Australian Government

Department of Education, Employment and Workplace Relations

MEM234006A Evaluate and select thermodynamic systems or subsystems

Release: 1

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Modification History

New unit

Unit Descriptor

This unit of competency covers the evaluation of performance, efficiency and the selection of appropriate thermodynamic plant and equipment using thermodynamic principles, including the Law of Entropy and the Second Law of Thermodynamics, as applied to gas cycles and vapour cycles, flow-through nozzles and blade passages, impulse and reaction stages of turbines. It includes generation and transfer of heat energy using solid, liquid and gas mediums and application of software.

Application of the Unit

This unit applies to the evaluation of performance, efficiency and selection of appropriate thermodynamic plant and equipment across all forms of manufacturing and engineering. It is suitable for Principal Technical Officers and people in equivalent positions working with heat transfer, air conditioning, solar, geo-thermal and other power generation applications involving thermal energy transfer.

Prior experience in the application of scientific principles, evaluation of thermodynamic system components, mathematics and computer techniques is required.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

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. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

1	Clarify the specifications required for thermodynamic system	1.1	Establish features of plant and equipment and thermodynamic performance and efficiency parameters
		1.2	Confirm technical, commercial and environmental parameters to specifications
		1.3	Determine stakeholders to be consulted in evaluation and selection process
		1.4	Assess occupational health and safety (OHS), regulatory, sustainability or environmental regulations and issues relevant to the evaluation and selection task
		1.5	Confirm selection requirements, including budget and schedule, and provide preliminary advice on feasibility
2	Evaluate thermodynamic system options and prepare concept proposals	2.1	Appraise initial qualitative and quantitative analysis of the evaluation and efficiency task
		2.2	Carry out required modelling and calculations using appropriate software and validation techniques
		2.3	Generate a range of thermodynamic system solutions to the selection requirements, including choice of equipment, layout, fluid source and delivery
		2.4	Check feasibility and evaluate solutions against selection requirements ensuring conformity to standards and codes, technical, economic and OHS requirements
		2.5	Determine, social and sustainability implications of solutions
		2.6	Present concept proposals to client

3	Select thermodynamic system	3.1	Evaluate concept proposals with client
		3.2	Finalise selection, including equipment, layout, fluid source and delivery, and other features desired by client
		3.3	Ensure preparation of all required documentation, drawings, specifications and instructions
		3.4	Consult with client and stakeholders to obtain sign-off on selection
		3.5	Monitor installation and commissioning with stakeholders and make any necessary adjustments to design

Required Skills and Knowledge

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

Required skills

Required skills include:

- interpreting features of plant and equipment and parameters to the brief or contract
- advising clients based on discipline knowledge and OHS and regulatory standards
- researching sustainability implications and current industrial design techniques
- determining OHS, regulatory and risk management requirements
- modelling and calculating using appropriate software and validation techniques
- calculating, measuring and assessing thermodynamic system performance parameters, such as:
  - efficiency
  - fuel consumption
  - carbon equivalent emissions
- evaluating a range of solutions for feasibility against design criteria
- selecting thermodynamic systems to match performance and efficiency requirements
- communicating, negotiating and reviewing with stakeholders and client throughout process to obtain agreement on proposal and sign-off on system selection
- document evaluation and selection with drawings, specifications and instructions

Required knowledge

Required knowledge includes:

- typical documentation, drawings, specifications and instructions required in thermodynamic system selection processes
- OHS and regulatory requirements, codes of practice, standards, risk minimisation and registration requirements
- current options and trends in design, performance analysis, and modelling and simulation software relevant to thermodynamic systems, including underpinning program techniques and software validation techniques
- concepts of thermodynamics, properties of substances, conservation of mass and energy principles
- Law of Entropy and the Second Law of Thermodynamics
- second law analysis of thermodynamic systems
- actual and ideal gas cycles and vapour cycles
- impulse and reaction stages of turbines
- theory of heat transfer, such as conduction, convection, and radiation through various

materials and geometric shapes

- heat flow solutions by analytical, electrical analogy, graphical, numerical, failure effects analysis (FEA) and graphical software solution techniques

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.

Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • interpret features of plant and equipment and parameters to the brief or contract • advise client based on discipline knowledge and OHS and regulatory standards • research sustainability implications and current thermodynamic system design techniques • determine OHS, regulatory and risk management requirements • model and calculate using appropriate software and validation techniques • generate and evaluate a range of solutions for feasibility against selection requirements • evaluate and select most appropriate thermodynamic solution • communicate, negotiate and review with stakeholders and client throughout process to obtain agreement on proposal and sign-off on selection • document evaluation and selection with drawings, specifications and instructions.
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, that is, the candidate is not in productive work, 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 its 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 able not only 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.

Parameters to the selection requirements	Parameters to the selection requirements include: • determination of the degree of innovation and creativity expected by the client • selection process limits and budgets • product cost limits and budgets • performance and efficiency specifications • equipment availability, capacities and restrictions • specified administrative, communication and approval procedures • other special features and limits in the requirements
OHS, regulatory requirements, codes of practice and enterprise procedures	OHS, regulatory requirements, codes of practice and enterprise procedures may include: • OHS 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
Initial qualitative and quantitative analysis	Initial qualitative and quantitative analysis may include: • a hazard and risk analysis related to existing or proposed plant or equipment • routine noise and vibration monitoring data or investigative measurements
Appropriate software and validation techniques	Software may be employed for performance analysis/modelling. Underpinning program techniques and algorithms should be understood, such as: • the use of FEA and numerical methods within object oriented modelling techniques Validation techniques include: • comparison of traditional solutions for simple thermodynamic system performance problems with software solutions to the same problems • review of previously implemented system performance challenges which were completed using the software
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular thermodynamic system task
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 OHS impact on employees, community and customer
Client	Client may be: • internal or external to the designer's organisation

Unit Sector(s)

Engineering practice

Custom Content Section

Not applicable.