

## Manufacturing Precast Concrete Jacking Pipe



Concrete Pipe Association  
of Australasia

# 1. Introduction

The CPAA Engineering Guideline “Manufacturing Precast Concrete Jacking Pipe” provides manufacturers, designers, and installers with a document that outlines the specific criteria required to produce concrete jacking pipe. It is appropriate for use in trenchless applications in Australia and New Zealand.

In Australia and New Zealand steel reinforced concrete pipe shall be manufactured and selected in accordance to AS/NZS 4058 – 2007 “Precast concrete pipe (pressure and non-pressure). However, AS/NZS 4058 does not provide enough detail on the appropriate specific requirements needed to manufacture concrete jacking pipe for Australian and New Zealand conditions. This document is designed to be used in conjunction with 4058 to produce quality jacking pipe for Australian and New Zealand conditions.

## NOTES:

1. This document does not cover the assessment of external loads to which the concrete jacking pipe will be subjected to during or after installation.
2. AS/NZS 3725 – 2007 “Design for installation of buried concrete pipes” provides the basis for the calculation of the vertical loads on the buried concrete jacking pipe.
3. The CPAA Design Manual “Designing Concrete Jacking Pipe” provides the basis for the determination of allowable jacking loads for concrete jacking pipe manufactured in accordance with this document.

# 2. Guidelines – Concrete Jacking Pipe

## 2.1 Referenced Documents

The following documents are referred to in this Engineering Guideline:

### AS/NZS

3725:2007 Design for installation of buried concrete pipes  
4058:2007 Precast concrete pipe (pressure and non-pressure)

### CPAA

Design Manual                      Designing Concrete Jacking Pipe  
Engineering Guideline          Field Testing of Concrete Pipes

## 2.2 Definitions

The definitions provided in Clause 1.3 of AS/NZS 4058, along with the following, apply to this document:

**Jacking pipe** – A pipe specifically manufactured for trenchless methods of installation that involve jacking techniques.

**Joint packer** – A cushion placed between joints to redistribute axial forces applied and prevents stress concentration when jacking pipes. This is usually made of plywood, MDF or a suitable compressible material.

**Pipe jacking** – A method of installing pipelines without disrupting existing surface facilities or activities using trenchless technology.

## NOTE:

Refer to CPAA Design Manual “Designing Concrete Jacking Pipe” for recommended material properties.

## 2.3 Classification

Concrete jacking pipes shall be classified according to size and class in accordance with Table 4.2 of AS/NZS 4058. The corresponding test loads (proof and ultimate) will apply.

## NOTES:

1. Concrete jacking pipe is not limited to the sizes and classes outlined in AS/NZS 4058. Other sizes and classes can be manufactured in consultation with the designer and the manufacturer for specific project requirements.
2. Check with the manufacturer for actual design diameters before finalising hydraulic design. Design diameters will vary for different classes and requirements.
3. For definition of design, external, internal and nominal diameters refer to Clause 1.3.2.4 of AS/NZS 4058.
4. Check with the manufacturer for allowable jacking loads on specific pipe sizes and classes.

## 2.4 Markings

Each concrete jacking pipe shall be marked in accordance with Clause 1.5.1 of AS/NZS 4058, with the following addition:

For concrete pipes manufactured for jacking they will be identified specifically by the manufacturer e.g. JP

## 2.5 Joint Selection

Concrete jacking pipe shall be manufactured with joints that are capable of –

- (a) maintaining adequate watertightness or pressure in accordance to its design and the limitations as outlined in AS/NZS 4058 and this guideline; and
- (b) transferring the expected axial loads in the jacking process

Generic joint types that can be used for concrete jacking pipe are detailed in Figure 2.1. For specific joint types for concrete jacking pipe refer to the manufacturer for detail.

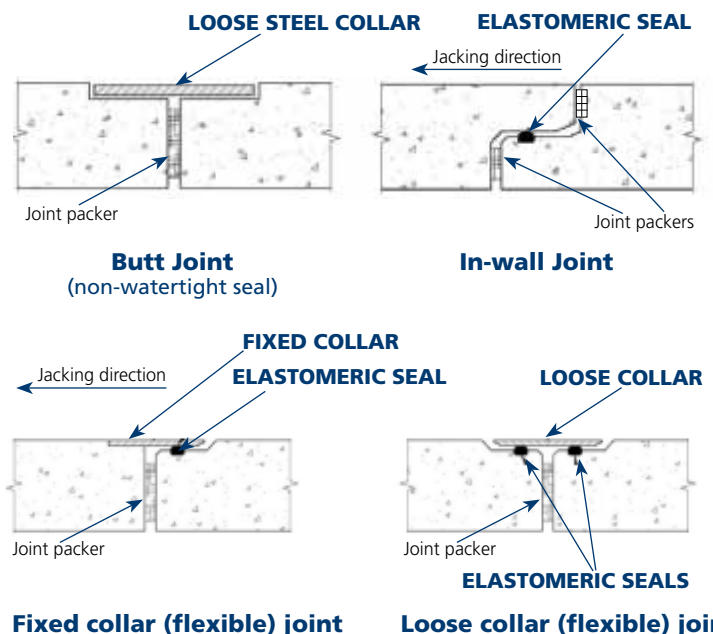


Figure 2.1 Generic concrete jacking pipe joint types

## NOTE:

Joints depicted are schematic only and not intended to restrict development of different joint designs and material properties. For specific details regarding joints refer to the manufacturer.

## 2.6 Manufacture

The manufacture of concrete jacking pipes (machine made horizontal cast, machine made vertical cast, and vertical wet cast) shall be in accordance with Section 3 of AS/NZS 4058 along with the following additions.

### 2.6.1 Manufacture

Joint design and the corresponding allowable jacking loads for concrete jacking pipe manufactured in accordance with this document is outlined in the CPAA Design Manual "Designing Concrete Jacking Pipe".

**TABLE 2.1**

### Concrete Cover to Steel Reinforcement in Concrete Jacking Pipe

		Minimum cover – barrel			Minimum cover - spigot		
		Normal	Marine	Other	Normal	Marine	Other
Machine made (horizontal and vertical)	Minimum cover – internal	10 mm	20 mm	(See note 5)	6 mm	10 mm	(See note 5)
	Minimum cover – external	15 mm (see Note 2)	25 mm (see Note 2)		6 mm	10 mm	
Wet cast (minimum 50 MPa concrete)	Minimum cover - internal	25 mm	35 mm		25 mm	35 mm	
	Minimum cover - external	30 mm	40 mm		15 mm	20 mm	

**NOTES:**

- Table 2.1 applies to concrete jacking pipe made in accordance with Clauses 2.3 and 2.6 of this document.
- The minimum cover for the external wall of the barrel of a concrete jacking pipe includes a 5 mm sacrificial layer to cover for unexpected installation conditions.
- The minimum cover specification applies to pipes with water absorption no greater than the values given in Clause 4.6 of AS/NZS 4058.
- Appendix E of AS/NZS 4058 gives information on concentration limits applicable to some constituents of the buried environment when using concrete with water absorption in accordance with Clause 4.6 AS/NZS 4058.
- Other Environment refers to environments that do not comply with the definitions for either normal or marine environments (as defined in AS/NZS 4058). These include environments in which one or more of the limits in Appendix E of AS/NZS 4058 is exceeded. Specification of cover or other protective treatments for these situations should be done in consultation with the manufacturer.

## 2.8 Tolerances

The dimensional tolerances of concrete jacking pipes shall be in accordance with Clause 3.3 of AS/NZS 4058 with the following exceptions.

### 2.8.1 Internal diameter

The internal diameter of concrete jacking pipe shall not vary from the design diameter nominated by the manufacturer by more than the tolerances nominated in Table 2.2.

In accordance with Clause 3.3.3 of AS/NZS 4058 no individual measurement of the internal diameter shall vary from the design diameter by more than –

- 10 mm for design diameters ≤ 1200 mm; or
- 15 mm for design diameters > 1200 mm

The internal diameter shall be measured in accordance with Clause 3.3.3 of AS/NZS 4058.

## 2.7 Cover to Steel Reinforcement

The concrete cover to reinforcement for jacking pipe, excluding radial ribs to circumferential reinforcement, end spacers, and longitudinal reinforcement ends, shall not be less than the values given in Table 2.1.

**TABLE 2.2**

### Permissible Tolerances on Internal Diameters

Design diameter	Jacking pipe internal diameter tolerance (mm)
≤ 600	± 6
> 600, ≤ 1200	± 8
> 1200, ≤ 1650	± 10
> 1650, ≤ 2100	± 12
> 2100	± 14

**NOTE:**

For concrete jacking pipe with an internal lining, the lining will not cause the design diameter to vary by more than 5 mm for design diameters below and including 1800 mm, and 10 mm for design diameters greater than 1800 mm. These tolerances are additional to the dimensional tolerances for unlined pipe.

### 2.8.2 External diameter

The external diameter of concrete jacking pipe shall not vary from the design diameter nominated by the manufacturer by more than the tolerances nominated in Table 2.3.

No individual measurement of the external diameter shall vary from the design diameter by no more than -

- (a) 10 mm for design diameters  $\leq 2100$  mm; or
- (b) 12 mm for design diameters  $> 2100$  mm

The external diameter shall be measured in accordance with Clause 3.3.4 of AS/NZS 4058.

**TABLE 2.3**  
**Permissible Tolerances on External Diameters**

Design diameter	Jacking pipe external diameter tolerance (mm)
$\leq 600$	$\pm 4$
$> 600, \leq 1200$	$\pm 5$
$> 1200, \leq 1650$	$\pm 6$
$> 1650, \leq 2100$	$\pm 8$
$> 2100$	$\pm 12$

**NOTE:**

The external diameter of any steel collar shall not exceed the external diameter of the concrete barrel by more than 6 mm.

### 2.8.3 Out of roundness

The permissible tolerance between the maximum and minimum external diameter of the pipe measured at a location along the pipe barrel shall be 1% of the nominated external diameter or 20 mm, whichever is less. For practical purposes the out of roundness should be measured at each end of the pipe, or within 200 mm of the pipe end.

### 2.8.4 Wall thickness

The wall thickness, when measured in accordance with Clause 3.3.5 of AS/NZS 4058, shall not be less than the value stated by the manufacturer for that particular jacking pipe, less the tolerance nominated in Table 2.4.

**TABLE 2.4**  
**Allowable Tolerances on Wall Thickness**

Design diameter	Jacking pipe minimum wall thickness tolerance (mm)
$\leq 600$	$+0, -3$
$> 600, \leq 1200$	$+0, -4$
$> 1200, \leq 1650$	$+0, -5$
$> 1650, \leq 2100$	$+0, -6$
$> 2100$	$+0, -7$

### 2.8.5 Effective length

The effective length ( $L_e$ ), when measured in accordance with Clause 3.3.5 of AS/NZS 4058, shall not vary from the value nominated by the manufacturer by more than  $\pm 15$  mm.

### 2.8.6 Straightness (internal and external)

For straight lengths of pipe, the total deviation from straightness of the inner and external surface when measured along the pipe axis from end to end shall not exceed 10 mm. In addition to this, the deviation from a straight line taken between any two points, one metre apart, along the pipe barrel shall not exceed 3 mm.

### 2.8.7 End squareness

End squareness of a concrete jacking pipe shall comply with Clause 3.3.8 of AS/NZS 4058. The specific tolerances for concrete jacking pipe are re-produced from AS/NZS 4058 in Table 2.5 for reference.

**TABLE 2.5**  
**Permissible Tolerances on End Squareness for Jacking Pipes**

Design diameter (mm)	Permissible tolerance (mm)
$< 900$	$\pm 2$
$\geq 900, < 1500$	$\pm 4$
$\geq 1500, < 2400$	$\pm 5$
$\geq 2400$	$\pm 7$

## 2.9 Workmanship and finish

The workmanship and finish of concrete jacking pipes shall be in accordance with Clause 3.4 of AS/NZS 4058.

### 2.10 Proof load

When tested in accordance with Appendix C of AS/NZS 4058, concrete jacking pipe shall sustain the proof load ( $T_c$ ) given in Table 2.6 below for the corresponding size and load class, without developing a crack width greater than the relevant test crack.

Upon removal of the test load, no crack shall be greater in width than that given in Table C2 of AS/NZS 4058.

**NOTE:**

For concrete jacking pipe with an internal lining the crack width will be measured at each end of the pipe. The average crack width shall be determined and shall not be greater than the width given in AS/NZS 4058.

**TABLE 2.6****Test Loads for Load Classes 3 to 6 – Concrete jacking pipes**

Proof or ultimate load test load (kN/m)						
Load Class	Class 3		Class 4		Class 6	
	Proof	Ultimate	Proof	Ultimate	Proof	Ultimate
<b>300</b>	23	34	30	45	45	56
<b>375</b>	26	39	34	51	51	64
<b>450</b>	30	45	40	60	60	75
<b>525</b>	35	52	46	69	69	86
<b>600</b>	39	59	52	78	78	98
<b>675</b>	44	65	58	87	87	109
<b>750</b>	48	72	64	96	96	120
<b>825</b>	52	78	69	104	104	129
<b>900</b>	56	84	74	111	111	139
<b>1050</b>	63	95	84	126	126	158
<b>1200</b>	69	104	92	138	138	173
<b>1350</b>	75	113	100	150	150	188
<b>1500</b>	81	122	108	162	162	203
<b>1650</b>	87	131	116	174	174	218
<b>1800</b>	93	139	124	186	186	233
<b>1950</b>	99	149	132	198	198	248
<b>2100</b>	105	158	140	210	210	263
<b>2400</b>	117	176	156	234	234	293
<b>2700</b>	129	194	172	258	258	323
<b>3000</b>	141	212	188	282	282	353

**NOTES:**

1. Refer to Table 4.2 of AS/NZS 4058 for notes on proof and ultimate loads for concrete pipe.
2. Refer to Table 4.2 of AS/NZS 4058 for proof and ultimate loads for other diameters and classes.
3. For concrete jacking pipe the nominal internal (design) diameter may vary from these values as they are based on TBM requirements. Proof and ultimate load can be interpolated accordingly.

**2.11 Watertightness**

The Watertightness of the jacking pipe and joint may be demonstrated by –

- (a) Internal watertightness test
- (b) External joint watertightness test
- (c) Internal joint watertightness test

**2.11.1 Internal barrel watertightness testing**

Internal barrel watertightness testing to a test pressure of 90 kPa, should be conducted in accordance with Appendix D of AS/NZS 4058 to meet with the requirements of Clause 4.4 of AS/NZS 4058. Internal barrel watertightness shall only apply to concrete jacking pipe designed and manufactured with sealed joints.

### 2.11.2 External joint watertightness testing

External joint watertightness testing to a test pressure of 90 kPa should be conducted in accordance with CPAA Engineering Guideline "Field Testing of Concrete Pipelines and Joints". External joint watertightness shall only apply to concrete jacking pipe designed and manufactured with sealed joints.

### 2.11.3 Internal joint watertightness testing

Internal joint watertightness testing to a test pressure of 90 kPa should be conducted in accordance with CPAA Engineering Guideline "Field Testing of Concrete Pipelines and Joints". Internal joint watertightness shall only apply to concrete jacking pipe designed and manufactured with sealed joints.

### 2.11.4 Hydrostatic pressure testing

Where project specific hydrostatic pressure testing is required this is to be agreed between the manufacturer and the specifier, prior to or at time of tender. Allowable water loss to be agreed.

## 2.12 Sampling and testing

The requirements of Section 5 of AS/NZS 4058 apply to the sampling and testing of concrete jacking pipe.

Type testing and routine testing for concrete jacking pipe shall be carried out in accordance with Table 2.7.

**TABLE 2.7**  
**Test Requirements for Concrete Jacking Pipe**

Characteristic	Reference clauses		Concrete jacking pipe	
	Test method <sup>1</sup>	Routine test frequency <sup>2</sup>	Type testing	Routine testing
Proof load	Appendix C	Para A4.1	Required	Required
Ultimate load	Appendix C	Para A4.2	Required	Only if specified
Internal hydrostatic pressure (a) Watertightness – internal (barrel) – external/internal (joint) (b) Specified pressure (c) Ultimate pressure	Appendix D Note 4 Appendix D Appendix D	Para A4.3(b) Note 4 Para A4.3(b) Para A4.3(b)	Only if specified Note 4 Only if specified Only if specified	Only if specified Note 4 Only if specified Only if specified
External hydrostatic pressure	TBD	TBD	Only if specified	N/A
Water absorption	Appendix F	Para A4.4	Required	Required
Cover	Appendix G	Para A4.6	Required	Required
Dimensional accuracy	Clause 3.3	Para A4.7	Required	Only if specified
Workmanship & finish	Clause 3.4.2.2	Each pipe	Required	Required

#### NOTES:

1. Refers to test methods outlined in AS/NZS 4058.
2. Refers to routine test frequency outlined in AS/NZS 4058.
3. Unsealed butt joints should not be used for applications where watertightness testing is required.
4. Refer to manufacturer for external/internal joint testing requirements.

#### LEGEND:

Required – test to be carried out whether specified or not

Only if specified – test to be carried out only if required by the specifier in accordance with Section 6 of AS/NZS 4058

N/A test is not applicable

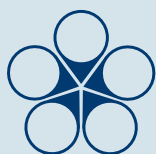


## 2.13 Information to be confirmed with manufacturer before order

- (a) Intended service requirements for application (pressure or non-pressure water supply, drainage, sewerage, or service ducts) as per Clause 1.1 of AS/NZS 4058
- (b) Intended installation environment (normal, marine, other) as per AS/NZS 4058
- (c) Pipe quantity, size (DN or nominal diameter) and load class (Section 2.3 and Table 2.6)
- (d) Actual design diameter (Note 2, Section 2.3)
- (e) Jacking loads (maximum jacking stress)
- (f) Watertightness or internal and external pressure requirements
- (g) Jacking pipe joint required, e.g. butt joint (sealed or unsealed), in wall joint, fixed collar, loose collar. (Section 2.5)
- (h) Details of any design requirements specifically required for joints due to jacking process (Section 2.5)
- (i) Effective pipe length (confirm with manufacturer)
- (j) Elastomer type for elastomeric seal joints if other than natural rubber
- (k) Joint packer type
- (l) Type and routine tests specified other than those required in Table 2.7.
- (m) Place and rate of delivery
- (n) Specific requirements for cement if any variation from Clause 2.2.1 of AS/NZS 4058
- (o) Type of admixtures, if any variation from those permitted in Clause 2.2.5 of AS/NZS 4058
- (p) Other specific material requirements, if any variation from Clauses 2.2 to 2.4 of AS/NZS 4058
- (q) Finishing and repair material specifications, if any variation from those permitted in Clause 3.4.5 of AS/NZS 4058
- (r) Special jacking pipe lubrication ports, grouting in intermediate jacking
- (s) Specific jacking pipe lubrication, grouting in immediate jacking station details if required
- (t) Marking requirements, if other than on outside of pipe (Section 2.4)

**DISCLAIMER**

The Concrete Pipe Association of Australasia believes the information given within this brochure is the most up-to-date and correct on the subject. Beyond this statement, no guarantee is given nor is any responsibility assumed by the Association and its members.



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