



Australian Government

CPCPMS5013A Design hydronic heating and cooling systems

Release 1

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Modification History

Changes to performance criteria, required skills and knowledge, range statement and critical aspects

Not equivalent to CPCPMS5003A

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.

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.

Licensing/Regulatory Information

In some jurisdictions, this unit of competency may form part of accreditation, licensing, legislative, regulatory or certification requirements.

Pre-Requisites

Nil

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

Elements and Performance Criteria

- | | | |
|---|------------------------------------|--|
| 1 | Evaluate design parameters. | 1.1 <i>Scope of work</i> for hydronic heating and cooling systems is established. |
| | | 1.2 <i>Design requirements</i> are determined from relevant Australian standards, codes, plans, specifications and client brief. |
| | | 1.3 <i>Cost-benefit analysis</i> is conducted comparing a range of pipe materials and system designs. |
| | | 1.4 <i>Statutory and regulatory requirements and relevant Australian standards and codes</i> for the design of hydronic heating and cooling systems are analysed and applied. |
| | | 1.5 <i>Manufacturer requirements</i> and trade and technical manuals are interpreted. |
| | | 1.6 Additional research, including a <i>desktop study</i> , is conducted to outline design parameters. |
| | | 1.7 Factors that contribute to quality, safety and time efficiency are determined. |
| | | 1.8 <i>Performance requirements</i> are established, considering safety of system users or building occupants. |
| 2 | Plan and detail system components. | 2.1 <i>Layout of pipework systems</i> , and type and location of <i>fittings, valves</i> and controls are planned. |
| | | 2.2 <i>Pipe size requirement calculations</i> are performed for a range of applications according to regulations and manufacturer requirements. |
| | | 2.3 <i>System components and circuits</i> are specified. |
| | | 2.4 <i>Pump and compressor systems</i> are detailed. |
| | | 2.5 Distribution flows, velocities and pressures are specified for a range of applications. |
| | | 2.6 <i>Insulation</i> is specified. |
| | | 2.7 <i>Pipe supports</i> are designed for a range of applications. |

- 2.8 Approved **materials, jointing methods** and **installation requirements** for hydronic heating and cooling systems are specified.
- 2.9 Allowance for expansion and contraction is provided.
- 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 calculations and computer software packages.
- 3.3 **Sustainability principles and concepts** are applied throughout the design process.
- 4 Prepare documentation.
- 4.1 Client brief of the desired design is prepared.
- 4.2 **Plans and specifications** are prepared for a range of hydronic heating and cooling systems.
- 4.3 **Testing and commissioning schedule** is prepared.
- 4.4 **Operation and maintenance manual** is produced, including information on how to properly and safely maintain the system.

Required Skills and Knowledge

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

Required skills

- 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
 - use language and concepts appropriate to cultural differences
 - use and interpret non-verbal communication
- literacy skills to:
 - prepare written documentation, including:
 - operation and maintenance manual
 - plans, specifications and schedules
 - read and interpret:
 - plans, specifications, drawings and design briefs
 - standards and manufacturer requirements and manuals
 - statutory and regulatory requirements
- initiative and enterprise skills to develop creative and responsive approaches
- numeracy skills to apply measurements and calculations
- planning and organising 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
- 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
- technical skills to:
 - determine relevant installation details for hydronic heating and cooling systems
 - prepare system specifications for hydronic heating and cooling systems
- technology skills to:
 - access and understand site-specific instructions in a variety of media
 - use mobile communication technology

Required knowledge

- application of National Construction Code or relevant Australian standards and codes, manufacturer specifications and operating procedures relevant to the sector
- common terminology and definitions used in design of hydronic heating and 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
- work health and safety (WHS) requirements, including relevant statutory regulations, codes and standards

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 as a minimum, provide evidence of the ability to:

- design, size and document the layout details for a hydronic heating and cooling system, including a specification for a high-rise mixed development building to a minimum of 29 floors, inclusive of a basement to include fixtures on each floor level (fixtures are included in the basement), including:
 - applying sustainability principles and concepts throughout the design to achieve a star rating under the Green Council of Australia rating scheme
 - evaluating and documenting design parameters, including client, regulatory, manufacturer and relevant Australian standard and code requirements for a range of hydronic heating and cooling systems
 - producing an appropriate layout for hydronic heating and cooling systems, planned according to manufacturer and regulatory requirements
 - calculating pipe sizes according to regulations and manufacturer requirements
 - designing hydronic circuits
 - designing and sizing hydronic systems using calculations and appropriate computer software
 - preparing plans and specifications for a range of hydronic heating and cooling systems
 - preparing testing and commissioning schedules
 - producing operation and maintenance manuals
 - communicating with others to ensure safe and

effective workplace operations.

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.

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
- 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

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:

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

- heat transfer
- 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, which may include:
 - 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 may include:

- architectural plans
- building specifications
- interpretation and application of mechanical services drawings and symbols
- fire rating of penetrations
- owner requirements
- pipework identification
- specialist hydronic applications.

Cost-benefit analysis:

- compares the range of suitable materials and system choices available to enable cost-effective choices to be made without compromising integrity of project
- may include:
 - design styles
 - energy costs
 - expected design life
 - labour costs
 - material costs
 - safety factors

- speed of installation
- suitable materials
- system choices.

Statutory and regulatory requirements and relevant Australian standards may include:

- Acts, regulations and commonwealth, state or territory, and local government requirements
- industry standards
- National Construction Code
- other relevant Australian standards.

Manufacturer requirements include:

- sizing tables
- specifications
- recommended specific fixings for pipework
- technical and trade manuals.

Desktop study may include collection and interpretation of data for design purposes in:

- architectural and building plans
- developer plans
- manufacturer data
- documents, which may include:
 - applications
 - brochures
 - forms
 - policies
 - other reports as available.

Performance requirements must include:

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

Layout of pipework systems:

- must include:
 - flow, velocity, pressure and discharge requirements established using relevant Australian standards, codes and local government authority requirements
 - location of pipework (fire rating of enclosure)
 - 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 may include:

- fittings:
 - bends
 - elbows
 - tees
 - unions
 - couplings
 - strainers
- valves:
 - excess pressure
 - flow and isolating
 - pressure limiting
 - pressure reduction.

Pipe size requirement calculations must include:

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

System components and circuits:

- boilers may include:
 - advantages and disadvantages of boiler types
 - capacity and size
 - coal
 - electric
 - energy sources
 - fire tube
 - gas
 - heat exchanger
 - 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 must include:
 - circulating pump appliances
 - flow and return pipework
 - pipework grades
 - valves and fittings
- cooling towers must include:
 - bacteriological safety
 - collection
 - construction
 - disinfection
 - fans
 - maintenance
 - size
 - sprays
- chillers and refrigerant plant must include:
 - engineered systems
 - packaged plants
 - proprietary commercial and industrial equipment and assemblies
- hydronic appliances must include:
 - calorifiers
 - components
 - concrete construction
 - electronic controls
 - heat exchangers
 - methods of temperature and pressure control
 - radiators
 - timber floor heating systems
 - types
 - water heaters.

Pump and compressor systems must include:

- chilled water pumps
- circulating pumps
- refrigeration compressors
- other applications as required.

Insulation may include:

- felt
- fibreglass

- insulation protection, including:
 - plastic
 - sheet metal
- rock wool.

Pipe supports may include:

- anchors
- bracket spacing
- corrosion protection
- hanging brackets
- manufacturer-recommended specific fixings
- material requirements
- provision for expansion
- saddles.

Materials may include:

- copper (Cu)
- steel
- other approved materials.

Joining methods may include:

- brazing
- mechanical joints
- threading
- other approved joining methods.

Installation requirements may include:

- pipe protection, which may include:
 - cover
 - corrosion
 - impact
- fire rating
- level of workmanship
- manufacturer-recommended specific fixings
- pipe support
- provision for expansion
- serviceability and access.

Sustainability principles and concepts:

- cover the current and future social, economic and environmental use of resources
- may include:
 - efficient use of material

- efficient energy use/capital outlay comparison
- water efficiency
- reuse of water, such as rainwater, greywater and recycled non-drinking water
- consideration of the Green Building Council of Australia rating scheme
- selecting appropriate components to ensure minimal environmental impact.

Plans:

- may include:
 - axonometrics
 - cross-sections
 - details
 - elevations
 - isometrics
 - sections
- schematics, which may be produced using:
 - computer generation
 - drawing equipment.

Specification may include:

- bedding
- support
- flow requirements
- jointing
- manufacturer requirements
- materials
- residual pressures
- safety (WHS)
- specialised components
- testing
- valve selection
- water treatment
- workmanship.

Testing may include:

- defect inspection
- flow testing
- inspection checklist
- leak testing
- pressure testing
- quality assurance (QA) audit.

Commissioning schedule must include:

- system certification
- flue balancing
- flow test
- leak check
- pressure test
- system purge
- system defects
- system functions as per design
- valve operation
- checking fit for purpose
- removing contaminants.

Operation and maintenance manual may include:

- as installed drawings
- certification documentation
- check for blockages
- leak detection
- maintenance schedules
- manufacturer brochures and technical information
- regular inspection
- regular maintenance requirements.
- results of commissioning test
- valve function.

Unit Sector(s)

Functional area

Unit sector Plumbing and services

Custom Content Section

Not applicable.