasks
		1.3	Review functions and features of devices, machines and systems
		1.4	Assess software techniques required for basic analysis and graphics required by the task
		1.5	Identify stakeholders to be consulted on analysis tasks
		1.6	Confirm work health and safety (WHS) and regulatory requirements, risk management and organisational procedures
		1.7	Review sustainability implications of tasks
		1.8	Determine available sources for any required technical and professional assistance
2	Apply engineering mechanics principles and techniques to tasks	2.1	Identify appropriate engineering mechanics principles and analytical, graphical and software-assisted techniques applicable to task
		2.2	Validate software results using analytical and graphical methods
		2.3	Ensure clear and logical process of analysis and compatibility of units in calculations

- 2.4 Apply resultant loads and reactions on machines, support frames and beams due to parallel and oblique, concentrated and distributed loads and moments
 - 2.5 Apply the torque and power required to drive translation screws and winding drums against inclined and vertically suspended loads subject to gravitation, acceleration and friction resistance loads
 - 2.6 Select a range of standard hardware to meet specifications
 - 2.7 Analyse bending and shear stresses in beams subject to static point and distributed loads
- 3 Report results
 - 3.1 Record results of investigation, evaluation and application
 - 3.2 Provide documentation, such as calculations, diagrams, programs and files

Required Skills and Knowledge

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

Required skills

Required skills include:

- identifying parameters and context of tasks, chain of responsibility, WHS and regulatory requirements, risk management and organisational procedures
- confirming personal functions and responsibilities, team and support functional group interdependencies and communications, appropriate qualifications and delegations, and appropriate support
- reviewing sustainability implications, functions and features of devices, machines and systems
- assessing and applying mechanics principles, software basic analysis and graphics skills and techniques to mechanical devices and systems
- employing techniques to ensure clear and logical process of analysis and compatibility of units in calculations
- reporting and documenting results of investigation, evaluation and application, calculations, diagrams, programs and files

Required knowledge

Required knowledge includes:

- mathematical techniques, including arithmetic, algebra, trigonometry, geometry and differential calculus
- definition of typical applications of mechanics, statics, dynamics, kinematics, kinetics and strength of materials
- analytical, graphical, semi-graphical and software-assisted techniques for all tasks
- physical quantities and dimensions, including international system of units (SI) and fundamental dimensions and units
- basic principles of statics applicable to mechanical devices and systems
- application of force systems applied to bodies, frames and beams
- friction laws and applications in mechanical devices and systems
- stress and strain:
 - axial stress
 - shear stress
 - bolted and welded joints
 - torsional stress
- bending of beams
- dynamics applicable to mechanical devices and systems, including:

- kinematics of rectilinear motion:
 - displacement, velocity and acceleration
 - equations of rectilinear motion
 - equations of simple harmonic motion
 - uniform acceleration and sinusoidal acceleration
- kinetics of rectilinear motion:
 - force, mass and acceleration
 - freely falling bodies
 - acceleration against resistance (accelerating force = unbalanced force)
 - acceleration against gravity and terminal velocity
 - acceleration against dry sliding friction and air resistance
 - forces diagrams
- curvilinear motion:
 - normal acceleration in curvilinear motion
 - centrifugal force
 - circular motion as a particular case of curvilinear motion
- kinematics of rotation:
 - rotational motion
 - angular displacement
 - angular velocity
 - angular acceleration
 - conversions of units of angular motion
 - equations of rotation with uniform acceleration
 - relation between linear and angular motion
- kinetics of rotation:
 - moment of inertia, second moment of mass, concept and units
 - torque due to inertia compared with torque due to winding drum rope force
- the law of a machine
- work, energy and power
- specifications for engineering hardware applicable to mechanical devices and systems

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.

<p>Overview of assessment</p>	<p>A person who demonstrates competency in this unit must be able to apply principles of mechanics to machines, support frames, beams and related components to determine static and dynamic loads, stresses and deformations to contribute to the design and component selection process.</p> <p>This includes working individually and as part of a team and recognising and complying with normal control procedures on engineering projects.</p>
<p>Critical aspects for assessment and evidence required to demonstrate competency in this unit</p>	<p>Assessors must be satisfied that the candidate can competently and consistently:</p> <ul style="list-style-type: none"> • determine parameters and context of tasks • apply WHS, regulatory requirements, risk management and organisational procedures • confirm personal functions and responsibilities • review sustainability implications, functions and features of devices, machines and systems • assess and apply engineering mechanics principles, including use of software basic analysis and graphics skills and techniques • ensure compatibility of units in calculations • report and document results.
<p>Context of and specific resources for assessment</p>	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.

Engineering mechanics tasks	<p>Engineering mechanics tasks covered by this unit include, but are not limited to:</p> <ul style="list-style-type: none"> • application of resultant loads and reactions on machines, support frames and beams • application of the torque and power required to drive translation screws and winding drums against inclined and vertically suspended loads subject to gravitation, acceleration and friction resistance loads • selecting a range of standard hardware, such as shafts, bolts and hooks, subject to plane axial or shear stresses and deformation limits
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	<ul style="list-style-type: none"> analysing bending and shear stresses in beams subject to static point and distributed loads
Motion	Motions described in this unit may be of constant velocity, constant acceleration or sinusoidal accelerations (e.g. sprung bodies). Other non-uniformly accelerated motions may be described for contrast only. This unit confines itself to 2-D plane motion
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 wiring with high current control voltages above extra low voltage professional support for technologies may include: <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 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
Analysis	<p>Analysis may include:</p> <ul style="list-style-type: none"> static and dynamic analysis of loads the stresses and deformations resulting the transmitted power, torque and speed graphical and mathematical methods and software options

Unit Sector(s)

Competency field

Unit sector Engineering science

Custom Content Section

Not applicable.