



Australian Government

CPCPPS5023A Design solar water heating 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 CPCPPS5003A

Unit Descriptor

This unit of competency specifies the outcomes required to design efficient, cost effective solar water heating systems for residential, commercial and industrial applications using proprietary components and manufacturer design information.

Application of the Unit

This unit of competency supports the needs of experienced tradespeople with a responsibility for designing solar water heating systems for residential, commercial and industrial buildings.

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. | <p>1.1 <i>Scope of work</i> for solar water heating system design is established.</p> <p>1.2 <i>Design requirements</i> are determined from relevant Australian standards, codes, plans, specifications and client brief.</p> <p>1.3 Locations of solar collectors are assessed and effect of each location on <i>efficiency</i> is evaluated.</p> <p>1.4 <i>Cost-benefit analysis</i> is conducted comparing a range of materials and system designs.</p> <p>1.5 Environmental and community benefits of solar water heating systems are evaluated.</p> <p>1.6 <i>Statutory and regulatory requirements and relevant Australian standards and codes</i> for the design of solar water heating systems are analysed and applied.</p> <p>1.7 <i>Manufacturer requirements</i> and trade and technical manuals are interpreted.</p> <p>1.8 Additional research, including a <i>desktop study</i>, is conducted to outline design parameters.</p> <p>1.9 <i>Performance requirements</i> are established, considering safety of system users or building occupants.</p> <p>1.10 Factors that contribute to quality, safety and time efficiency are determined.</p> |
| 2 | Plan and detail system components. | <p>2.1 <i>Layout of pipework systems</i>, and type and location of <i>fittings and valves</i>, are planned.</p> <p>2.2 Range configuration and application of <i>proprietary solar heated water systems</i>, and materials and valves to be selected, are evaluated.</p> <p>2.3 <i>Solar water heating system calculations</i> are performed.</p> <p>2.4 Typical configuration of a hydraulic circuit (flow and return) and its <i>components</i> for a pumped-storage solar water heating system is designed.</p> |

- 2.5 Water quality and water pre-treatment methods are specified.
 - 2.6 Suitable types and levels of insulation for system components are specified and a range of *methods to prevent freezing and protect from over performance* is detailed.
 - 2.7 *Pipe size, velocity, flow and pressure calculations* are performed for a range of applications.
 - 2.8 *Pipe supports* are designed for a range of applications.
 - 2.9 Approved *materials, jointing methods* and *installation requirements* for solar water heating systems are specified.
 - 2.10 Allowance for expansion and contraction is provided.
- 3 Design and size systems.**
- 3.1 *Solar collectors* are selected to meet the installation requirements.
 - 3.2 Residential, commercial and industrial solar water heating systems are designed.
 - 3.3 Solar pre-heat systems are designed.
 - 3.4 Solar pool and spa heating systems are designed.
 - 3.5 Solar water heating systems are designed and sized using calculations and computer software packages.
 - 3.6 *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 solar water heating 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, such as hand signals
- initiative and enterprise skills to develop creative and responsive approaches
- literacy skills to:
 - prepare documentation, including:
 - operation and maintenance manual
 - plans, specifications and schedules
 - read and interpret:
 - documentation from a variety of sources
 - plans, specifications, drawings and design briefs
 - standards and manufacturer requirements and manuals
 - statutory and regulatory requirements
- numeracy skills to interpret data and to apply measurements and calculations
- planning and organising skills to:
 - research, collect, organise and understand information relating to the design of solar water heating systems
 - take initiative and make decisions
- problem-solving skills to analyse requirements, consider options and design an appropriate system
- technical skills to design solar water heating systems
- technology skills to:
 - access and understand site-specific instructions in a variety of media
 - use mobile communication technology

Required knowledge

- application of:
 - relevant Australian standards, including AS/NZS3500 National plumbing and

drainage

- manufacturer specifications, including hazards identified in relation to devices and systems used
- other codes or standard operating procedures
- state or territory regulatory authorities' requirements
- common terminology and definitions used in design of solar water heating systems
- principles of technology used in design of solar water heating 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 using two methods of providing solar-heated water systems;
 - one to be a gas-boosted commercial solar system; one to be a heat pump-boosted system
- develop a specification for each of the following projects:
 - 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)
 - a wide span project, such as a school
- specifications for each of the projects, to include:
 - evaluating and documenting design parameters, including client, regulatory, manufacturer and relevant Australian standard and code requirements for a range of solar water heating systems
 - evaluating health risks associated with heated water supplies
 - conducting a cost-benefit analysis
 - planning and detailing system components, including:
 - circulating systems
 - solar collectors
 - valve and piping systems
 - designing a range of residential, commercial and

industrial solar water heating systems

- designing solar pre-heat systems
- designing solar pool and spa heating systems
- preparing plans and specifications for a range of solar water heating systems
- preparing testing and commissioning schedules
- producing operation and maintenance manuals
- applying sustainability principles and concepts throughout the design
- communicating with others to ensure safe and effective work site 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, including design brief drawings, specifications, codes, design concepts and construction schedules
- tools and equipment appropriate to applying safe work practices, including computers, software and calculators
- 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:

- interpreting plans and specifications, and sizing and documenting layout of solar water heating systems for applications including residential, commercial and industrial buildings for new projects or an existing structure being renovated, extended, restored or maintained
- heat transfer mechanism analysis, including conduction, convection and radiation (long wave and short wave), and the evaluation of transmittance, absorption and emittance properties of materials used in solar collectors
- solar radiation calculations, including:
 - calculations of efficiency
 - calculations of radiation falling on collectors
 - daily, monthly and yearly calculations.

Design requirements may include:

- architectural plans
- building specifications
- fire rating of penetrations
- frost protection
- integration with other heat sources
- limitations of various systems
- overheating protection
- owner requirements
- pipework identification
- specialist heated water use applications.

Efficiency must include:

- angle of collector in relation to latitude
- comparison of demand and efficiency curves for various types of solar collectors
- current and potential shading
- direction in relation to north
- efficiency in relation to:
 - ambient temperature
 - flow
 - location
 - pollution
 - prevailing wind conditions

- magnetic north as opposed to true north.

Cost-benefit analysis:

- compares the range of suitable materials and system choices available to enable cost-effective choices to be made without compromising the integrity of the project
- may include:
 - design styles
 - energy costs
 - expected design life
 - labour costs
 - material costs
 - safety factors
 - speed of installation
 - suitable materials
- comparison and evaluation of capital cost, simple pay back and lifecycle cost of solar and other heat sources
- comparison of initial set-up costs to the energy savings available and establishment of cost-recovery period.

Statutory and regulatory requirements and relevant Australian standards and codes may include:

- Acts, regulations, and commonwealth, state or territory, and local government requirements
- Australian standards:
 - AS/NZS3500 National plumbing and drainage
 - AS2200 Design charts for water supply and sewerage
 - AS2369.1 Materials for solar collectors for swimming pool heating – rubber materials
 - AS2369.2 Materials for solar collectors for swimming pool heating – flexible or plasticised polyvinyl chloride
 - AS/NZS2535.1 Test methods for solar collectors – thermal performance of glazed liquid heating collectors including pressure drop
 - AS/NZS2712 Solar and heat pump water heaters design and construction
 - AS3634 Solar heating systems for swimming pools
 - AS/NZS4234 Solar water heaters domestic and heat pump – calculation of energy consumption

- AS/NZS4445.1 Solar heating domestic water heating systems performance rating procedure using indoor test methods
- DR04527 Amendment 1 to AS/NZS2712 Solar water heaters design and construction
- National Construction Code.

Manufacturer requirements may include:

- heater maintenance and servicing
- material specifications
- provision for heater pressure and temperature discharge
- protection for freezing and overheating
- recommended specific fixings for pipework
- sizing tables
- technical and trade manuals
- limitations of use.

Desktop study may include:

- collection and interpretation of data for design purposes, such as:
 - architectural and building plans
 - developer plans
 - manufacturer's data
 - documents, which may include:
 - applications
 - brochures
 - forms
 - policies
 - other reports as available
- local authorities' requirements
- area suitability for solar
- shadow studies
- comparison of performance of various types of solar water heaters in terms of design, location and predicted solar fraction.

Performance requirements are established using relevant Australian standards, codes, commonwealth, state or territory and local authority plans and may include:

- flow rate requirements
- pressure
- system design
- velocity
- water quality and its effect on the system.

Layout of pipework systems:

- must include:
 - dual feed
 - ring main
 - single pipe
- 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
- valves:
 - backflow prevention
 - excess pressure
 - frost protection devices
 - isolating
 - location of valves
 - over temperature
 - pressure limiting
 - pressure reduction
 - strainers.

Proprietary solar heated water systems may include:

- alternative supplementary fuel sources, including:
 - coal
 - electricity
 - fuel oil
 - gas
 - heat pump
 - waste heat recovery (mechanical plant)
 - wood
- circulating systems
- clarifiers
- close coupled, split systems
- direct and indirect heating systems
- heat exchange systems

- heated water heaters
- pool heaters
- solar pre-heaters
- spa heaters
- storage systems
- sun track systems.

Solar water heating system calculations may include:

- area locality
- circulation calculations
- energy balance equation
- flow calculations
- heat loss calculations, covering:
 - collector losses
 - overnight losses
 - standing losses
- incoming water temperature
- temperature and energy equations
- varying inlet temperature and flow rate effect on the performance of a solar collector
- volume calculations.

Components may include:

- collectors
- differential controllers
- electronics
- expansion tanks
- filters
- fittings
- flow and return pipework
- heat exchangers
- insulation
- overflows
- pumps
- safe trays
- storage vessels
- suitable type and size of circulating pumps
- supplementary heat sources
- support frames
- timers and mechanical components
- valves
- water treatment.

Methods to prevent freezing and protect from over performance may include:

- circulating systems
- drain back systems
- dump valves
- heat trace systems
- indirect systems
- insulation.

Pipe size, velocity, flow and pressure calculations must include:

- rate of discharge
- temperature
- velocities
- volume.

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)
- other approved materials.

Jointing methods may include:

- brazing
- compression
- flaring
- mechanical joints
- other approved jointing methods.

Installation requirements include:

- pipe protection, which may include:
 - corrosion
 - impact
- fire rating
- level of workmanship
- manufacturer-recommended specific fixings
- pipe support

- provision for expansion
- serviceability and access
- system structure support.

Solar collector design may include:

- collector housing
- fin and tube collectors
- glass
- insulation
- pipe collectors
- pre-heat systems
- sun tracking systems
- vacuum tube.

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
 - selecting energy efficient water heater
 - reusing 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
 - schematics
 - sections
- may be produced using:
 - computer generation
 - drawing equipment.

Specification may include:

- support
- jointing
- flow requirements
- manufacturer requirements
- materials
- safety (WHS)
- specialised components
- testing
- valve selection
- workmanship.

Testing may include:

- air pressure
- defect inspection
- hydrostatic
- mains pressure
- performance
- quality assurance (QA) audit.

Commissioning schedule may include:

- balancing the system
- checking and flushing the system
- checking and maintaining heat transfer fluid levels
- temperature setting
- disinfection
- flow test
- leak check
- pressure test
- system certification
- system defects
- system functions as per design
- valve operation.

Operation and maintenance manual may include:

- as installed drawings
- certification documentation
- results of commissioning test
- heater detail, setting and operations
- maintenance schedules
- manufacturer brochures and technical information
- valve function
- safety management system
- system detail, setting and operations.

Unit Sector(s)

Functional area

Unit sector Plumbing and services

Custom Content Section

Not applicable.