

Technical Specification

**Transport and Main Roads Specifications
MRTS25 Steel Reinforced Precast Concrete Pipes**

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1 Introduction

This Technical Specification applies to the manufacture of steel-reinforced precast concrete circular pipes used for the conveyance of stormwater in applications where the pipe is not subject to internal pressure.

This Technical Specification does not cover the design of drainage systems, nor the determination of load class and exposure classification. These details are covered in the *Road Planning and Design Manual (RPDM)*.

Installation of pipe is covered by MRTS03 *Drainage Structures, Retaining Structures and Slope Protections*.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other relevant technical specifications as appropriate.

This Technical Specification forms part of the *Transport and Main Roads Specifications Manual*.

2 Definition of terms

The terms and symbols used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications* and AS/NZS 4058 *Precast concrete pipes (pressure and non-pressure)*, unless noted otherwise.

Table 2 – Definition of terms

Term	Definition
aggressive environment	An underground environment with significant influence on the in-service life expectancy of pipe. The precise parameters are defined in the <i>Road Planning and Design Manual (RPDM)</i> . A subset of 'other environment' as defined by AS/NZS 4058.
normal environment	An underground environment having negligible influence on the in-service life expectancy of pipe.
registered	Prequalified product or supplier in accordance with departmental registration schemes, for example: <ul style="list-style-type: none"> • <i>Supplier Registration Scheme: Bridges and Other Structures</i> • <i>Product index for Bridges and Other Structures</i> • <i>Quarry Registration System</i>

Term	Definition
wet cast pipe	Pipe manufactured by semi-automated or manual processes in rigid metal moulds with either compaction through vibration or super-workable concrete. Concrete will be a typical slump (80–200) or spread mix.

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS/NZS 1554.3	<i>Structural steel welding</i>
AS 3582.4	<i>Supplementary cementitious materials</i>
AS/NZS 4058	<i>Precast concrete pipes (pressure and non-pressure)</i>
AS 4198	<i>Precast concrete access and maintenance chambers for sewerage applications</i>
AS/NZS 4671	<i>Steel for the reinforcement of concrete</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS03	<i>Drainage Structures, Retaining Structures and Slope Protections</i>
MRTS36	<i>Recycled Glass Aggregate</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS70	<i>Concrete</i>
MRTS72	<i>Manufacture of Precast Concrete Elements</i>
MRTS270	<i>Supply of Geopolymer Concrete</i>
MRTS274	<i>Repair of New Concrete Construction</i>
SRS:BOS	<i>Supplier Registration Scheme: Bridges and Other Structures</i>
RPDM	<i>Road Planning and Design Manual (Part 5B)</i>

4 Quality system requirements

4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in MRTS01 *Introduction to Technical Specifications*.

The Hold Points and Milestones applicable to this Technical Specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points, and Milestones

Clause	Hold Point	Witness Point	Milestone
6	1. Approval of alternate internal diameter		Submission of alternate internal diameter
8.5		1. Testing of Non-standard pipes	
11	2. Delivery of pipes		Submission of documentation
12		2. Inspection of manufactured pipes	

5 Pipe design

Pipe elements shall be designed to withstand the test loads outlined in AS/NZS 4058 *Precast concrete pipes (pressure and non pressure)*.

The design internal diameter, as defined in AS/NZS 4058, shall not be less than:

- a) 95% of the nominal internal diameter for normal environment for pipes up to Class 6
- b) 90% of the nominal internal diameter for:
 - i. Class 8 and Class 10 pipes with 10 mm of cover, and
 - ii. pipes with 20 mm or more of cover.

Where the design internal diameter does not meet these requirements, an alternative design internal diameter may be submitted to the Administrator for approval. Drawings or tabulations showing the alternative design internal diameter shall be submitted not less than three weeks before supply of pipes is due to commence **Milestone**. No pipes of an alternative design internal diameter shall be supplied until written approval is granted by the Administrator. **Hold Point 1**

This requirement is added to give confidence of the hydraulic performance of pipes. AS/NZS 4058 does not specify a relationship between the design and nominal diameters.

6 Materials

6.1 Concrete

Concrete used for the manufacture of steel-reinforced concrete in accordance with this Technical Specification shall comply with AS/NZS 4058 and this clause.

Cementitious materials shall comply with MRTS70 *Concrete* and be registered products. Proprietary cementitious systems in accordance with MRTS70 *Concrete* and geopolymeric systems in accordance with MRTS270 *Supply of Geopolymer Concrete* may be used.

This allows pipe manufacturers to utilise a wider range of materials (e.g., GL cement, calcined clay) managed through the mix design approval process. Material-specific requirements may be imposed.

Admixtures shall comply with MRTS70 *Concrete* and be registered products.

Aggregates shall comply with Clause 7 of MRTS70 *Concrete*. Recycled crushed concrete and reclaimed aggregates may be used up to a replacement rate of 20% for coarse aggregates. Recycled glass aggregate shall conform to MRTS36 *Recycled Glass Aggregate* and may be used up to a replacement rate of 20%. The blended fractions shall be tested yearly and conform to MRTS70 *Concrete* requirements.

That is, the virgin aggregate will meet the minimum requirements (to be registered through the quarry registration system) and the recycled-virgin blend will also meet the minimum requirements. The recycled material alone does not need to meet the MRTS70 *Concrete* requirements.

6.1.1 Cementitious blends

Cementitious material is to be a blend compliant with any of the following options with the combined total adding to 100%:

- a) 65–75% GP cement, 25–35% fly ash
- b) 40–55% GP cement, 20–35% ground granulated blast furnace slag, and 25–30% fly ash
- c) 65–71% GP cement, 4–8% amorphous silica, and 25–31% fly ash, or
- d) 30–40% GP cement, 60–70% ground granulated blast furnace slag.

These blends are presented to ensure resistance to alkali-silicate reactions and promote sustainability.

Blends are presented as design / target values.

Alternate blends and materials assessed in accordance with MRTS70 *Concrete* (see Clause 6.1) shall comply with any additional conditions imposed. Compliance to AS 3582.4 *Supplementary cementitious materials* will be imposed for alternate supplementary cementitious materials.

Additional approval conditions may include, for example:

- a) testing for alkali-silica reactions
- b) submission of test data (in lieu of ATIC registration), and/or
- c) more regular water absorption testing.

6.1.2 Concrete mix designs

Concrete mix designs shall be submitted for approval as part of the *Supplier Registration Scheme*. Submissions shall be made every 12 months.

Submitted concrete mix designs shall include the following:

- a) Mix identifier.
- b) Nominated source materials.
 - i. Cementitious material (with ATIC reference).
 - ii. Aggregates (with quarry registration number).
 - iii. Admixtures.
- c) Nominated cementitious blend.
- d) Water absorption test results (see Clause 4.6 of AS/NZS 4058).
- e) Chloride content test results (see Clause 2.2.6 AS/NZS 4058). Chloride content may be calculated from components in accordance with MRTS70 *Concrete*.
- f) Material test results, for alternate aggregates and cementitious materials.

6.2 Reinforcement

Reinforcement shall comply with AS/NZS 4671 *Steel for the reinforcement of concrete* and this clause.

Reinforcing steel shall be supplied by a department-registered supplier.

Decoiling and straightening of reinforcement shall be conducted using a controlled and consistent process.

Welding of reinforcement shall not substantially reduce the cross section of the reinforcement. Manual welding shall be conducted to a Welding Procedure Specification (WPS) as described in AS/NZS 1554.3 *Structural steel welding*. Qualification of the WPS and of welders is not required, if joints and consumables are prequalified.

Having a suitable procedure ensures consistency and control.

6.3 Nibs and spacers

Nibs used to maintain cover to reinforcement during manufacture shall be either steel or stainless steel. For aggressive environments, only stainless steel shall be used. Plastic nibs or spacers shall not be used.

7 Manufacture

Pipes shall be manufactured in accordance with AS/NZS 4058 and the following additional requirements.

Pipes shall be manufactured by a registered supplier in accordance with the *Supplier Registration Scheme*.

7.1 Wet cast pipes

Wet cast pipes shall be manufactured in the accordance with MRTS72 *Manufacture of Precast Concrete Elements* and this Technical Specification. Cover to reinforcement shall be to AS/NZS 4058.

Note: AS/NZS 4058 uses 'minimum cover' (that is, zero negative tolerance), not 'nominal cover'. For wet cast in aggressive environments, Clause 7.3 (a) is not applicable.

7.2 Concrete batching

The manufacturer shall maintain a batch recording system which includes control and measurement of added mix water, and records details and quantities of all batch constituents for each batch for all concrete mixes. These records shall be available for inspection at the manufacturer's batch plant by the Administrator.

7.3 Aggressive environments

When an aggressive environment has been nominated by the Designer, this shall be catered for by either:

- a) increased cover to reinforcement of 30 mm (20 mm in spigot)
- b) use of blends (ii) and (iii) from Clause 6.1.1 ("triple blends")
- c) addition of protective coating
- d) addition of keyed in internal and external liner, and/or
- e) addition of inert pipe sleeve where the gap between the pipe and sleeve is grouted or sealed. For use where external protection only is required.

The nominated method for addressing aggressive environments shall be submitted to the Administrator and Designer for approval.

Since not all aggressive environments are classified as such for the same reason, the most appropriate mitigation measure may differ from project to project.

- a) **Additional cover:** Depending on the size / class of pipe, increased cover may not be practical to achieve and will require bespoke moulding.
- b) **Higher specification pipe concrete:** In most cases this will be the preferred option by the department as it is likely to offer the least future maintenance. In general, it is expected that this option will provide water absorption values better than those achieved for standard normal and marine pipe concrete.
- c) **Protective coatings:** Consideration should be given to the design life of the coating and its ability, in combination with the existing concrete and cover to reinforcement, to provide a pipe with a 100 year design life. For PASS/ASS environments the coating would need to be acid resistant.
- d) **Keyed-in internal and external liner:** These would be similar to those used in some sewerage applications. Future maintenance of the liner and hydraulic performance of the pipe during the full design life needs to be considered.
- e) **Sleeving though an inert pipe material:** The pipe sleeve would have to be not subject to degradation to the surrounding environment. For example, in PASS/ASS environments, the pipe material used for the sleeve would need to be acid resistant.

7.4 Jacking pipes

Cover to reinforcement on the external surface of jacking pipes shall be increased by a further 5 mm.

An additional 5 mm of cover has been added to the external pipe surface for pipe jacking applications to account for any damage or abrasion to the external surface of the pipe during jacking.

7.5 Curing

If heat curing is used the maximum enclosure temperature shall not exceed 70°C. Temperature monitoring shall be conducted at least daily in each curing facility. Monitoring equipment shall be calibrated.

Temperatures for steaming enclosures are limited to 70°C to prevent the occurrence of Delayed Ettringite Formation (DEF).

7.6 Defects

Defect Types 3 and 6, as defined by AS/NZS 4058, are not acceptable. Repairs to other defects shall be undertaken in accordance with MRTS274 *Repair of New Concrete Construction* with procedures pre-approved through the *Supplier Registration Scheme*.

This clause should be used to assess pipes up until installation. For defect classification and rectification post-installation, refer to MRTS03 *Drainage Structures, Retaining Structures and Slope Protections*.

7.7 Testing

Type and routine testing shall be in accordance with in AS/NZS 4058, as modified by this clause.

Testing shall generally be on a per size and per class basis, with water absorption testing on a per mix and per process basis. Production records shall be held for audit to confirm the rate of testing.

Ultimate load testing shall be conducted on a 3-yearly basis, and as required for type testing. Designs manufactured in batches of less than 100 for a rolling 3-year period are exempt from routine ultimate load testing.

Acceptance of batches based on testing shall be in accordance with Clause A4 of AS/NZS 4058. All non-conforming load tests shall be reported through the *Supplier Registration Scheme* within 5 business days.

Pipes used for proof load testing are acceptable for delivery, provided that after testing the pipes comply with all requirements of this Technical Specification.

Water absorption testing shall be conducted in accordance with AS/NZS 4058, with the following additional stipulations:

- a) all masses, and changes in mass, to be measured and recorded to the nearest 0.1 g
- b) specimens to be dried until the change in mass is the lessor of 0.1% or 0.1 g
- c) water to be maintained at a vigorous (rolling) boil for 5 h \pm 10 min
- d) top-up water to be pre-boiled and at temperature when added, and
- e) if net water absorption is calculated, then both water absorption and net absorption to be reported.

Pipes used for sampling for water absorption may be accepted, provided the core hole has been satisfactorily repaired with a registered cementitious repair mortar.

Testing to Appendix E of AS 4198 *Precast concrete access and maintenance chambers for sewerage applications* is permitted and is deemed to satisfy the additional stipulations. The additions are intended to produce more consistent results between laboratories.

For non-standard pipes manufactured to order for a specific project, pipe testing shall be a **Witness Point 1**.

8 Handling and storage

Pipes shall be handled and stored in accordance with AS/NZS 4058.

9 Product marking

Pipes manufactured to meet requirements for aggressive environments (Clause 8.3) shall be suitably marked to denote this. The method of marking shall be communicated to the Administrator.

This allows for the particular technique used to mitigate aggressive environments to be identified on the pipe.

10 Information to be supplied prior to delivery

The following information shall be provided to the Administrator 3 weeks before any pipes are delivered to site: **Milestone**

- a) drawings or tabulations showing complete dimensions (including applicable tolerances) of:
 - i. pipes
 - ii. joint profiles
 - iii. joint seal dimension and specification, and
 - iv. maximum permissible joint deflection angle for elastomeric seal jointed pipes.
- b) the calculated mass of the pipe
- c) the place of manufacture
- d) method of manufacture and testing

These requirements match those in AS/NZS 4058 Clause 6.3

- e) methodology for addressing aggressive environments (including pipe marking)
- f) supplier registration certificate, and
- g) mix design approval certificate

Pipes shall not be delivered until the above have been received and approved by the Administrator. **Hold Point 2**

11 Inspection and delivery

Steel-reinforced precast concrete pipes shall remain available for inspection at the place of manufacture, or on site, for a combined minimum of 7 days from identification of the specific pipes intended for installation. **Witness Point 2**

Steel-reinforced precast concrete pipes shall not be transported from the place of manufacture until all testing has been completed, or, in the case of water absorption testing, until samples have been taken, and any necessary pipes repairs have been carried out.

Each delivery of pipes shall be accompanied by a statement of conformity to this Technical Specification from the supplier (refer also to Clause 6.2 of AS/NZS 4058).

Early transport of pipes can lead to adverse effects on durability, serviceability, pipe profile, and surface finish.

