



Australian Government

Department of Education, Employment and Workplace Relations

CPCPPS5003A Design solar water heating systems

Release: 1

CPCPPS5003A Design solar water heating systems

Modification History

Not Applicable

Unit Descriptor

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.
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Application of the Unit

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.
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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 solar water heating system design. 1.2. Design requirements are determined from plans, specifications and client briefs. 1.3. Locations of solar collectors are assessed and effect of each location on efficiency is evaluated. 1.4. Cost-benefit analysis is conducted comparing a range of materials and system designs. 1.5. Environmental and community benefits of solar water heating systems are evaluated. 1.6. Statutory and regulatory requirements and Australian and New Zealand standards for the design of solar water heating systems are analysed and applied. 1.7. Manufacturer requirements and trade and technical manuals are interpreted. 1.8. Additional research, including a desktop study, is conducted to outline design parameters. 1.9. 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. Range configuration and application of proprietary solar heated water systems, and materials and valves to be selected, are evaluated. 2.3. Solar water heating system calculations are performed. 2.4. Typical configuration of a hydraulic circuit (flow and return) and its components for a pumped-storage solar water heating system is designed. 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 for freezing protection is detailed. 2.7. Pipe size, velocity, flow and pressure calculations are performed for a range of applications. 2.8. Pipe fixings are designed for a range of applications. 2.9. Approved materials, jointing methods and installation requirements for solar water heating systems are specified.

ELEMENT	PERFORMANCE CRITERIA
3. Design and size systems.	3.1. Solar collector is designed. 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 computer software packages.
4. Prepare documentation.	4.1. Plans are prepared for a range of solar water heating systems. 4.2. Specification for a solar water heating 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:
 - documentation from a variety of sources
 - 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, such as hand signals
- written skills to prepare documentation, including:
 - operation and maintenance manual
 - plans, specifications and schedules

REQUIRED SKILLS AND KNOWLEDGE

- innovation skills to develop creative and responsive approaches
- numeracy skills to interpret data and to apply measurements and calculations
- planning and organisational 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.

Required knowledge

Required knowledge for this unit is:

- common terminology and definitions used in design of solar water heating systems
- principles of technology used in design of solar water heating 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 solar water heating systems
- 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 for a range of solar water heating systems
- preparing specifications for solar water heating 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

EVIDENCE GUIDE

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:

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- 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

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:

- interpreting plans and specifications, and sizing and documenting layout of solar water heating systems for applications including residential, commercial and industrial buildings for new

RANGE STATEMENT

	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.
<i>Design requirements</i> include:	• architectural specifications • builder specifications • owner requirements • specialist water heating applications.
<i>Efficiency</i> includes:	• 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.
<i>Cost-benefit analysis</i> includes:	• comparison and evaluation of capital cost, simple pay back and life cycle cost of solar and electric or gas heated water heaters • comparison of initial set-up costs to the energy savings available and establishment of cost-recovery period • comparison of range of suitable materials and system choices available to enable cost-effective choices to be made without compromising integrity of project.
<i>Statutory and regulatory requirements and Australian and New Zealand standards</i> include:	• Acts, regulations, and local and state government policies • Australian and New Zealand standards:

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Manufacturer requirements
include:

Desktop study includes:

- AS/NZS3500 National plumbing and drainage set
- 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
- AS2535.1 Test methods for solar collectors - thermal performance of glazed liquid heating collectors including pressure drop
- AS2712 Solar and heat pump water heaters - design and construction
- AS3634 Solar heating systems for swimming pools
- AS4234 Solar water heaters - domestic and heat pump - calculation of energy consumption
- AS4445.1 Solar heating - domestic water heating systems - performance rating procedure using indoor test methods
- DR04527 Amendment 1 to AS2712 Solar water heaters - design and construction
- Building Code of Australia.
- material specifications
- pump tables
- sizing tables
- technical and trade manuals.
- collection and interpretation of existing data for design purposes from:
 - architectural and building plans
 - council plans
 - developer plans
 - other documents, including:
 - applications
 - forms
 - other reports as available
- comparison of performance of various types of solar water heaters in terms of design, location and predicted solar fraction.

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Performance requirements are established using Australian and New Zealand standards and local authority plans and may include:

- discharge requirements
- flow
- pressure
- velocity
- water quality and its effect on system life.

Layout of pipework systems:

- includes:
 - 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 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 include:

- alternative supplementary fuel sources, including:
 - coal
 - electricity
 - fuel oil
 - gas
 - wood
- circulating systems
- clarifiers
- close coupled, split systems
- direct and indirect heating systems

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Solar water heating system calculations include:

- heat exchange systems
- heated water heaters
- pool heaters
- solar pre-heaters
- spa heaters
- storage systems
- sun track systems.
- circulation calculations
- energy balance equation
- flow calculations
- heat loss calculations, covering:
 - collector losses
 - overnight losses
 - standing losses
- temperature and energy equations
- varying inlet temperature and flow rate effect on the performance of a solar collector
- volume calculations.

Components include:

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

Methods for freezing protection include:

- circulating systems
- dump valves
- heat trace systems.

Pipe size, velocity, flow and

- rate of discharge
- temperature

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- pressure calculations*** include:
- volume.
- Pipe fixings*** include:
- anchors
 - bracket spacing
 - corrosion protection
 - hanging brackets
 - material requirements
 - saddles
 - wall and ceiling brackets.
- Materials*** include:
- copper
 - fittings and fixtures
 - galvanised steel
 - glass
 - other approved pipe materials
 - polybutylene
 - protective coatings.
- Jointing methods*** include:
- brazing
 - compression
 - flaring
 - mechanical joints
 - soldering
 - threading.
- Installation requirements*** include:
- clipping
 - installation details
 - jointing requirements
 - level of workmanship
 - roof support.
- Solar collector*** design includes:
- box
 - fin and tube collectors
 - glass
 - insulation
 - pipe collectors
 - pre-heat systems
 - sun tracking systems.
- Plans*** include:
- axonometrics
 - cross-sections
 - details
 - elevations
 - isometrics
 - schematics, which may be produced using:

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|---|--|
| Specification includes: | <ul style="list-style-type: none">• pencil• Indian ink• pigment liner• computer generation• sections.• clipping• details of specialised components• jointing• manufacturer requirements• materials• valve selection• workmanship. |
| Testing includes: | <ul style="list-style-type: none">• air pressure test• defect inspection• hydrostatic test• mains pressure test• quality assurance (QA) audit. |
| Commissioning schedule includes: | <ul style="list-style-type: none">• flow test• leak check• pressure test• pump commissioning• system purge• valve operation. |
| Operation and maintenance manual includes: | <ul style="list-style-type: none">• leak detection• pump maintenance• valve maintenance• water and energy auditing• yearly inspection• yearly maintenance requirements. |

Unit Sector(s)

Unit sector Plumbing and services

Co-requisite units

Co-requisite units Nil

Functional area

Functional area