



Australian Government

CPCPPS5033A Design vacuum sewerage 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 CPCPPS5013A

Unit Descriptor

This unit of competency specifies the outcomes required to design vacuum sewerage systems, determine installation details, and prepare specifications for a range of residential, commercial and industrial buildings, using proprietary components.

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. | <p>1.1 Scope of work is established for vacuum sewerage systems designed for sewer infrastructure systems and high-rise building projects.</p> <p>1.2 Design requirements are determined from relevant Australian standards, codes, plans, specifications and client brief.</p> <p>1.3 Vacuum sewerage system attributes are evaluated and a cost-benefit analysis is conducted, comparing a range of pipe materials and system designs.</p> <p>1.4 Statutory and regulatory requirements and relevant Australian standards and codes for the design of vacuum sewerage systems are analysed and applied.</p> <p>1.5 Manufacturer requirements and trade and technical manuals are interpreted.</p> <p>1.6 Additional research, including a desktop study, is conducted to outline design parameters.</p> <p>1.7 Factors that contribute to quality, safety and time efficiency are determined.</p> <p>1.8 Performance requirements are established, considering safety of system users or building occupants.</p> |
| 2 | Plan and detail system components. | <p>2.1 Layout of pipework systems and type and location of fittings, valves and controls are planned.</p> <p>2.2 Sewerage loading is calculated using equivalent population (EP) density for a residential development in excess of 25 dwellings and National Construction Code for a high-rise project.</p> <p>2.3 Pipe size calculations are performed for a range of applications according to regulations and manufacturer requirements.</p> <p>2.4 Pipe supports are designed for a range of applications.</p> <p>2.5 Vacuum pumping station and pump control requirements are sized and detailed.</p> |

- 2.6 Approved **materials, jointing methods** and **installation requirements** for vacuum sewerage systems are specified.
 - 2.7 Approved point of discharge to authority's main is determined.
 - 2.8 Acoustic performance of the system is included in the plan.
- 3 **Design and size systems.**
 - 3.1 Vacuum sewerage systems are designed for a range of applications.
 - 3.2 Vacuum sewerage 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 vacuum sewerage 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:
 - plans, specifications, drawings and design briefs
 - standards and manufacturer requirements and manuals
 - statutory and regulatory requirements
- numeracy skills to:
 - apply measurements and calculations
 - interpret data
- planning and organising skills to:
 - research, collect, organise and understand information relating to the design of vacuum sewerage 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 installation details for vacuum sewerage systems
 - prepare specifications for vacuum sewerage systems
- technology skills to:
 - access and understand site-specific instructions in a variety of media
 - use mobile communication technology

Required knowledge

- relevant Australian standards, including Sewerage Code of Australia
- manufacturer specifications, including hazards identified in relation to devices and systems used
- fire safety requirements
- other codes or standard operating procedures
- pipe-sizing procedures
- pump selection and rising main requirements
- ventilation requirements
- odour control
- regulatory authorities' requirements
- nature of materials used and effects of performance under various conditions
- common terminology and definitions used in the design of vacuum sewer systems
- principles of technology in the design of sewer infrastructure 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 installation and layout details for a vacuum infrastructure sewer system for a:
- residential development of 50 properties, incorporating:
 - vacuum sewage collection chambers
 - vacuum sewer mains
 - vacuum pump station
 - pump rising main
 - ventilation
 - odour control
- 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), incorporating:
 - vacuum pump station
 - vacuum sanitary drainage system
 - pump rising main
 - ventilation
 - odour control
- apply sustainability principles and concepts throughout to achieve a star rating under the Green Building Council of Australia rating scheme
- evaluate and document design parameters, including client, regulatory and manufacturer requirements and relevant Australian standards and codes for a range of complex sanitary plumbing and drainage systems
- evaluate health risks associated with the sanitary

plumbing and drainage system

- calculate pipe sizes according to regulations and manufacturer requirements
- design and size vacuum sewerage systems using appropriate calculations and computer software
- select materials and components for compliance, fit for purpose, durability, compatibility and cost-effectiveness
- prepare a testing and commissioning schedule
- produce an operation and maintenance manual
- communicate 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, 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
 - sizing and documenting layout of vacuum sewerage systems, including residential, commercial and industrial
- may be for new projects or an existing structure being renovated, extended, restored or maintained.

Design requirements must include:

- acoustic performance
- architectural plans
- building specifications
- fire safety requirements
- flow requirements and sizing of pipework
- odour control
- owner requirements
- pipework identification
- Sewerage Code of Australia
- vacuum pumping station
- ventilation requirements.

Vacuum sewerage system attributes must include:

- availability
- cost
- flexibility
- installation requirements
- low water usage
- risks
- sewerage loading
- site conditions.

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:
 - energy costs
 - expected design life

- labour costs
- material costs
- safety factors
- speed of installation
- suitability of design.

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

- Acts, regulations and commonwealth, state or territory, and local government requirements
- Sewerage Code of Australia
- AS/NZS3500 National plumbing and drainage
- AS2200 Design charts for water supply and sewerage
- Environmental Protection Authority (EPA)
- National Construction Code
- other relevant Australian standards or codes.

Manufacturer requirements may include:

- material specifications
- collection and storage systems
- design and installation
- equipment installation
- pump installation
- selection of compatible sanitary fixtures
- technical 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
 - sewer detail maps
 - other reports as available.

Performance requirements may include:

- discharge requirements
- durability
- emergency storage and/or power backup
- longevity

- noise level
- self-cleaning ability
- sufficient capacity.

Layout of pipework systems:

- sewer infrastructure systems must include consideration of:
 - cover
 - grade
 - location of vacuum pump station
 - location vacuum sewage collection chambers
 - odour control
 - pipe access
 - ventilation
- high-rise building projects must include consideration of:
 - acoustic performance
 - amenity of the building
 - clipping and pipe support
 - location of pipework (fire rating of enclosure)
 - function of the building
 - impingement on floor heights
 - materials to be used
 - size of penetrations
 - type of building structure
- should not unduly affect building integrity and aesthetic appeal
- should include principles of economy, serviceability, durability and fit for use should be applied.

Fittings, valves and controls
include:

- fittings:
 - bends
 - elbows
 - inspection and maintenance access
 - tees
 - unions
- valves:
 - backflow prevention
 - isolating
 - non-return

- strainers
- vacuum diaphragm valve
- controls:
 - pneumatic control switch assembly
 - vacuum management system.

Pipe size calculations must include:

- determining flow and fixture loadings
- EP density
- calculating gradient
- interpreting design charts and tables
- determining self-cleaning velocities
- manufacturer requirements
- probable simultaneous demand.

Pipe supports may include:

- bedding
- bracket spacing
- concrete support
- corrosion protection
- cover
- hanging brackets
- manufacturer-recommended specific fixings
- material requirements
- provision for expansion
- thrust blocks
- wall and ceiling brackets.

Vacuum pumping station and pump control requirements may include:

- access covers
- automatic controls
- capacity
- corrosion-resistant materials
- detailing
- emergency storage
- emergency power supply
- high and low-level water controls and alarms
- impeller sizing
- inlet and outlet design requirements
- installation and mounting requirements
- macerator requirements
- odour control
- pneumatic control switch assembly

- pump selection
- pump sizing
- pumpwell sizing
- space requirements
- vacuum pump systems
- valve requirements
- ventilation
- warning system.

Materials:

- appropriate materials specified based on:
 - compatibility
 - cost effectiveness
 - durability
 - fit for purpose
- may include:
 - copper (Cu)
 - polyethylene (PE)
 - polypropylene (PP)
 - polyvinyl chloride (PVC)
 - stainless steel
 - other approved material.

Jointing methods may include:

- brazing
- electrofusion welding
- flanged
- mechanical joints
- rubber ring
- solvent cement welding
- threading.

Installation requirements may include:

- acoustic performance
- bedding
- pipe protection, which may include:
 - cover
 - corrosion
 - impact
- grade
- level of workmanship.
- fire rating

- manufacturer-recommended specific fixings
- pipe support
- provision for pipe movement
- serviceability and access.

Computer software packages may include:

- manufacturer software
- proprietary design software.

Sustainability principles and concepts:

- cover the current and future social, economic and environmental use of resources
- may include:
 - selecting appropriate material to ensure minimal environmental impact
 - efficient use of material
 - capital outlay/energy usage comparison
 - positive effect on the environment in regard to no potential overflow or leakage
 - water efficient
 - consideration of the Green Building Council of Australia rating scheme
 - local environment consideration overflow disposal/reuse.

Plans:

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

Specification includes:

- access chambers (manholes)
- bedding
- commissioning

- concrete support and detailing specialised components
- jointing
- manufacturer requirements
- materials
- odour control
- pump rising main
- safety (WHS)
- selection of compatible sanitary fixtures
- support
- testing
- vacuum pump station
- vacuum sewage collection chambers
- vacuum sewer mains
- ventilation
- workmanship.

Testing may include:

- compressed air test
- flow testing
- hydrostatic test
- inspection checklist
- performance
- vacuum
- quality assurance (QA) audit.

Commissioning schedule must include:

- system certification
- check for foreign material
- checking leaks
- emergency procedures
- system defects
- system functions as per design.

Operation and maintenance manual includes:

- as installed drawings
- results of commissioning test
- certification documentation
- maintenance schedules
- manufacturer brochures and technical information
- operating procedures.

Unit Sector(s)

Functional area

Unit sector Plumbing and services

Custom Content Section

Not applicable.