



Australian Government

MEM23121 Analyse loads on frames and mechanisms

Release: 1

MEM23121 Analyse loads on frames and mechanisms

Modification History

Release 1. Supersedes and is equivalent to MEM23121A Analyse loads on frames and mechanisms.

Application

This unit of competency defines the skills and knowledge required to analyse loads on mechanisms, frames and structural support elements including linkages, rods, shafts and beam elements within machines and mechanisms. It includes a focus on safe working practices, work health and safety (WHS) compliance requirements, function and features of frames and mechanisms, load and deflection analysis for static and dynamic elements, and traditional and software-based techniques.

This unit applies to the analysis of loads on mechanisms, beams, frames and support elements either individually or with the assistance of a professional engineer for more complex calculations of loads and stresses. It is suitable for people working as mechanical detailers or designers and draftspersons, and for those pursuing careers and qualifications in mechanical engineering or related disciplines.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

MEM23004 Apply technical mathematics

MEM23007 Apply calculus to engineering tasks

MEM23109 Apply engineering mechanics principles

Competency Field

Engineering science

Elements and Performance Criteria

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Establish scope of frame and mechanism analysis	1.1 Determine compliance requirements of WHS and regulatory requirements, codes of practice, standards and risk assessment considerations for design and use of machines and equipment 1.2 Identify features, functions, operating conditions and performance

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	requirements of frames, beams and mechanisms 1.3 Investigate sustainability implications of frames and mechanisms 1.4 Review design loads, working stresses, allowable deformations and factor of safety for elements 1.5 Review element arrangements, assembly and fastening methods 1.6 Identify any complex load calculations to be done with, or obtained from, a professional engineer 1.7 Establish availability of technical and professional assistance 1.8 Identify and evaluate appropriate analysis techniques, software and software validation techniques 1.9 Identify stakeholders to be consulted on selection tasks
2. Analyse loads and performance of frames and mechanisms	2.1 Estimate static and dynamic operating conditions and determine design or selection parameters 2.2 Optimise frame, beam and mechanism elements for strength, deflection, arrangement and fastening 2.3 Review analysis with stakeholders and make any required adjustments 2.4 Confirm compliance of frames and mechanisms with WHS and regulatory requirements, standards and codes of practice
3. Report results	3.1 Record results of analysis 3.2 Provide documentation including calculations, specifications diagrams and drawings

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance.

Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.	
Structural support and machine elements include:	• beam, strut and tie elements of machines and machine supports subject to bending, tension, compression and shear stresses including: • shafts, levers, cams and linkages • frames, stanchions and beams • mechanisms for converting linear to rotary motion and rotary to linear motion • mechanisms with up to five linkages • lifting machines.
Machine mechanisms include:	• a device to produce a constrained motion while producing a required output • an assembly of elements or links which can be called kinematic pairs (turning, sliding, rolling or skidding pairs), which remain in contact throughout their motions. One link, typically the base element, is fixed.
WHS, regulatory requirements and organisational procedures include:	• WHS acts, regulations and relevant standards • codes of practice • risk assessments • registration requirements • safe work practices • state and territory regulatory requirements.
Load calculations to be done with, or obtained from, a professional engineer and include one or more of the following:	• regulatory or organisational requirement for professional engineer involvement • static and dynamic complex analysis of loads, including resulting stresses and deformations • choice of graphical and mathematical methods and software options.
Appropriate licensed technical and professional assistance includes:	• technical support and advice relating to elements which have intrinsic dangers • professional support for technologies.
Sustainability includes:	• 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.
Appropriate	• software employed for performance analysis and/or modelling

computer-aided solutions and validation techniques include:	including program techniques and algorithms including the use of finite element analysis (FEA) and numerical methods within object-oriented modelling techniques • comparison of traditional solutions for simple design problems with software solutions to the same design problems • review of previously implemented design challenges which were completed using the software.
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Unit Mapping Information

Release 1. Supersedes and is equivalent to MEM23121A Analyse loads on frames and mechanisms.

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM23121 Analyse loads on frames and mechanisms

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include:

- identifying and reviewing features, functions and performance requirement of frames, beams and mechanisms
- identifying complex calculations requiring professional engineering assistance
- establishing dynamics, design loads, working stresses, allowable deformations and factor of safety element arrangements for calculations to be done
- evaluating assembly and fastening methods, analysis techniques, software and software validation techniques
- identifying relevant analysis support including graphs, tables, nomograms or computer-aided solutions and validation techniques
- analysing static and dynamic operating conditions and determining design or selection parameters on at least two occasions
- optimising frame, beam and mechanism elements for strength, deflection, arrangement and fastening on at least two occasions
- communicating and negotiating with stakeholders, professionals and technicians and adjusting accordingly
- evaluating frames, beams and mechanisms for work health and safety (WHS) and regulatory requirements and risk management compliance
- reporting and documenting results of analysis including calculations, specifications, diagrams and drawings.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- WHS and regulatory requirements, codes of practice, and directives and standards, including those related to risk management
- structural support and machine elements
- current options and trends in performance analysis software including underpinning program and software validation techniques
- technical and professional assistance

- types and functions of frames and mechanisms
- mechanisms for converting linear to rotary motion and rotary to linear motion
- lifting machines
- design loads, working stresses, allowable deflections and factor of safety for machine elements
- conditions for equilibrium
- non-coplanar and force systems
- equilibrium of non-coplanar and non-concurrent force systems
- reactions at beam supports including simply supported, overhung and cantilever beam with vertical and oblique concentrated, uniform and variable distributed loads and couples
- shear force and bending moments and diagrams
- vertical and oblique concentrated and uniform and variable distributed loads
- types and locations of stresses including:
 - combined stresses
 - thermal stress due to restrained expansion
 - stress concentration and fatigue due to alternating stresses
- centre of gravity and percussion
- methods of analysis of frames and trusses
- deflection of beams
- statically indeterminate beams
- buckling of compressed members
- loads and stresses on bolted and welded connections
- static versus dynamic forces, balanced and unbalanced
- dynamics and laws of rotational motion
- dynamic analysis of mechanisms
- linked bodies in motion including types, impulse, momentum and work energy methods
- work, energy and power for balanced and unbalanced force systems.
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Assessment Conditions

- Assessors must:
 - have vocational competency in analysing loads on frames and mechanisms at least to the level being assessed with relevant industry knowledge and experience
 - satisfy the assessor requirements in the *Standards for Registered Training Organisations 2015 or its replacement* and comply with the *National Vocational Education and Training Regulator Act 2011*, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.

- Conditions for assessment must include access to all tools, equipment, materials and documentation required including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
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