Australian Government

MEM23006A Apply fluid and thermodynamics principles in engineering

Release: 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MEM23006A Apply fluid and thermodynamics principles in engineering

Modification History

Release 1 (MEM05v9).

Unit Descriptor

This unit of competency covers the application of fluid and thermodynamic principles to engineering applications. It includes sustainability issues; fundamental scientific principles; fundamentals of vacuum technology; properties of gases and liquids; heat transfer due to conduction, convection and radiation heat and compression processes; closed and open systems; continuity, enthalpy and energy transfers related to compressors, boilers, turbine heat exchangers, heat engines, refrigerators and heat pump performance. It also includes fluid systems and components, forces on floating and submerged bodies, turbine and pumping systems, and jet forces on blades and plates.

Application of the Unit

This unit applies to fluid and thermodynamic devices and systems used in industry. It is suitable for people working as technicians in engineering or related fields using hydrostatic, hydrodynamic, fluid power or heating, ventilation and air conditioning (HVAC) equipment 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	Determine scope of fluid or thermodynamic application	1.1	Determine compliance requirements of work health and safety (WHS) and regulatory requirements, codes of practice standards, risk assessment and registration requirements
		1.2	Review sustainability implications of fluid and thermodynamic tasks
		1.3	Assess fluid, thermodynamic and vacuum principles, skills and techniques required by tasks
		1.4	Review functions and features of fluid, thermodynamic and vacuum devices, machines and systems
		1.5	Assess software techniques required for analysis and graphics required by the task
2	Interpret fluid or thermodynamic system design for effective performance	2.1	Determine the energy cost for running boilers, heat engines, compressors or turbines over a billing period, the efficiency of conversion of energy source to electrical, fluid, thermal or mechanical power and the sustainability of the processes
		2.2	Select components for thermal and fluid systems ensuring compatible materials, pressure, temperature and flow capacity and appropriate performance
		2.3	Determine pumping system power requirements to provide for raising fluid, adequate flow rate and specified system losses
		2.4	Specify vacuum system components and performance requirements for moulding, dust removal, film

			deposition, chemical reaction control, and prove or test performance of specified system or individual components
		2.5	Seek technical and professional assistance or clarification of design information, as required
		2.6	Ensure clear and logical process of specification development and compatibility of units in calculations
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:

- determining and confirming parameters and context of tasks, personal responsibilities, team and support personnel relations, chain of responsibility, WHS, regulatory requirements, risk management and organisational procedures
- reviewing sustainability implications, functions and features of fluid, thermodynamic and vacuum devices, machines and systems
- assessing and applying fluid, thermodynamic and vacuum principles and software skills and techniques
- ensuring clear and logical process of specification development 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:

- definition of fluid mechanics and thermodynamics and recognition of applications
- analytical, graphical, semi-graphical and software assisted techniques for applications for fluid and thermodynamic principles in engineering
- energy and sustainability concepts relevant to fluid and thermodynamic applications
- principles of turbines and heat engines
- basic properties and concepts common to fluids and thermodynamics:
  - atoms, molecules, inter-molecular forces, molecular motion, states of matter, solids, liquids, gases, basic properties and units
  - ideal or perfect gases and liquids
  - definitions
- energy types and concepts:
  - potential energy, kinetic energy and internal energy
  - chemical energy = energy content of a fuel
  - work, constant and variable force, relationship to pressure and volume changes
  - sensible heat and specific heat capacity (Cp and Cv)
  - phase change, latent heat, enthalpy and enthalpy diagram
- heat transfer processes

- concepts and properties of gases
- energy transfer in closed and open systems:
  - definition of a closed system
  - non-flow energy equation definition of an open system
  - mass and volume flow rate and the continuity equation
- fluid mechanics
- fluid system components
- fluid statics
- fluid dynamics
- fluid power
- vacuum technology:
  - definition of vacuum
  - states of matter
  - purposes of vacuums
  - degrees of vacuum
- methods of lowering pressure:
  - displacement or transfer of gas
  - sorption or condensation
- barometric pressure:
  - inverted mercury tube
  - variation of atmospheric pressure with altitude
- quantity of gas:
  - mole, Avogadro's Number and molar mass
- types of vacuum pumps for evacuating volumes
- description of typical vacuum vessels, features and functions
- applications of vacuum technology in industry

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 fluid, thermodynamic and vacuum principles to the selection and evaluation of components and systems. This includes working individually and as part of a team and recognising and complying with normal control procedures on engineering projects.

Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • review sustainability implications, functions and features of fluid, thermodynamic and vacuum devices, machines and systems • interpret fluid, thermodynamic and vacuum system designs for industry applications • select components for specified technical performance • calculate energy use in fluid, thermodynamic and vacuum system • assess and apply fluid, thermodynamic and vacuum principles and software skills and techniques to engineering tasks.
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.

Fluid and thermodynamic tasks	Fluid and thermodynamic tasks covered by this unit may include: • energy costs, efficiency and sustainability assessment of running boilers, heat engines, compressors or turbines • fluid and thermal system component selection • pumping and turbine system power evaluation • evaluating vacuum system components and performance requirements
Basic properties and units common to fluids and thermodynamics	Basic properties and units include: • mass, weight and force • volume, density, specific volume and relative density • pressure (absolute and gauge), and atmospheric pressure variation • temperature (Celsius, Kelvin and others) • viscosity and surface tension • vapour pressure of a liquid (saturation vapour pressure) • temperature and pressure effects on properties • international system of units (SI) • fundamental dimensions and units • derived dimensions and units
Static and hydrodynamic devices or systems	Static and hydrodynamic devices or systems may include: • floating and submerged bodies • turbine and pumping systems

	• stationary or moving plates or blades • vacuum systems
Thermodynamic devices or systems	Thermodynamic devices or systems may include: • heat transfer devices • compressors • boilers • turbines • heat exchangers • heat engines • refrigerators • heat pumps

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 • codes of practice • risk assessments • registration requirements • safe work practices • state and territory regulatory requirements
Enthalpy	Enthalpy is a thermodynamic property equal to the sum of the internal energy of a system and the product of its pressure and volume

Unit Sector(s)

Competency field

Unit sector Engineering science

Custom Content Section

Not applicable.