



Australian Government

Department of Education, Employment and Workplace Relations

CPCPMS5003A Design hydronic heating and cooling systems

Release: 1

CPCPMS5003A Design hydronic heating and cooling systems

Modification History

Not Applicable

Unit Descriptor

Unit descriptor	This unit of competency specifies the outcomes required to design hydronic heating and cooling systems, determine relevant installation details and prepare system specifications for a range of residential, commercial and industrial buildings.
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Application of the Unit

Application of the unit	This unit of competency supports development of skills and knowledge required for competent workplace performance in a consultancy or supervisory capacity in relation to plumbing services and hydraulics.
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Licensing/Regulatory Information

Not Applicable

Pre-Requisites

Prerequisite units	Nil
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Employability Skills Information

Employability skills 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

ELEMENT	PERFORMANCE CRITERIA
1. Evaluate design parameters.	1.1. Scope of work is established for hydronic heating and cooling systems. 1.2. Design requirements are determined from plans, specifications and client briefs. 1.3. Cost-benefit analysis is conducted comparing a range of pipe materials and system designs. 1.4. Statutory and regulatory requirements and Australian and New Zealand standards for the design of hydronic heating and cooling systems are analysed and applied. 1.5. Manufacturer requirements and trade and technical manuals are interpreted. 1.6. Additional research, including a desktop study, is conducted to outline design parameters. 1.7. Performance requirements are established.
2. Plan and detail system components.	2.1. Layout of pipework systems and type and location of fittings and valves are planned. 2.2. Pipe size requirement calculations are performed for a range of applications in accordance with regulations and manufacturer requirements. 2.3. System components and circuits are specified. 2.4. Pump and compressor systems are detailed. 2.5. Distribution flows, velocities and pressures are specified for a range of applications. 2.6. Insulation is specified. 2.7. Pipe fixings are designed for a range of applications. 2.8. Approved materials, jointing methods and installation requirements for hydronic heating and cooling systems are specified.
3. Design and size systems.	3.1. Hydronic systems and circuits are designed for a range of applications. 3.2. Hydronic systems are designed and sized using computer software packages.
4. Prepare documentation.	4.1. Plans are prepared for a range of hydronic heating and cooling systems. 4.2. Specification for a hydronic system is prepared. 4.3. Testing and commissioning schedule is prepared. 4.4. Operation and maintenance manual is produced.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

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

Required skills

Required skills for this unit are:

- communication skills to:
 - communicate with others to ensure safe and effective work practices
 - confirm job specifications and client requirements
 - enable clear and direct communication, using questioning to identify and confirm requirements, share information, listen and understand
 - read and interpret:
 - plans, specifications, drawings and design briefs
 - standards and manufacturer requirements and manuals
 - statutory and regulatory requirements
 - use language and concepts appropriate to cultural differences
 - use and interpret non-verbal communication
- written skills to prepare documentation, including:
 - operation and maintenance manual
 - plans, specifications and schedules
- determining relevant installation details for hydronic heating and cooling systems
- innovation skills to develop creative and responsive approaches
- numeracy skills to apply measurements and calculations
- planning and organisational skills to:
 - plan and set out work
 - research, collect, organise and understand information relating to the design of hydronic heating and cooling systems
 - take initiative and make decisions
- preparing system specifications for hydronic heating and cooling systems
- problem solving skills to analyse requirements, consider options and design an appropriate system
- teamwork skills to work with others to action tasks and relate to people from a range of cultural and ethnic backgrounds and with varying physical and mental abilities.

Required knowledge

Required knowledge for this unit is:

- common terminology and definitions used in design of hydronic heating and

REQUIRED SKILLS AND KNOWLEDGE

cooling systems for all classes of building

- drafting principles
- nature of materials used in hydronic heating and cooling systems and effects of performance under various conditions
- principles of technology in the design of hydronic heating and cooling systems
- requirements of state regulatory authorities, Australian standards and manufacturer specifications, including hazards identified in relation to devices and systems used
- workplace safety requirements, including relevant statutory regulations, codes and standards.

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, range statement and the Assessment Guidelines for the Training Package.

Overview of assessment

This unit of competency could be assessed in the workplace or a close simulation of the workplace environment providing that simulated or project-based assessment techniques fully replicate plumbing and services workplace conditions, materials, activities, responsibilities and procedures.

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

A person who demonstrates competency in this unit must be able to provide evidence of:

- evaluating and documenting design parameters, including client, regulatory, manufacturer and Australian and New Zealand standard requirements for a range of hydronic heating and cooling systems
- producing an appropriate layout for hydronic heating and cooling systems, planned in accordance with manufacturer and regulatory requirements
- calculating pipe sizes in accordance with regulations and manufacturer requirements
- designing hydronic circuits
- designing and sizing hydronic systems using appropriate software
- preparing plans for a range of hydronic systems
- preparing specifications for hydronic heating and cooling systems
- preparing testing and commissioning schedules
- producing operation and maintenance manuals.

Context of and specific resources for assessment

This competency is to be assessed using standard and authorised work practices, safety requirements and environmental constraints.

Assessment of essential underpinning knowledge will usually be conducted in an off-site context.

EVIDENCE GUIDE

Assessment is to comply with relevant regulatory or Australian standards' requirements.

Resource implications for assessment include:

- an induction procedure and requirement
- realistic tasks or simulated tasks covering the minimum task requirements
- relevant specifications and work instructions
- tools and equipment appropriate to applying safe work practices
- support materials appropriate to activity
- workplace instructions relating to safe working practices and addressing hazards and emergencies
- material safety data sheets
- research resources, including industry related systems information.

Reasonable adjustments for people with disabilities must be made to assessment processes where required. This could include access to modified equipment and other physical resources, and the provision of appropriate assessment support.

Method of assessment

Assessment methods must:

- satisfy the endorsed Assessment Guidelines of the Construction, Plumbing and Services Training Package
- include direct observation of tasks in real or simulated work conditions, with questioning to confirm the ability to consistently identify and correctly interpret the essential underpinning knowledge required for practical application
- reinforce the integration of employability skills with workplace tasks and job roles
- confirm that competency is verified and able to be transferred to other circumstances and environments.

Validity and sufficiency of evidence requires that:

- competency will need to be demonstrated over a period of time reflecting the scope of the role and the practical requirements of the workplace

EVIDENCE GUIDE

- where the assessment is part of a structured learning experience the evidence collected must relate to a number of performances assessed at different points in time and separated by further learning and practice, with a decision on competency only taken at the point when the assessor has complete confidence in the person's demonstrated ability and applied knowledge
- all assessment that is part of a structured learning experience must include a combination of direct, indirect and supplementary evidence.

Assessment processes and techniques should as far as is practical take into account the language, literacy and numeracy capacity of the candidate in relation to the competency being assessed.

Supplementary evidence of competency may be obtained from relevant authenticated documentation from third parties, such as existing supervisors, team leaders or specialist training staff.

Range Statement

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.

Scope of work includes:

- interpretation of plans and specifications
- principles and properties of hydronic systems, including:
 - barriers to heat transfer
 - conduction
 - convection
 - heat transfer

RANGE STATEMENT

- principles of hydronic circuits
- principles of pressure and energy related to hydronic systems
- properties of water steam and gases used for hydronic systems
- radiation
- hydronic applications, including:
 - chiller circuits for air conditioning and refrigeration applications
 - concrete floor heating circuits
 - heat removal applications
 - manufacturing and industrial applications
 - room heating circuits for residential, commercial and industrial heating applications
 - timber floor heating circuits
- sizing and documenting layout of hydronic heating and cooling systems for residential, commercial or industrial applications for either new projects or an existing structure being renovated, extended, restored or maintained.

Design requirements include:

- architectural specifications
- builder specifications
- interpretation and application of mechanical services drawings and symbols
- owner requirements
- specialist hydronic applications.

Cost-benefit analysis includes:

- comparison of range of suitable materials and system choices available to enable cost-effective choices to be made without compromising integrity of project.

Statutory and regulatory requirements and Australian and New Zealand standards include:

- Acts, regulations and local and state government policies, including group and strata titling
- Australian and New Zealand standards
- Building Code of Australia
- industry standards.

Manufacturer requirements include:

- sizing tables
- specifications
- technical and trade manuals.

Desktop study includes collection

- architectural and building plans

RANGE STATEMENT

and interpretation of existing data for design purposes from:

- council plans
- developer plans
- other documents, including:
 - applications
 - forms
 - other reports as available.

Performance requirements include:

- hydronic heating and cooling system requirements, including temperature and safety requirements, established using Australian and New Zealand standards and manufacturer information.

Layout of pipework systems:

- includes compliance with hydronic principles
- should not unduly affect building integrity and aesthetic appeal
- should have principles of economy, serviceability, durability and fit for use applied.

Fittings and valves include:

- bends
- couplings
- flow and isolating valves
- pressure
- tees
- thermostats
- unions.

Pipe size requirement calculations include:

- energy
- flow and velocity
- pressure
- sizing
- temperature
- volume and storage.

System components and circuits include:

- boilers, including:
 - advantages and disadvantages of boiler types
 - capacity and size
 - coal
 - electric
 - energy sources
 - fire tube
 - gas
 - heat exchanger

RANGE STATEMENT

- methods of reducing heat losses
- oil
- packaged
- pressure controls and components
- solid fuel
- valves
- water tube
- factors to be considered when selecting a boiler hydronic circuit, include:
 - circulating pump appliances
 - flow and return pipework
 - pipework grades
 - valves and fittings
- cooling towers, including:
 - bacteriological safety
 - collection
 - construction
 - disinfection
 - fans
 - maintenance
 - size
 - sprays
- chillers and refrigerant plant, including:
 - engineered systems
 - packaged plants
 - proprietary commercial and industrial equipment and assemblies
- hydronic appliances, including:
 - calorifiers
 - components
 - concrete construction
 - electronic controls
 - heat exchangers
 - methods of temperature and pressure control
 - radiators
 - timber floor heating systems
 - types

RANGE STATEMENT

	• water heaters.
<i>Pump and compressor systems</i> include:	• chilled water pumps • circulating pumps • refrigeration compressors • other applications as required.
<i>Insulation</i> includes:	• felt • fibreglass • insulation protection, including: • plastic. • sheet metal • rock wool.
<i>Pipe fixings</i> include:	• anchors • bracket spacing • corrosion protection • hanging brackets • material requirements • saddles • wall and ceiling brackets.
<i>Materials</i> include:	• copper • steel • other approved materials.
<i>Jointing methods</i> include:	• brazing • mechanical joints • threading.
<i>Installation requirements</i> include:	• clipping • installation details • jointing requirements • level of workmanship.
<i>Plans</i> include:	• axonometrics • cross-sections • details • elevations • isometrics • schematics, which may be produced using: • pencil • Indian ink • pigment liner • computer generation • sections.

RANGE STATEMENT

Specification includes:	• appliances • clipping • details of specialised components • jointing • manufacturer requirements • materials • valves • workmanship.
Testing includes:	• flow testing • inspection checklist • leak testing • pressure testing • quality assurance (QA) audit.
Commissioning schedule includes:	• checking fit for purpose • checking for burrs and obstructions • commissioning appliances • purging system • removing contaminants.
Operation and maintenance manual includes:	• check for blockages • leak detection • regular inspection • regular maintenance requirements.

Unit Sector(s)

Unit sector	Plumbing and services
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Co-requisite units

Co-requisite units	Nil
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Functional area

Functional area