



Australian Government

Department of Education, Employment and Workplace Relations

PMAOPS511B Determine energy transfer loads

Revision Number: 1

PMAOPS511B Determine energy transfer loads

Modification History

Not applicable.

Unit Descriptor

Unit descriptor	This competency covers the application of a knowledge of energy transfer and energy balance principles to the design and use of processing equipment.
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Application of the Unit

Application of the unit	<p>In a typical scenario, the heat transfer loads for process equipment is required to be determined. Calculations are performed to determine the heat transfer loads, to help in the diagnosis of plant performance problems, to identify heat losses or for the specification of new or modified equipment.</p> <p>This competency is typically performed by senior technicians.</p> <p>It includes:</p> <ul style="list-style-type: none"> • conduction, convection and radiation • thermal properties of materials, particularly process materials • methods of heating process materials • cooling systems • energy balances.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisite units		
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Employability Skills Information

Employability skills	This unit contains employability skills.
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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.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Prepare for work.	1.1. Identify work requirements 1.2. Identify and control hazards 1.3. Coordinate with appropriate personnel
2. Calculate heat transferred from/to items.	2.1. Calculate conductive heat transfer to/from an object 2.2. Calculate convective heat transfer to/from an object 2.3. Calculate radiative heat transfer to/from an object 2.4. Calculate combined heat transfer to/from an object, including resistances in series and parallel.
3. Calculate temperature change	3.1. Calculate temperature change caused by heating/cooling of process materials in typical examples of processing equipment 3.2. Calculate change in heat content caused by chemical reaction 3.3. Calculate temperature rise caused by chemical reaction.
4. Select appropriate heating and/or cooling mechanism for an application.	4.1. Compare rates of heat transfer/overall heat transfer coefficients for major methods of heating and cooling 4.2. Determine appropriate methods of varying/controlling rates of heat transfer 4.3. Calculate heat transfer rates under a range of conditions.
5. Conduct energy balance over process components.	5.1. Determine desired boundaries for energy balance calculation 5.2. Determine possible sources of data required from the plant 5.3. Match and adjust sources of data to desired boundary for energy balance 5.4. Determine overall heating load 5.5. Determine overall cooling load 5.6. Determine the adequacy (or otherwise) of the process/plant heating/cooling system to cope with this load.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills

Competence includes the ability to:

- determine the boundaries of the system to be studied
- collect the required plant data from measurements, readings or calculated quantities
- calculate the energy transfer loads
- report the results.

Competence also includes the ability, for the practical completion of the job, to apply and/or explain:

- conduction
- convection
- radiation
- combined conduction/convection
- specific heat capacity
- exothermic and endothermic reaction calculations
- energy balances.

Required knowledge

Knowledge and understanding of heat transfer principles and calculations sufficient to determine the heating/cooling loads of an existing or a new process.

Evidence Guide

EVIDENCE GUIDE

The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

Overview of assessment

Assessment of this unit should include demonstrated competence on actual plant and equipment in a work environment. The unit will be assessed in as holistic a manner as is practical and may be integrated with the assessment of other relevant units of competency.

This unit may be appropriately assessed using a special project based on an actual plant. This unit of competency requires a significant body of knowledge which will be assessed through questioning and the use of what-if scenarios both on the plant and off the plant.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Competence must be demonstrated in the ability to complete an energy balance in a structured way, taking real data from an operating plant.

Consistent performance should be demonstrated. In particular look to see that:

- realistic boundaries are drawn for the energy balance which align with practical sources of data from the plant
- data is collected from the plant with minimum disruption to production
- theoretical and practical requirements for the energy balance are consistent
- the energy balance data is used to identify and contribute to solutions for plant problems.

This will typically be assessed by one or more energy balance projects on an operating plant. One complex energy balance, or a number of simple energy balances, are required to demonstrate competence.

Context of and specific resources for assessment

Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios/case studies/what-ifs will be required as will a bank of

EVIDENCE GUIDE	
	questions which will be used to probe the reasoning behind the observable actions.
Method of assessment	In all plants it may be appropriate to assess this unit concurrently with relevant teamwork and communication units.
Guidance information for assessment	Assessment processes and techniques must be culturally appropriate and appropriate to the oracy, language and literacy capacity of the assessee and the work being performed.

Range Statement

RANGE STATEMENT	
<p>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. Add any 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.</p>	
Codes of practice/ standards	Where reference is made to industry codes of practice, and/or Australian/international standards, the latest version must be used.
Context	<p>This competency unit includes the heating/cooling loads of all processing equipment and requires the quantitative determination of loads. This competency applies to all sectors within the chemical, hydrocarbons and oil refining industry.</p> <p>Heat transfer modes include:</p> <ul style="list-style-type: none"> • conduction • convection (forced and natural) • radiation • combined conduction/convection. <p>Sources of heating/cooling include:</p> <ul style="list-style-type: none"> • chemical reaction • water cooling • air cooling • steam heating (calculations for saturated steam only) • hot fluid (eg oil) heating.
Health, safety and environment (HSE)	All operations to which this unit applies are subject to stringent health, safety and environment requirements, which may be imposed through State or Federal legislation, and these must not be compromised at any time. Where there is an apparent conflict between Performance Criteria and HSE requirements, the HSE requirements take precedence.

Unit Sector(s)

Unit sector	Operational/technical
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Competency field

Competency field

Co-requisite units

Co-requisite units
