Technical Specification

Transport and Main Roads Specifications
MRTS25 Steel Reinforced Precast Concrete Pipes

September 2014

Feedback: Please send your feedback regarding this document to: mr.techdocs@tmr.qld.gov.au

Contents

1 Introduction

This technical specification applies to the design, supply and manufacture of steel-reinforced precast concrete circular pipes by spinning, roller suspension, or vertical dry cast (Bi-directional roller compacted, Packerhead or Rising Core) manufacturing processes used for the conveyance of stormwater in applications where the pipe is not subject to internal pressure.

Concrete pipes manufactured using wet cast methods shall be manufactured in accordance with MRTS72 *Manufacture of Precast Concrete Elements* and with concrete and reinforcement cover as defined by that specification.

Wet cast methods are typically used for manufacture of large pipes, or special pipes where mechanised methods are not suitable.

Installation of pipes is to be in accordance with MRTS03 *Drainage, Retaining Structures and Protective Treatments*, by either trench or embankment conditions as defined by AS 3725, or by jacking to a maximum length of 100 m.

Where longer or more accurate installations are required, it is recommended specialist advice be obtained.

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 Administrative requirements

Steel-reinforced precast concrete pipes shall be manufactured only by a Transport and Main Roads (TMR) registered supplier.

To be eligible for registration as a registered supplier for the manufacture of steel reinforced concrete pipes, a manufacturer shall:

a) Operate a Quality Management System certified to a minimum of AS/NZS ISO 9001. Certification shall be by a JAS/ANZ accredited certifier.

b) Have established procedures for manufacture of steel reinforced concrete pipes, and

c) Have an inspection and test plan including Hold Points acceptable to the department for manufacturing steel reinforced concrete pipes which demonstrates compliance with this specification. The inspection and test plan shall address supply of materials.

Registration as a registered supplier of steel reinforced concrete pipes shall be reviewed at intervals varying from six months to three years depending on registration level, or earlier if unsatisfactory performance is reported.

A copy of the registered suppliers list for precast concrete is available on the Transport and Main Roads internet. This list includes suppliers registered to manufacture pipes.

2.1 Registration status

Information regarding approved suppliers and products, and registration status can be obtained from the TMR website, www.tmr.qld.gov.au.

The requirements for registration are outlined in the document SMP-PC01 - *Procedures Manual: Registration of Approved Suppliers of Precast Concrete Products*. For a copy of this document refer to:

Queensland Department of Transport and Main Roads
Bridge Construction, Maintenance and Asset Management
GPO Box 1412
Brisbane Qld 4001

3 Referenced documents

Table 3 lists documents referenced in this technical specification.

Table 3 – Referenced documents

Reference	Title
AS 1379 (2007)	Supply and specification of concrete
AS 1726 (1993)	Geotechnical Site Investigations
AS/NZS 3725 (2007)	Design for installation of buried concrete pipes
AS/NZS 4058 (2007)	Precast concrete pipes (pressure and non pressure)
AS/NZS 4671 (2001)	Steel reinforcing materials
AS 5100 Set (2007)	Bridge design standard
SMP-PC01	Procedures Manual: Registration of Approved Suppliers of Precast Concrete Products

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 specification are summarised in Table 4.1.

Table 4.1 – Hold Points, Witness Points, and Milestones

Clause	Hold Point	Witness Point	Milestone
5.2	Approval of alternative design diameter.		Submission of drawings or tabulations for alternative design diameter.
5.3.3.1	Approval of alternative treatments for pipes in aggressive environments.		
6.1.1	Approval of constituent concrete materials and blend of cementitious materials.		Submission of constituent concrete materials and blend of cementitious materials.

Clause	Hold Point	Witness Point	Milestone
7		Pipe Testing for non standard pipes manufactured to order for a specific project	
8.2	Supply of information prior to delivery of pipes to site.		Supply of Information
8.3	Supply of monthly conformance reports.		
9		Inspection of manufactured pipes	

5 Design

Design of steel-reinforced precast concrete pipes shall comply with the requirements of this specification and AS/NZS 4058 with the hierarchy of documents as listed in this clause.

5.1 Design life

The design life of precast concrete pipes shall be 100 years. The design life means that 95% of the production of all pipes supplied shall remain in a serviceable condition with negligible maintenance for 100 years.

5.2 Design internal diameter

The design internal diameter as defined in AS/NZS 4058 shall not be less than 95% of the nominal internal diameter specified on the drawings for all classes of pipes. 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**.

The design internal diameter is critical for the hydraulic performance of the pipe. Consideration of alternative smaller design internal diameters for pipes shall take into consideration the reduction in hydraulic performance. Depending on the method of manufacture the external diameter of the pipe may also vary from standard designs. In this case compatibility with other elements such as pits and headwalls may need to be considered. In addition compatibility with existing installed pipes may also need to be considered.

5.3 Environments

5.3.1 General

Environments for pipes supplied in accordance with this specification shall be as defined in Clauses 5.3.1 to 5.3.3. The following definitions are also applicable:

a) freshwater – chloride content less than 2000 ppm

b) brackish water – 2000 to 8000 ppm

c) saltwater – 8000 ppm or higher and or seawater.

Environments rather than exposure classifications are defined to be consistent with AS/NZS 4058. Due to the lack of detail in the normative definitions of environments in AS/NZS 4058 further detail has been provided. Where possible and technically acceptable some guidance has been drawn from the informative sections of AS/NZS 4058.

5.3.2 Normal environment

For pipes installed in underground or above ground environments and consistent with all of the following:

a) non aggressive soil conditions

b) aggressive soil conditions nominated as Normal in Clause 5.4

c) no saltwater, no salt spray or no tidal conditions present

d) internal or external surface of pipe exposed to fresh or brackish water only.

5.3.3 Marine environment

For pipes installed in underground or above ground environments consistent with any of the following:

a) aggressive soil conditions nominated as Marine in Clause 5.4

b) for pipes installed in underground environments with the external pipe surface only exposed to fluctuating on non fluctuating levels of saltwater present in the ground

c) internal surface of pipe, or external surface if above ground, exposed to occasional (maximum of twenty times per year) tidal or non tidal salt water flow.

5.3.4 Aggressive environments

For pipes installed in environments consistent with any of the following:

a) underground in aggressive soil conditions nominated as Aggressive in Clause 5.4

b) underground environments where the internal pipe surface is exposed to wave action, wind driven salt spray or regular tidal or non tidal saltwater flow

c) above ground environments where the pipe is exposed to wave action, wind driven salt spray or exposed to regular tidal or non tidal saltwater flow.

5.3.5 Alternative requirement for aggressive environments

Further to the requirements of Table 5.5, minimum cover to reinforcement for Aggressive environments may be the same as for Marine environments if one of the following options is adopted as approved by TMR (Director Bridge Construction Maintenance and Asset Management) **Hold Point**. These options are as follows:

a) protective coating, or

b) keyed in internal and external liner, or

c) pipe concrete with a cementitious material blend in accordance with Clause 6.1(b)(ii) or 6.1(b)(iii), or

d) Where external protection only is required, the pipe is sleeved through an inert pipe material and the gap between the pipe and sleeve is grouted or sealed.

Some manufactures may not be able to meet the additional cover requirements specified for Aggressive Environments. Therefore the following options have been made available for consideration. Approval of these options is the responsibility of the Director - Bridge Construction Maintenance and Asset Management and approval shall be project specific with correspondence through the Administrator:

a) Protective coatings – consideration shall be given to the design life of the coating and its ability to provide, in combination with the existing concrete and cover to reinforcement, a pipe with the ability to provide a 100 year design life in accordance with this specification. For PASS/ASS soil applications the coating would need to be acid resistant.

b) 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 shall also be considered.

c) Higher specification pipe concrete. In most cases this will be the preferred option by TMR 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.

d) 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.

5.4 Aggressive soil conditions

For potential acid sulphate soils (PASS) or acid sulphate soil (ASS) environments, Normal, Marine, and Aggressive are as listed in Table 5.4.

Table 5.4 –Environments for Steel Reinforced Concrete Pipes in PASS/ASS Ground Conditions.

Acidity (pH)	Soil Classification	SO_4 in Groundwater (mg/l or ppm)			
		≤ 1500	> 1500 to ≤ 3000	> 3000 to ≤ 6000	> 6000
> 5.5	All Soil Types	Normal	Normal	Normal	Aggressive
≤ 5.5 to > 5.0	Clay/Stagnant and Medium	Normal	Normal	Normal	Aggressive
	Sandy/Flowing	Marine	Marine	Marine	Aggressive
≤ 5.0 to > 4.5	Clay/Stagnant	Normal	Normal	Normal	Aggressive
	Medium and Sandy / Flowing	Marine	Marine	Marine	Aggressive
≤ 4.5 to > 3.5	Clay/Stagnant and Medium	Marine	Marine	Marine	Aggressive
	Sandy/Flowing	Aggressive	Aggressive	Aggressive	Aggressive

Acidity (pH)	Soil Classification	SO_4 in Groundwater (mg/l or ppm)			
		≤ 1500	> 1500 to ≤ 3000	> 3000 to ≤ 6000	> 6000
≤ 3.5	All soil Types	Aggressive	Aggressive	Aggressive	Aggressive

Soil Type Definitions are as follows

1. Clay/Stagnant = practically impervious for example homogeneous clays.
2. Medium – Poorly draining soils for example fine sands, organic and inorganic silt, mixtures of silt, sand and clay, glacial till, and stratified clay.
3. Sandy/Flowing – Well drained soils such as clean gravel, sands, and mixtures of sand and gravels.

In relation to soi types, further guidance may be found in AS/NZS4058 or AS1726 if required.

5.5 Cover to reinforcement

Concrete cover to reinforcement shall be as per Table 5.5. Cover to reinforcement on the external surface of jacking pipes shall be increased by a further 5 mm.

The minimum cover to reinforcement for all pipes with a design internal diameter greater than 1.8 m shall be as per Table 5.5 for marine environment.

Precast concrete pipes manufactured using wet cast processes shall have cover to reinforcement as defined by MRTS72.

Table 5.5 – Concrete cover to steel reinforcement

Pipe Size	Pipes up to including 1.8 m design internal diameter		Pipes over and above 1.8 m design internal diameter	
Environment (AS/NZS 4058)	Minimum Cover to Reinforcement Barrel and Socket (mm)	Minimum Cover to Reinforcement Mating Surface of Spigot (mm)	Minimum Cover to Reinforcement Barrel and Socket (mm)	Minimum Cover to Reinforcement Mating Surface of Spigot (mm)
Normal [1]	10	6	Not applicable	Not applicable
Marine [2]	20	10	20	10
Aggressive [3]	30	20	30	20

Notes

1. Cover is as per AS/NZS 4058. Note that this cover and environment can only be used for pipes with an internal design diameter of 1.8 m or less.
2. Cover is as per AS/NZS 4058.
3. Also refer Clause 5.3.5 of this specification.

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.

For pipe manufacturing processes where a surface finish in accordance with AS/NZS 4058 cannot be routinely achieved, consideration should be given to increasing the cover to account for the lack of acceptable surface finish.

For pipes of an internal design diameter greater than 1.8 m, Transport and Main Roads has specified a minimum cover for pipes as defined by Marine environment to ensure the most economical whole of life cost for these pipe sizes.

5.6 Pipe joints

Pipe joints shall be as specified in the following clauses.

Figure 1.1 of AS/NZS 4058 includes diagrams and details of pipe joint types.

5.6.1 Pipes 800 mm diameter or less

All joints are to be spigot and socket with rubber ring joints.

Spigot and socket joints are required for pipes of 800mm or less as this joint type has significantly higher joint shear capacity in these pipe sizes and are significantly more resistant to leakage at the joints.

5.6.2 Pipes greater than 800 mm diameter

Where water seal is essential including under all road pavements, and/or where some ground movement is expected, spigot and socket pipes with rubber ring joints must be used. Otherwise where ground conditions are stable and infiltration or exfiltration is insignificant, flush joint pipes with appropriate sealing bands may be used.

5.6.3 Jacking pipes

All joints to be flush joint with a fixed external galvanised steel collar or locating band and rubber sealing ring. The pipe joint or joint components must not extend radially past the main barrel of the pipe.

5.7 Design for installation

Steel-reinforced concrete pipes shall be designed for installation in accordance with AS/NZS 3725 with the following exceptions.

Clause 6.5 of AS/NZS 3725 shall be deleted and replaced by:

a) the effects of superimposed live loads shall be calculated in accordance with AS 5100

b) distribution of live loads shall be in accordance with AS 5100

c) dynamic load allowance shall be as follows:

   i. a value of 0.4 for zero fill height

   ii. a value of 0.1 for fill heights of 2 m or higher

   iii. a linear interpolation between 0.4 and 0.1 for depths between zero and 2 m respectively.

Superimposed live loads shall be considered as detailed in Clause 5.7.1 and 5.7.2 of this specification. These loads apply to both construction and service loads.

The effects of superimposed live loads are specified to be calculated in accordance with AS 5100 to be consistent with the design of all Transport and Main Roads infrastructure.

5.7.1 Construction loads

The following mandatory minimum construction load cases shall be considered in addition to loads associated with compaction of fill.

a) Truck and dog trailer with a minimum height of compacted fill of 0.5 m over the top of the pipe. Load is defined in Figure 5.7.1(a)

b) 25.9 tonne excavator and 580 mm compaction wheel acting separately with a minimum height of compacted fill of 1.0 m over the top of the pipe. Load is defined in Figure 5.7.1(b).

Where additional load cases, other than those listed above, are required, as part of the construction sequence, these cases shall be designed and listed in Annexure MRTS25.1.

If the actual construction sequence results in lower fill heights, and or heavier equipment than those specified, then the pipe installation shall be redesigned with a higher load class of pipe, or different installation conditions.

Figure 5.7.1(a) – Design load truck and dog trailer

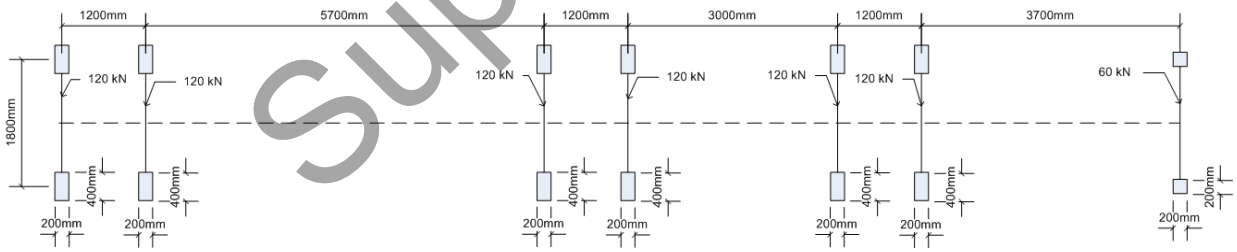
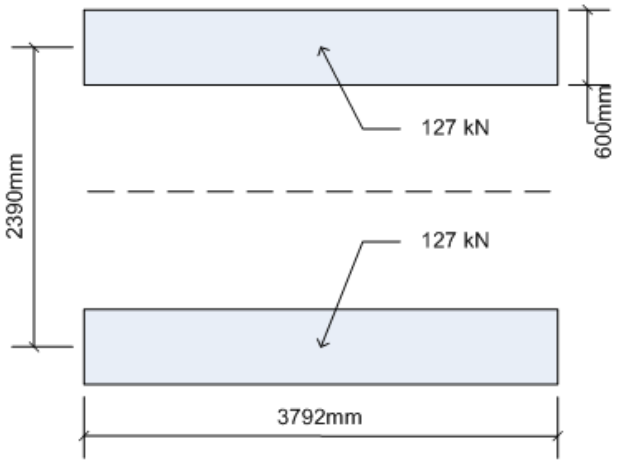
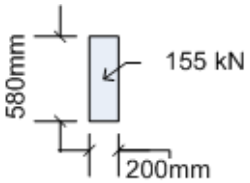


Figure 5.7.1(b) – Design load 25.9 t excavator and 580 mm wide compaction wheel



25.9 tonne excavator



Compaction Wheel

Design of the pipe and installation for construction load cases is critical, including consideration of loading during placement and compaction of fill around the pipe.

In addition to loads associated with compaction of fill around the pipe, this specification nominates two construction load cases which must be considered by designers.

To aid the designer and contractor Figure B-1 shows the relationship between fill height and pipe load class for the truck and dog trailer (T54) construction load case for the following conditions:

a) the embankment installation condition with positive projection

b) soil type wet clay

c) support types H1, H2/HS1 and HS2.

The installation conditions and support types are as defined in AS/NZS 3725. Load cases and or installation conditions that are not covered by this information must be considered separately by the designer or contractor. Typically the embankment installation condition with positive projection is the installation condition which provides the highest load on the pipe.

Likewise as a design and construction aid only, Figure B-2 shows the relationship between fill height and pipe load class for the same installation conditions for the 25.9 tonne excavator and 580 mm wide compaction wheel acting separately. Again load cases that are not covered by this information must be considered separately by the designer.

It is critical for both the designer and the construction team to note that if load cases outside of these two minimum specified load cases are required during the construction sequence, then these cases must be considered separately and the pipe load class and or installation conditions modified to suit. Details of these alternative cases are typically listed in Annexure MRTS25.1

5.7.2 Road vehicle loads

W80, A160, SM1600 and HLP400 as defined in AS 5100 for the completed fill height.

Maximum live load pressures due to the design road vehicle load distributed in accordance with AS 5100 are as listed in Table 5.7.2.

Table 5.7.2 - Live load pressure for AS 5100 Road Vehicle Loads

Depth (m)	Wheel Load Pressure (kPa)	Depth (m)	Wheel Load Pressure (kPa)
0.40	246	2.80	19
0.60	129	3.00	18
0.80	78	3.20	17
1.00	52	3.40	17
1.20	37	3.60	16
1.40	27	3.80	16
1.60	24	4.00	15
1.80	23	4.20	15
2.00	22	4.40	14
2.20	21	4.60	14
2.40	20	4.80	13
2.60	19	5.00	13

5.7.3 Jacking pipes

In addition to the requirement of this specification and AS/NZS 3725, jacking pipes shall be designed to resist the jacking forces generated during the installation process using an appropriate and accepted engineering method.

6 Materials

6.1 Concrete

Concrete used for the manufacture of steel-reinforced concrete in accordance with this specification shall comply with AS/NZS 4058 with the following additional requirements:

a) All cementitious and supplementary cementitious materials, aggregates, chemical admixtures, and water, shall comply with MRTS70.

b) Cementitious material shall be a blend compliant with any of the following criteria with the combined total adding to 100%. Tolerances on blend percentage shall be calculated in accordance with AS 1379 Table 4.1 assuming a batch size of 2 to 4 m^3 regardless of actual batch quantity. However under no circumstances shall the amount of Fly Ash on any individual batch be less than 20%. Type HE cement which also meets the requirements of Type GP cement may be substituted for Type GP Cement in any of the blends.

   i. 65% to 75% GP Cement, 25% to 35% Fly Ash.

ii. 50% to 55% GP Cement, 20% to 25% Ground Granulated Blast Furnace Slag, and 25% to 30% Fly Ash.

iii. 65% to 71% GP Cement, 4% to 8% Amorphous Silica, and 25% to 31% Fly Ash.

In relation to blend tolerances in Clause 6.1(b) it should be noted that the specified tolerances on blend percentage generally ensure that the minimum Fly Ash percentage is never less than around 21 to 23%.

6.1.1 Submission of information

The manufacturer shall submit the source and type of all constituent concrete materials, and the proposed blend of cementitious materials for approval in the template format included in Appendix A of this specification to the Director – Bridge Construction, Maintenance and Asset Management or nominated delegate (Refer Clause 0). Upon acceptance of the mix an approval certificate will be issued.

This approval certificate shall be submitted to the Administrator two weeks before any pipes are delivered to site. **Milestone** No pipes shall be delivered to site before the constituent concrete materials and blend of cementitious materials are approved. **Hold Point**.

6.1.2 Batch recording and records

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 plant by the Administrator.

Added water is the water added to the mix not including the water contained within the aggregate above the saturated surface dry condition of the aggregate

6.2 Reinforcement

Reinforcement used in the manufacture of steel-reinforced precast concrete pipes in accordance with this specification, shall comply with the requirements of AS/NZS 4058 with the following additions:

a) Reinforcement shall be sourced from a Transport and Main Roads registered supplier in accordance with MRTS71 *Reinforcing Steel* and shall comply with the mechanical and physical properties specified in AS/NZS 4671.

b) Welding of reinforcement by either:

   i. Electrical resistance welding by automated or semi-automated processes. These processes shall not substantially reduce the cross section of the reinforcement nor adversely affect the strength of the reinforcement, or

   ii. Manual welding of reinforcement complying with the requirements of MRTS71.

Compliance with MRTS71 for Clause 6.2(b)(ii) to be demonstrated by use of appropriately qualified staff, compliant weld procedures and satisfactory quality of welds. Weld quality to conform to MRTS71.

c) Processing of reinforcement using off coil machines for longitudinal pipe reinforcement shall comply with MRTS71 Reinforcing Steel. Compliance shall be demonstrated by yearly testing of mechanical and geometric properties of the reinforcement post straightening.

6.3 Nibs and spacers

Nibs and spacers used to maintain cover to reinforcement during manufacture shall be one of the following:

a) Normal and Marine Environments – Steel Nibs or Stainless Steel Nibs

b) Aggressive Environments – Stainless Steel Nibs.

Steel nibs shall be manufactured from material compliant with AS/NZS 4671, stainless steel nibs shall be manufactured from a Grade of Stainless steel listed in MRTS71A *Stainless Steel Reinforcing*. Plastic nibs or spacers shall not be used.

7 Manufacture

Concrete pipes shall be manufactured in accordance with this specification, and AS/NZS 4058 with the following amendments:

a) Specified cover requirements are not applicable to steel nibs or stainless steel nibs used to maintain cover to circumferential reinforcement, or the ends of longitudinal reinforcement.

b) Curing of concrete pipes shall be conducted by either wet or steam curing to ensure that all specified performance and durability requirements of this specification and AS/NZS 4058 are met. If steam curing is used, the rate of temperature rise shall be managed to ensure that no damage or cracking occurs in the pipe, and the maximum enclosure temperature shall not exceed 70^{o}C. The manufacturer shall control and monitor the curing process (wet or steam) to ensure conformance with these requirements and to ensure a consistent controlled process to meet the durability requirements of this specification and AS/NZS 4058. Temperature monitoring shall be conducted at least daily in each curing facility. Monitoring equipment shall be calibrated and shall record temperatures at no less than 15 minute intervals for the curing period.

c) Table 3.6 of AS/NZS 4058 shall be amended such that defect Types 3, 6 and 7 are not acceptable as detailed in Table 7-A. All repairs shall be undertaken with an approved cementitious grout or repair mortar.

d) Clause 5.2.3 of AS/NZS 4058 shall be amended to more specifically define the frequency of testing as shown in Table 7-B. All tests, with the exception of water absorption, shall be conducted per pipe size and class for each factory at the specified frequencies (Table 7-B), or at the specified intervals whichever gives the most test results. Water absorption shall be completed as specified (Table 7-B) and when there is a change of concrete mix design or concrete materials (Clause 6.1(a)), for each factory. For non standard pipes manufactured to order for a specific project, pipe testing shall be a **Witness Point**.

Table 7-A – Acceptability of Pipe Wall and Joint Surface Defects

ACCEPTABILITY OF PIPE WALL AND JOINT SURFACE DEFECTS			
Acceptability and conditions			
Defect type (AS/NZS 4058)	**Pipe Wall**	**Joint Surface**	
	Drainage Pipes	**Drainage Pipes Flush joints**	**Drainage Pipes Rubber Ring Joints**
1	Acceptable	Not applicable	Not applicable
2	Acceptable after repair if load test passed.	Not applicable	Not applicable
3	Not acceptable	Not acceptable	Not acceptable
4	Acceptable	Acceptable	Acceptable
5	Acceptable after repair	Acceptable	Acceptable after repair
6	Not acceptable	Not acceptable	Not acceptable
7	Not acceptable	Not acceptable	Not acceptable

Table 7-B – Test requirements

SUMMARY OF TEST REQUIREMENTS				
Test Name	**Appendix / Reference Clause (AS/NZS 4058)**	**Pipe Application/Test Purpose**		
		Drainage		
		Type testing	**Routine testing / Frequency of Testing per pipe size and class**	**Relaxed Routine Frequency of Testing per pipe size and class[10]**
Proof load [7]	Appendix C	Required [1]	Monthly or 1 per 50 pipes [4,5,9]	Bi Monthly or 1 per 100 pipes [4,5,9]
Ultimate load	Appendix C	Required [1]	Quarterly	Six Monthly
Hydrostatic pressure – (only for rubber–ring jointed pipes)	Appendix D	Not Applicable [3]	Not Applicable	Not Applicable
Water tightness (90 kPa)	Appendix D	Not Applicable [3]	Not Applicable	Not Applicable
Specified pressure (≥ 50 kPa)	Appendix D	Not Applicable [3]	Not Applicable	Not Applicable
Ultimate pressure	Appendix D	Not Applicable [3]	Not Applicable	Not Applicable
Water absorption [8]	Appendix F	Required [1]	Test per mix design at monthly intervals.	Test per mix design at monthly intervals.
Cover– (only for reinforced pipes)	Appendix G	Required [1]	Monthly or 1 per 100 pipes [4,9]	Bi Monthly or 1 per 200 pipes [4,9]

SUMMARY OF TEST REQUIREMENTS				
Test Name	**Appendix / Reference Clause (AS/NZS 4058)**	**Pipe Application/Test Purpose**		
		Drainage		
		Type testing	**Routine testing / Frequency of Testing per pipe size and class**	**Relaxed Routine Frequency of Testing per pipe size and class[10]**
Dimensional accuracy [6]	Clauses 3.3 and Appendix A 4.7	Required [1]	Monthly or 1 per 100 pipes [4,9]	Bi Monthly or 1 per 200 pipes [4,9]
Joint assembly test – (Only for rubber ring jointed pipes)	Appendix H	Only if specified [2]	Frequency to be specified.	Frequency to be specified.

Notes:

1. Required test is to be carried out whether specified or not.
2. Only if Specified test is carried out only if specified by the Purchaser as a required test.
3. Not Applicable test is not applicable and not required.
4. Which ever gives the most tests dependant on production volume. Testing to be conducted per pipe size and class.
5. Subject to the approval of the administrator, where delivery and or installation of pipes is required before 7 days, the requirement for ultimate load testing may be waived subject to proof load testing being conducted at a frequency of no less than 1 in 20 pipes before delivery.
6. Additional requirements may be relevant for jacking pipe applications.
7. Pipes used for proof load testing, may be accepted, subject to approval by the Administrator, provided that after testing the pipes comply with all requirements of this specification.
8. Pipes used for sampling for water absorption may be accepted subject to approval by the Administrator provided the core hole has been satisfactorily repaired with an approved cementitious repair mortar. Note that results for water absorption testing may not be available at the time of installation. Previous results for the same mix designs can be accepted provided there is a demonstrated history of compliance and there has been no change to materials or mix designs.
9. Where pipe production exceeds 200 pipes per month per pipe size and class, frequency of testing may be decreased to 1 per 100 pipes for proof load, and 1 per 200 pipes for cover to reinforcement, and dimensional accuracy.
10. In addition where a factory has demonstrated 6 continuous months of compliant results then the testing frequencies specified can move to the relaxed routine frequencies. A non compliance would result in a return to the routine testing rate. Bi-Monthly is once every 2 months.

7.1 Additional requirements

The proof load and ultimate load for Class 2 to Class 10 pipes (inclusive) shall be in accordance with AS/NZS 4058. For pipes with higher load classes than defined by AS/NZS 4058 check availability and appropriateness with the manufacturer and designer.

Dimensional tolerances for wet cast pipes shall be in accordance with this specification.

Additional dimensional accuracy requirements may be specified for Jacking Pipe applications.

8 Information to be supplied at delivery

8.1 General

Information shall provide to the Administrator as specified in Clauses 8.2 and 8.3, obtained from the precast concrete pipe manufacturer, in accordance with the times specified.

8.2 Prior to delivery of pipes to the site

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

a) drawings or tablulations showing pipe dimensions and tolerances,

b) type of joint.

No pipes shall be delivered to the site until written acceptance has been obtained from the Administrator. **Hold Point**

8.3 With the delivery of each batch of pipes

With each batch of pipes delivered to the site a delivery docket shall be supplied that provides traceability to a conformance report for the batch. The delivery docket shall also state that the pipes supplied conform to the requirements of AS/NZS 4058 and this specification.

At no less than monthly intervals, the Contractor shall provide a conformance report, issued by the precast concrete pipe manufacturer, confirming that the pipes supplied conform to the requirements of AS/NZS 4058 and this specification. This conformance report will include relevant test results as specified in Table 7-B for each batch of pipes. Final acceptance of pipes shall be subject to receipt and acceptance of this report by the Administrator. **Hold Point**

9 Inspection and delivery

Steel-reinforced precast concrete pipes shall remain available for inspection at the place of manufacture for a minimum of 7 days from the date of manufacture or be inspected on site prior to installation. **Witness Point**

It is generally expected that the most practical method will be for the administrator to inspect the pipes on site prior to installation.

Steel-reinforced precast concrete pipes shall not be transported from the place of manufacture until all testing has been completed, and until the pipes are of an age where the durability, serviceability, pipe profile, and surface finish is not adversely affected in any way.

With respect to water absorption, the test may not have been completed but the sample must have been taken if required before delivery.

10 Product marking

Pipes shall be marked in accordance with AS/NZS 4058 with the addition that pipes manufactured for Aggressive environments in accordance with this specification will be labelled “Aggressive” or “30/30” as appropriate.

Where aggressive environment pipes have 30mm cover to the reinforcement inside and outside, label 30/30 should be used. Where the pipe is manufactured from a triple blend concrete, or uses a protective coating or keyed in liner (Refer Clause 5.3.5) then the lable “aggressive” should be used.

11 Installation

Pipes shall be installed as specified in MRTS03 *Drainage, Retaining Structures and Protective Treatments*. Pipes shall not be installed until seven days has elapsed since the date of manufacture, and all test results have been provided and are conforming in accordance with Table 7-B for the batch of pipes manufactured.

Where circumstances require installation before seven days, modifications to pipe testing are required in accordance with Note 5 of Table 7-B.

The maximum angle of deflection of joints for pipes is two degrees.

Pipes shall be installed in accordance with MRTS03, the nominated loading and installation conditions in Clause 5.7 of this specification and as detailed in Annexure MRTS25.1.

Appendix A – Example mix design submission template

Unique Mix Code Identifier/ Date/Version			
Material	**Type[1]**	**Source[2]**	**Requirement/Comment**
Cementitious Material			
Cement			Manufacturer to certify that total Cementitious content to be not less than 330 kg/m³ and blend percentages in accordance with MRTS25 and state the blend and blend percentages.
Fly Ash			
GGBFS (Slag)[4]			
Amorphous Silica[4]			
Aggregates			
Coarse 1			As per MRTS70
Coarse 2			As per MRTS70
Fine 1			As per MRTS70
Fine 2			As per MRTS70
Water			
Water	n/a		As per MRTS70
Water/Total Cementitious Ratio	n/a	n/a	Manufacturer to certify that water to total cementitious ratio is less than or equal to 0.4.
Admixtures			
Admixture 1			All admixtures are to be TMR approved in accordance with MRTS70. Manufacturer to certify maximum listed dose rates are not exceeded.
Admixture 2			

1. Manufacturer must nominate the type and size (where appropriate) of the material.
2. All materials are to be Transport and Main Roads approved. Source information to include supplier, type and ATIC registration number for cementitious materials. For Aggregates please include Transport and Main Roads Quarry Certificate number in source description. Admixture source to include manufacturer and manufacturer's brand name for admixture.
3. Manufacturer must nominate that the actual quantity complies with the specified requirement where appropriate.
4. In most applications these components are not mandatory.

Appendix B – Design guide for construction loads

Figure B-1 Fill height and Pipe Load Class for various installation conditions for Truck and Dog Trailer

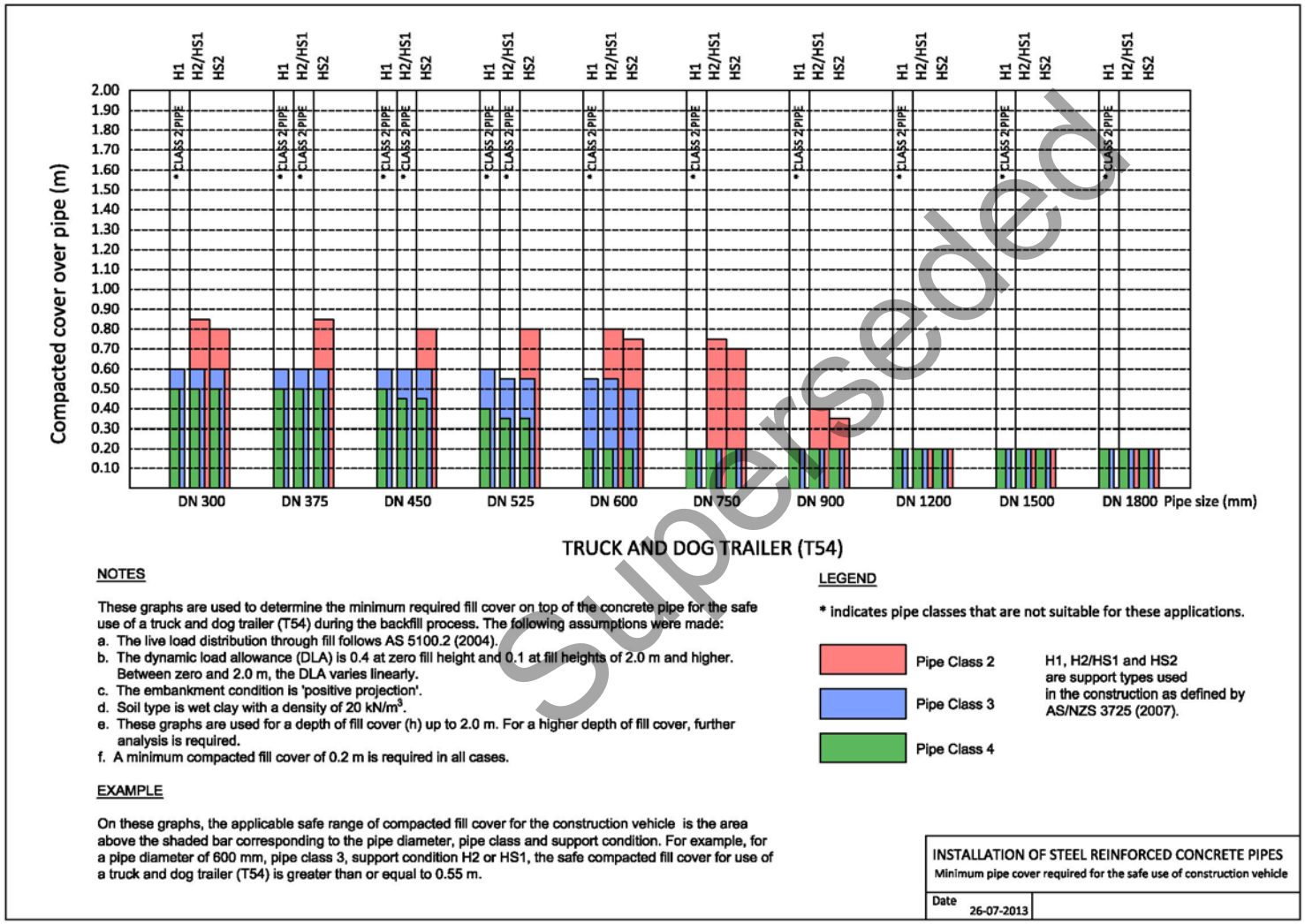


Figure B-2 Fill height and Pipe Load Class for various installation conditions for 25.9 tonne excavator and 580 mm wide compaction wheel