Australian Government

MEM23129A Evaluate thermal loads for heating, ventilation, air conditioning and refrigeration

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MEM23129A Evaluate thermal loads for heating, ventilation, air conditioning and refrigeration

Modification History

Release 1 (MEM05v9).

Unit Descriptor

This unit of competency covers the evaluation of thermal load estimates for a commercial refrigeration system and a multiple zone commercial/industrial building. It includes work health and safety (WHS) and related safety compliance requirements, and system evaluation, including the use of software and validation, thermodynamic concepts and laws.

Application of the Unit

This unit applies to individuals conducting thermal load evaluations for heating, ventilation, air conditioning and refrigeration (HVAC/R) systems in buildings and engineering, commercial refrigeration systems and related installations. It is suitable for people working as technicians, system designers, draftspersons, maintainers 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 evaluation of thermal loads and HVAC/R systems	1.1	Establish type, location and scope of HVAC/R systems, building and refrigerated enclosures from plans, data sheets, specifications and site inspections
		1.2	Identify stakeholders to be consulted during evaluation
		1.3	Establish software and software techniques required for evaluation analysis
		1.4	Determine WHS, regulatory and environmental requirements relevant to evaluation
		1.5	Investigate sustainability implications of HVAC/R and building management systems
2	Prepare for thermal loads and HVAC/R systems evaluation	2.1	Review thermal load analysis techniques for multiple zone commercial or industrial buildings, including use of tabulations and computer software
		2.2	Identify sources of heat gains for building
		2.3	Review room sensible and latent heat, including peak values
		2.4	Review thermal load analysis techniques for commercial refrigeration systems, including use of tabulations and computer software
		2.5	Identify heat load sources for refrigerated enclosures or zones
		2.6	Determine tools, equipment, testing devices and

			materials required for evaluation
		2.7	Determine required measurements and measurement techniques
		2.8	Calibrate, set up, and test measurement equipment and procedures
		2.9	Identify appropriate analysis techniques, analysis and simulation software and software validation techniques
3	Evaluate thermal loads and HVAC/R systems	3.1	Evaluate thermal load for a commercial refrigeration system
		3.2	Evaluate thermal load for a multiple zone commercial or industrial building
		3.3	Evaluate the effects of internal and external parameter changes on refrigeration system performance
		3.4	Evaluate thermal performance of a building and options for design improvements
		3.5	Evaluate building to identify and mitigate high thermal loads
		3.6	Evaluate performance of refrigeration and air conditioning system against specifications and determine optimum operational settings
		3.7	Evaluate equipment size, including coil and air handling unit capacities for constant and variable volume systems, and central refrigeration and boiler capacities
		3.8	Evaluate and validate software for refrigeration and building thermal performance analysis and system simulation
4	Report results	4.1	Record results of evaluation, including recommendations for design and system setting optimisation
		4.2	Provide relevant documentation, such as thermal load audits, calculations for heating and cooling loads, building and refrigeration layouts, heating and cooling system and component arrangements, and system improvement diagrams

Required Skills and Knowledge

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

Required skills

Required skills include:

- determining HVAC/R system parameters from plans, specifications and site inspections
- reviewing features and functions of HVAC/R system components
- investigating sustainability implications of HVAC/R systems
- identifying relevant thermodynamic principles and techniques
- testing and measuring system and component performance parameters
- evaluating system thermal loads and relationship to, and implications for, component sizes and system performance
- selecting and using appropriate calculations, techniques and software for analysis and simulations
- validating software and software techniques required for thermal load evaluations
- reporting and documenting processes, results and recommendations

Required knowledge

Required knowledge includes:

- WHS and regulatory requirements, codes of practice, standards, risk management and registration requirements
- sources of professional and technical assistance
- current options and trends in performance analysis software, including underpinning program techniques
- thermal load measuring equipment and test apparatus
- sustainability implications of HVAC systems, including consideration of energy sources and energy efficiency
- thermodynamic principles required by thermal loading analysis and HVAC/R management systems
- thermodynamic concepts related to HVAC/R:
  - properties, process and state
  - mass, conservation of mass, specific volume and density, specific volume, relative density, force, weight, pressure, temperature, Zeroth law, absolute scales and International System of Units (SI) units
  - systems, cycles and steady state
- energy forms
- effects of heating of solids and liquids

- heat transfer, conduction, convection and radiation:
  - property tables for conductivity, convection and radiation coefficients
  - Fourier law of conduction and conductivity of materials
  - convection:
    - mechanism of convection
    - convection heat transfer coefficient and factors affecting the coefficient
    - fluid flow characteristics (geometry of convection surfaces, natural and forced convection and flow regime)
    - units, kinematic viscosity and dynamic viscosity
    - convective heat transfer coefficients for conduit and annular flow, hydraulic diameter
    - heat exchangers (types, efficiency and measurements)
  - radiators:
    - emission, absorption and reflection (properties and measurements)
    - Wien's displacement law
    - Kirchhoff's law
  - solar energy, heating and power generation
  - radiant energy on surfaces $G_a = G_o \tau^{\blacksquare}$
  - variations, such as Azimuth and zenith angles, path length, cloud cover and water vapour, and shade factors for windows
  - combined heat transfer
  - conduction plus convection, heat exchangers using air and water as transfer mediums
  - conduction, convection and radiation (qualitative)
  - cooling fins
  - heat flow, electrical analogy, graphical solution techniques and qualitative understanding of numerical methods
- vapour compression refrigeration:
  - vapour-compression cycle for refrigeration
  - system components, including throttling valves and capillary tubes as throttling devices
  - performance criteria for refrigeration system evaluation
  - types of refrigerant
  - refrigerant properties and p-h diagrams:
    - ideal vapour compression cycle on the p-h diagram
    - energy balance and heat transfers in compressor, evaporator and condenser
    - variation of actual cycles from the ideal
    - vapour-compression cycle with suction superheating, liquid sub-cooling and pressure drop in system components
- mechanical components of vapour compression (refrigeration and HVAC systems)
- refrigeration enclosures, cabinets, cold rooms and freezer rooms
- factors affecting refrigeration heat transfer
- building thermal performance survey procedures

- standard thermal values in relation to a commercial/industrial building
- equipment size for constant and variable volume systems and central refrigeration and boiler capacities
- thermal properties of buildings and building materials
- people loads
- cost implications of air conditioning and heating designs
- heat loads
- thermal lag
- occupant comfort and safety factors

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 the thermal loads for a commercial refrigeration system and for a multiple zone commercial or industrial building.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • determine HVAC/R system parameters • investigate sustainability implications of HVAC/R systems • identify relevant thermodynamic principles and techniques for particular HVAC/R system thermal load evaluations • review features and functions of HVAC/R systems and components • test and measure HVAC/R systems and component performance parameters • evaluate system and component performance with tabulated and software generated data • apply and validate software for analysis and simulation • report and document results.
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.

Sustainability	Sustainability is used to mean the entire sustainable performance of the organisation/plant, including: • 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 technical and professional assistance	Appropriate 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, 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 from Australian and overseas engineering and technical associations and societies • risk assessments • registration requirements • safe work practices • state and territory regulatory requirements
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular task
Building heat gains	Buidling heat gains are affected by: • external, internal and system heat gains • U values and infiltration rates for various wall and roof constructions • sun, Azimuth and altitude angles, and overall shade factors for various windows
Commercial refrigeration cabinets	Characteristics of commercial refrigeration cabinets include: • defrost systems/heat • temperature control • air flows (refrigeration) • air screens (refrigerated and ambient store) • types of evaporation • lighting
Miscellaneous heat	Miscellaneous heat loads on refrigeration systems include: • electrical load • human load • defrost load • machinery load
Relevant documentation	Relevant documentation may include: • thermal load audits • calculations for heating and cooling loads • building and refrigeration layouts

	• heating and cooling system and component arrangements • system improvement diagrams

Unit Sector(s)

Competency field

Unit sector Engineering science

Custom Content Section

Not applicable.