



Australian Government

MEM23114A Evaluate thermodynamic systems and components

Release 1

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Modification History

Release 1 - New unit. Replaces MEM23081A, but not equivalent.

Unit Descriptor

This unit of competency covers the evaluation of thermodynamic systems and components, such as heat exchangers, heat engines, refrigeration and air conditioners, and air compressors.

Application of the Unit

This unit applies to the evaluation of thermodynamic systems and components. The evaluation may be undertaken as part of a design or system selection process or to assess system condition, sustainability or efficiency. It is suitable for people working as technicians or system designers and draftspersons, and those pursuing careers and qualifications in engineering or related disciplines.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A Apply technical mathematics

MEM23006A Apply fluid and thermodynamics principles in engineering

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	Determine scope of thermodynamic system	1.1	Determine thermodynamic system and system components to be evaluated
		1.2	Determine stakeholders to be consulted on the evaluation
		1.3	Confirm that appropriate support, including technical and professional assistance, is available
		1.4	Determine work health and safety (WHS) and regulatory requirements, risk management and organisational procedures
		1.5	Investigate sustainability implications of thermodynamic applications
2	Identify principles and techniques required for evaluation of thermodynamic system and components	2.1	Review features and functions of thermodynamic system and components
		2.2	Determine thermodynamic principles and techniques required to evaluate system and select and optimise components
		2.3	Determine appropriate analysis techniques, software and software validation techniques
3	Evaluate thermodynamic applications and components	3.1	Assess the performance of heat transfer devices
		3.2	Assess heat engine performance
		3.3	Assess combustion processes

- 3.4 Assess steam processes, where present
 - 3.5 Assess refrigeration and air conditioning processes, where present
 - 3.6 Assess air compression processes, where present
- 4 Report results
- 4.1 Record outcomes of evaluation
 - 4.2 Provide documentation, such as calculations, component and system layouts, and functional and thermodynamic cycle diagrams

Required Skills and Knowledge

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

Required skills

Required skills include:

- determining parameters and context of tasks
- identifying WHS and regulatory requirements
- identifying risk management and organisational procedures
- investigating and reviewing sustainability implications, features and functions of thermodynamic systems and components
- identifying thermodynamic principles and techniques, analysis techniques, software and software validation techniques
- evaluating components, combustion, steam, air compression, refrigeration and air conditioning processes
- system compatibility with fluid properties, pumps, turbines, piping forces and thermodynamic performance of components
- selecting equipment and instruments for use in evaluation considering properties and compatibility
- reporting and documenting results of scoping, principles and techniques identification, evaluation of applications, calculations, component and system layouts, and functional diagrams and thermodynamic cycle diagrams

Required knowledge

Required knowledge includes:

- WHS and regulatory requirements, codes of practice, standards and risk management requirements
- availability of professional and technical assistance
- current options and trends in performance analysis software, including underpinning program techniques and software validation techniques
- descriptions of thermodynamic devices and systems, such as boilers, turbines, refrigerators, gas-turbines and rockets
- concepts related to thermodynamics, such as:
 - properties, process and state
 - mass, conservation of mass, specific volume and density, force, weight, pressure and temperature
 - systems, cycles and steady state
- energy forms

- effects of heating of solids and liquids
- heat transfer, conduction, convection and radiation, including related laws and calculations
- typical thermodynamic devices and engines, and thermal cycles
- closed and open systems:
 - non-flow, internal energy
 - flow systems, mass and volumetric flow and continuity of flow
- steady flow and enthalpy, turbines, compressors, boilers and heat exchanger applications
- zeroth and first laws in detail and second law (conceptual)
- gas laws and characteristics
- gas compression effects, measurements and calculations
- compressor types and characteristics heat engines, including types, cycles, performance and efficiency fuels and combustion steam plant and processes for steam generation, heat transfer and power production, including:
 - steam saturation steam tables
- air conditioning, refrigeration and heat pumping plant and processes

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 evaluate thermodynamic systems, including evaluation of system performance and selection of components.
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"> • determine parameters and context of evaluation task • determine WHS, regulatory requirements, risk management and organisational procedures • identify features, functions and components of a range of thermodynamic dynamic systems and components • investigate and review sustainability implications, features and functions of thermodynamic systems and components • evaluate components and systems to determine safety, efficiency and fitness for purpose • evaluate combustion, steam, air compression and refrigeration and air conditioning processes • determine system performance and heat transfer • report and document results.
Context of and specific resources for assessment	<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

	<p>Training Package.</p> <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.

Sustainability	<p>Sustainability is used to mean the entire sustainable performance of the organisation/plant, including:</p> <ul style="list-style-type: none"> • 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 licensed	Appropriate technical and professional assistance may include:

technical and professional assistance	<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, 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 • relevant standards • codes of practice from Australian and overseas engineering and technical associations and societies • ministerial directives • risk assessments • safe work practices • state and territory regulatory requirements applying to electrical work
Standards and codes	<p>Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular thermodynamic system task</p>

Unit Sector(s)

Competency field

Unit sector Engineering science

Custom Content Section

Not applicable.