

NZS 4442:1988

**SPECIFICATION FOR
WELDED STEEL PIPES
AND FITTINGS
FOR WATER, SEWAGE, AND
MEDIUM PRESSURE GAS**

SUPERSEDING NZS 4442:1978

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This Standard was prepared under the direction of the Building and Civil Engineering Divisional Committee (30/-) for the Standards Council, established under the Standards Act 1965.

The Welded Steel Pipes and Fittings Committee (44/5) was responsible for the preparation of the Standard and consisted of representatives of the following organizations:

Department of Health
Department of Scientific and Industrial Research
Institution of Professional Engineers New Zealand
Municipal and Counties Associations of New Zealand
New Zealand Institution of Gas Engineers
New Zealand Manufacturers' Federation

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AMENDMENTS

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RELATED DOCUMENTS

Reference is made in this Standard to the following:

NEW ZEALAND STANDARDS	Clause reference herein
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NZS 3109:1987	Specification for concrete construction	204.2.3
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NZS 3112:1986	Methods of test for concrete	206.4.1 206.4.4 206.5.3
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NZS 3121:1986	Water and aggregate for concrete	206.1.1
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NZS 3122:1974	Portland cement (ordinary rapid hardening and modified)	206.1.1
---------------	---	---------

NZS 3202:1977	Asbestos cement pressure pipes (revoked)	Foreword, table 1
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INTERNATIONAL STANDARD

ISO 4200-1985	Plain end steel tubes, welded and seamless - General tables of dimensions and masses per unit length	Foreword
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AMERICAN STANDARDS

ANSI/AWWA C 203-86	Coal-tar protective coatings and linings for steel water pipelines - Enamel and tape - Hot-applied	205.3.1
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ASTM A 570:1985	Specification for hot-rolled carbon steel sheet and strip, structural quality	101.1
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ASTM A 611:1985	Specification for steel, cold-rolled sheet, carbon, structural	101.1
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AUSTRALIAN STANDARDS

AS 1204:1980	Structural steels - ordinary weldable grades	101.1
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AS 1518:1979	Extruded high density polyethylene protective coating for pipes	201.2
AS 1594:1981	Hot-rolled low carbon steel plate, sheet and strip (incorporating Amndt 1)	101.1
AS 2043:1977	Coal-tar and synthetic (fast dry) primers for steel pipes	202.1
AS 2044:1977	Coal-tar enamel for steel pipes	201.3 202.2
AS 2045:1977	Materials associated with the coating and lining of steel pipes with coal-tar primer/enamel systems	202.4
AS 2046:1977	Code of practice for the coating and lining of steel pipes with coal-tar primer/enamel systems	202.3 202.4
BRITISH STANDARDS		
BS 18:1987	Methods for tensile testing of metals (including aerospace materials)	101.1
BS 499:— Part 2:1980	Welding terms and symbols Specification for symbols for welding	2.1
BS 534:1981	Specification for steel pipes and specials for water and sewage	Foreword, table 1
BS 709:1983	Methods of destructive testing fusion welded joints and weld metal in steel	113.2
BS 1211:1958	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage	Foreword, table 1
BS 1780:1985	Specification for bourdon tube pressure and vacuum gauges	116.1.4
BS 2600:—	Radiographic examination of fusion welded butt joints in steel	113.1.3

Part 1:1983	Methods for steel 2 mm up to and including 50 mm thick	
BS 3600:1976	Dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes	Table 1
BS 4360:1986	Specification for weldable structural steels	101.1
JAPANESE STANDARD		
JIS G3101:1987	Rolled steel for general structure	101.1

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FOREWORD

This Standard is a revision of NZS 4442:1978 Welded steel pipes and fittings for water, sewage and medium pressure gas. This edition incorporates provisions for the use of high density polyethylene for the external coating of steel pipes and the application of concrete lining to the internal surfaces of steel pipes by the (mechanical) spinning head method. It also updates references to related documents. Outside diameters are listed in two alternative groups, corresponding to the following Standards:

- (a) NZS 3202 Asbestos cement pressure pipes (revoked); and
 BS 1211 Centrifugally cast (spun) iron pressure pipes for water, gas and sewage; and
- (b) BS 534 Steel pipes and specials for water and sewage; and
 ISO 4200 Plain and steel tubes, welded and seamless - General tables of dimensions and masses per unit length

The Standard also sets out requirements for certain fittings commonly used in mains and branch mains and fire hydrant installations. These fittings have been commonly referred to as "specials", but, for the purpose of uniformity, it is desirable that the term "fitting" be used.

In addition, the Standard lists types of coatings and linings most commonly used. By specifying that these shall comply with the requirements of the relevant New Zealand and Australian Standards it has been possible to dispense with appendices setting out the methods of testing.

Attention is drawn to the fact that other types of coatings, more suited for specific purposes, are available, and that any of these, in lieu of those listed in the Standard, may be stipulated by the purchaser in his contract.

NEW ZEALAND STANDARD

Specification for
**WELDED STEEL PIPES AND FITTINGS FOR WATER, SEWAGE, AND MEDIUM
 PRESSURE GAS**

GENERAL

1
 SCOPE

1.1
 This Standard applies to welded steel pipes and fittings with butt welded seams in nominal sizes of 100 mm to 1000 mm intended primarily for the conveyance of water, sewage and medium pressure gas.

1.2
 The high density polyethylene and coal tar enamel coatings specified in this Standard are most suitable for pipes buried underground.

2
 DEFINITIONS

2.1
 In this Standard, unless inconsistent with the context, the following definitions shall apply:

COATING. A corrosion protection medium applied to the external surface of pipes.

ENAMEL. Coal-tar enamel.

FITTING. A connecting piece other than a pipe, for example, bend, tee or taper.

JOINTER. A length of pipe made up by welding together two short lengths of pipe.

LAITANCE. A chalky surface layer composed of finer fractions of mortar, which can readily be removed from the mortar lining by scraping with a blade of a penknife or similar implement after the lining has cured.

LENGTH. The overall length of the

pipe minus the nominal joint entry, if any.

LINING. A corrosion protection medium applied to the internal surface of pipes.

MEDIUM PRESSURE GAS. Gas at a pressure of less than 200 kPa.

NOMINAL PIPE SIZE. The nominal internal diameter of the pipe.

NOTE -

The actual internal diameter of a pipe is not related to the nominal size other than through its relationship with its outside diameter (see table 1), this relationship depending on the thickness of the pipe wall and the lining, if any.

OUTSIDE DIAMETER. The outside diameter of the metal shell excluding any coating.

PRIMER. Material applied to the surface of metal pipes to bond the tar enamel to the pipe.

REINFORCEMENT. Glass-fibre fabric embedded in enamel coatings to strengthen the coatings.

SEALANT. The mastic compound interposed between the pipe and extruded polyethylene compound.

WALL THICKNESS. The thickness of the metal wall of the pipe, not including any lining or coating.

WELDING TERMS. Welding terms shall be interpreted in accordance with the definitions given in BS 499*.

WRAPPING. Fabric or tissue, closely wrapped round or embedded in the final layer of enamel coating to

protect the coating against mechanical damage and prevent displacement by earth pressure.

3 INFORMATION TO BE SUPPLIED BY PURCHASER AND MANUFACTURER

3.1

The following information shall be supplied by the purchaser with his enquiry.

3.1.1

Steel shell

- (a) The outside diameter of the pipes selected from table 1
- (b) The required wall thickness of the pipes (selected after reference to table 2)
- (c) The total length of straight pipe
- (d) The number of pipes that are to be of exact length (see clauses 102.3 and 104.4)
- (e) The type of field joint to be provided.

3.1.2

Coating and lining

- (a) Whether enamel, or concrete, or other lining is required
- (b) Whether enamel or other coating is required
- (c) Type of wrapping or reinforcement required.

3.1.3

Completed pipes

Whether final inspection is required, where it is to be made, and whether before or after loading.

3.1.4

Additional information, if applicable:

- (a) The working pressure that the pipes are required to resist

- (b) The external load conditions applicable to the pipes
- (c) The test pressure which is to be applied to the bare pipes
- (d) Whether the misalignment permitted in 108.4 is to apply to the inside or the outside surface of the pipe
- (e) Whether a certificate in accordance with section 5 is required
- (f) Whether reinforcement of the coating is required
- (g) Whether separate quantities of coating or lining materials are required (see section 206)
- (h) Whether thicker concrete lining is required
- (j) Whether thicker enamel coating or lining is required
- (k) The length at the ends of the pipes to be left uncoated (if different from 150 mm) and any particular protection to be applied
- (m) Whether the purchaser requires independent inspection of welds or welding (see 106.2)
- (n) Where the joint is to be welded internally, the length of the stop-back of the lining shall be nominated.

3.2

The following information shall be supplied by the manufacturer with his offer:

- (a) If the enamel offered is of a higher quality than required by this Standard, the overseas standard complied with shall be cited.
- (b) When required by the purchaser, details shall be supplied of the proposed joint, including dimensions and tolerances and

* See list of Related Documents.

angular deflection permissible, and the system of protection proposed for the length of pipe left uncoated and unlined at each end of each pipe.

- (c) If the steel complies with a Standard not listed in 101.1, that Standard shall be cited.

4 MARKING

4.1
Every pipe shall have stencilled on the outside of the pipe (with the approval of the purchaser):

- (a) The number of this Standard and the thickness of the pipe wall, for example, NZS 4442 - 6 mm
- (b) The manufacturer's name or registered mark.

Provided that at the request of the purchaser of a specific contract production run, every pipe shall be marked by stamping of the manufacturer's serial number on an area of bare pipe.

5 MANUFACTURER'S CERTIFICATE

5.1
When inspection of the pipes and fittings at the manufacturer's works is not required by the purchaser, the manufacturer, when requested by the purchaser at the time of the enquiry, shall supply a signed certificate stating the quality and thickness of the plate used, giving the results of all or any of the tests specified, and certifying that the pipes and fittings have been manufactured in accordance with the appropriate clauses of this Standard.

Part 1
Manufacture of pipe shells

101
MATERIALS

101.1
Steel

101.1.1
Unless otherwise agreed between the purchaser and the pipe manufacturer, the steel used for the fabrication of the pipe shall comply with the following requirements:

- (a) The yield stress or 0.2 % proof stress shall be greater than 245 MPa as measured in accordance with BS 18*
- (b) The tensile strength shall be 430-510 MPa as measured in accordance with BS 18*
- (c) The minimum elongation measured on a proportional specimen shall be greater than 18 % as measured in accordance with BS 18*
- (d) The carbon and manganese contents of the steel product shall be less than the following:

$$C + \frac{Mn}{6} < 0.4 \%$$

- (e) The maximum levels of sulphur and phosphorus shall be less than 0.05 % each.

101.1.2
Typical specifications which can meet the requirements of 101.1.1 are AS 1204, AS 1594, BS 4360, and JIS G3101.

101.2
The pipe manufacturer shall, on request, produce mill certificates covering the plate used for the manufacture of pipes.

102
DIMENSIONS

102.1
Diameter
The Standard outside diameters are given in table 1.

102.2
Wall thickness
The wall thickness shall be as given in table 2.

102.3
Standard lengths
Unless otherwise specified the standard length of all pipes measured in terms of 2.1 shall be 6.25 m for pipe up to and including 150 mm nominal size and 10 m for all pipes larger than 150 mm nominal size.

103
JOINTS

103.1
Pipe joints may be welded, flexible or rigid. The type of joint shall be agreed between the purchaser and the manufacturer. Unless otherwise stated by the manufacturer in his tender, not less than 3° deflection per joint shall be possible in those joints where deflection is acceptable.

104
TOLERANCES

104.1
Plate thickness

The thickness of plate used in the manufacture of pipe of all nominal sizes shall be the thickness specified ± 0.5 mm at any point.

104.2
Circularity and circumference

104.2.1
The tolerances specified in 104.3.1 and 104.4.1 shall apply throughout the length of the pipe, excepting the length at the end of the pipe required to be specially prepared for jointing.

*See list of Related Documents.

104.3 Circularity

104.3.1

The tolerance on the specified diameter shall not exceed 0.5 % or 5 mm, whichever is the greater.

Table 1
STANDARD OUTSIDE DIAMETERS

Column (a) lists outside diameters interchangeable with the outside diameters of class C asbestos cement previously manufactured to NZS 3202* and cast iron pipes specified in BS 1211*.

Column (b) lists outside diameters corresponding to those listed in BS 534*, BS 3600* and ISO 4200*.

104.3.2

The tolerance on pipe diameters for a distance of 200 mm from each end shall be as follows:

<u>Pipe diameter</u>	<u>Tolerance</u>
100 mm and up to 200 mm	<u>+1.5 mm</u>
Over 200 mm and to 450 mm	<u>+2.0 mm</u>
Over 450 mm and up to 900 mm	<u>+3.0 mm</u>
Over 900 mm	<u>+4.0 mm</u>

Pipes to be used with joints requiring closer tolerances shall be subject to agreement between purchaser and supplier.

104.3.3

All departures from circularity shall be gradual.

104.3.4

Allowance shall be made for sag when checking for compliance with these requirements.

<u>Nominal pipe size</u>	<u>Standard outside diameters</u>	
	<u>(a)</u>	<u>(b)</u>
mm	mm	mm
100	122	114
150	177	168
200	232	219
230 ⁽¹⁾	259	245
250	286	273
300	345	324
350	-	356
400	426	406
450	507	457
500	-	508
526 ⁽¹⁾	587	-
550	-	559
600	667	610
650	-	660
700	-	711
750	-	762
800	-	813
850	-	864
900	-	914
1000	-	1016

NOTE -

The use of these sizes is not recommended in order to reduce the number of pipe diameters in service.

* See list of Related Documents

Table 2
WALL THICKNESS

Column (a) lists thicknesses for buried pipes with flexible lining and welded or other joints that deflect integrally with the pipe.

Column (b) lists thicknesses for buried pipes with concrete linings or radially rigid mechanical joints, or both, that permit radial deflection of the pipe independently of the joint, for example those consisting of independent stiff metal collar and rings, and rubber rings.

Column (c) lists increased thicknesses alternative to column (b).

Hydraulic test pressures shown in table 2 are works inspection test pressures calculated from the formula:

$$P = \frac{2 S t}{D}$$

where

P is the hydraulic test pressure (MPa)
S is 75 % of the minimum yield stress of the plate taken as 245 MPa
t is the specified thickness (mm)
D is the specified outside diameter (mm)

Test pressures are not intended as a basis for pipeline design and do not necessarily have any direct relationship to working pressures. See section 116 for testing requirements.

Nominal pipe size	Wall thickness (mm) and hydraulic test pressure (MPa) ⁽²⁾					
	(a)		(b)		(c)	
mm	mm	MPa	mm	MPa	mm	MPa
100	3.2	7.0	3.2	7.0	4.8	7.0
150	3.2	7.0	3.2	7.0	4.8	7.0
200	3.2	5.4	3.2	5.4	4.8	7.0
230 ⁽¹⁾	3.2	4.8	3.2	4.8	4.8	7.0
250	3.2	4.3	3.2	4.3	4.8	6.5
300	3.2	3.6	4.8	5.4	6.4	7.0
350	3.2	3.3	4.8	5.0	6.4	6.6
400	3.2	2.9	4.8	4.3	6.4	5.8
450	3.2	2.6	4.8	3.9	6.4	5.1
500	4.8	3.5	4.8	3.5	6.4	4.6
550	4.8	3.2	6.4	4.2	7.9	5.2
600	4.8	2.9	6.4	3.9	7.9	4.8
650	4.8	2.7	6.4	3.6	7.9	4.4
700	6.4	3.3	6.4	3.3	7.9	4.1
750	6.4	3.1	6.4	3.1	7.9	3.8
800	6.4	2.9	7.9	3.6	9.5	4.3
850	6.4	2.7	7.9	3.4	9.5	4.0
900	6.4	2.6	7.9	3.2	9.5	3.8
1000	6.4	2.3	7.9	2.9	9.5	3.4

NOTE -

- (1) In order to reduce the number of pipe diameters in service, the use of 230 mm pipes is not recommended.
- (2) 1 MPa = 100 m head of water (approx).

- (3) Columns (a) and (b) are intended for general use without special design.
- (4) Where the outside diameters given in column (a) of table 1 are used for pipes over 300 mm nominal pipe size, values of wall thickness and test pressure may be obtained by interpolation.

104.4 Circumference

104.4.1

The measured outside circumference shall not differ from the circumference calculated from the standard outside diameter or from the specified outside diameter, when the pipe ordered is not of standard size, by more than the amount given in table 3 appropriate to the nominal size of the pipe.

104.5 Length

104.5.1

When the pipes are ordered to be of exact length, the measured length of any pipe shall not differ from the agreed length (see 102.3) by more than ± 1 mm per metre of pipe length.

104.5.2

When the pipes are not ordered to be of exact length, the measured length of any pipe shall not differ from the standard length by more than ± 75 mm.

104.5.3

Subject to agreement by the purchaser, up to 5 % of the total number of pipes ordered may be supplied in lengths varying between standard length and half standard length. Provided the total length

ordered is supplied, jointers may be included in the 5 % of pipes ordered.

104.6 Straightness

104.6.1

When tested by means of a line or straight-edge, the deviation from straightness shall not exceed 3 mm per 3 m length of pipe, provided that the total deviation along the length of the pipe shall not exceed 10 mm.

104.7 Squareness of ends

104.7.1

When measured by means of a try-square, the ends of a pipe shall be square with the walls as specified in the following items appropriate to the type of joint:

- (a) Butt welded joint: 0.8 mm per 300 mm of nominal pipe size, or 2 mm, whichever is the greater.
- (b) Other types of joint: 3 mm per 300 mm of nominal pipe size, or 6 mm, whichever is the greater.

104.7.2

Out-of-squareness may be local, but shall not exceed the total amount allowed.

Table 3
TOLERANCE OF CIRCUMFERENCE

<u>Outside diameter</u>	<u>Tolerance on circumference</u>
(1) Up to and including 300 mm	mm ± 4
(2) Over 300 mm and up to and including 600 mm	± 5
(3) Over 600 mm	± 6

105

FABRICATION OF PIPES

105.1

Edge preparation

105.1.1

General

Where the plates at a seam differ in thickness by more than 5 mm, the thicker plate shall be bevelled at the abutting edge to approximately the same thickness as the thinner plate by machining, flame-cutting, or grinding. The slope of the bevel shall be approximately one in four. The width of the weld face may be included in the length of the bevel.

105.1.2

For automatic welding

The edges of the plate shall be prepared by one of the following methods:

- (a) Machining
- (b) Machine or hand flame cutting
- (c) Grinding
- (d) Shearing.

The shape of the edge shall be at the option of the manufacturer but shall be appropriate to the welding process and shall enable welds complying with this Standard to be produced.

105.2

Rolling and forming

105.2.1

The strip or plate shall be rolled or formed to the required shape by a process that will not detrimentally affect the physical properties of the steel. It shall not be shaped by hammering.

105.3

Welding

105.3.1

The pipes shall be fabricated by an automatic arc butt-welding process capable of consistently producing welds complying with the requirements of this Standard.

105.3.2

Manual or semi-automatic arc welding may be used for the fabrication of fittings and the repair of weld defects. The welding procedure used shall be such that the weld produced will comply with the requirements of this Standard.

105.3.3

The manufacturer shall, on request, supply to the purchaser full details of the welding procedure and of the edge preparation proposed to be used.

106

WELDING SUPERVISION

106.1

It shall be the responsibility of the pipe manufacturer, or the fabricator of fittings, or both, to ensure that all welding is carried out in accordance with the terms of this Standard and he or they shall provide all the supervision necessary to fulfil this requirement.

106.2

Where the purchaser, by arrangement prior to manufacture, requires independent inspection or testing of welds or welding, the pipe manufacturer and the fabricator of fittings shall co-operate and assist the purchaser or his nominee with the inspection.

107 WELDING OPERATORS

107.1

Welding shall be carried out by competent operators who have been operating the appropriate equipment for a period of not less than one month. If the operator does not meet this qualification, the purchaser may require that the operator be tested. Such a test shall be in the form of a procedure test on the actual pipe being manufactured. The test weld shall be subjected to a bend test, with the applicable weld in tension, and the nick break test. The tests shall be carried out and interpreted as in section 113.

108 PLATE SET UP FOR WELDING

108.1 Application

When plates are set up for welding, the requirements specified in 108.2, 108.3 and 108.4 shall be observed.

108.2 Edge condition

The plate edges shall, at the time of welding, be dry and free from slag, detrimental rust, paint, loose scale, and other foreign material. Discoloured (blued) flame-cut edges and drying by heating shall be accepted.

108.3 Plate assembly

The plate edges shall be assembled and held in position in a manner that will ensure that they abut or that the gap between them is of the necessary dimensions and is uniform.

108.4 Plate alignment

108.4.1 Plates of equal thickness

Where the plates at the seam are of equal thickness, any misalignment of the plates measured on the outside of the seam shall not exceed 50 % of plate thickness or 3.2 mm, whichever is the lesser, for longitudinal or helical welds, and 50 % or 5 mm, whichever is the lesser, for circumferential seams.

108.4.2 Plates of unequal thickness

Where the plates at a seam are of different thickness, the misalignment permitted in 108.4.1 shall apply at the inner or the outer surface of the pipe, as agreed between the purchaser and the manufacturer.

108.4.3 Bevelled plates

Notwithstanding the requirements specified in 108.4.1 and 108.4.2, where one of the plates has been bevelled in accordance with 105.1.1, the root

faces shall be in alignment within the tolerance permitted in 108.4.1.

109 WELDS

109.1 Profile

The profile of welds shall comply with the following requirements:

- (a) The profile of finished welds shall be convex; with the exception that when tandem arc or other multiple wire welding process is used concave weld profiles will be acceptable, provided that no part of the weld surface lies below the plate surface and that changes in shape are gradual
- (b) The profile of repair welds shall, in general, conform to the profile of the adjacent welds. Any change in profile between repair and original weld shall be gradual
- (c) Any changes in the thickness of welds shall be effected gradually.

109.2 Undercutting

109.2.1
Undercutting is acceptable within the limits set out in 111.1.3.

109.3 Root concavities

109.3.1
Where a pipe is welded from the outside only with the aid of a backing bar, root concavities occurring on the inside surface of the pipe shall be accepted if the manufacturer can demonstrate by means of the tests prescribed in section 113 that such root concavities do not result in failure of the bend test.

109.4 Reinforcement

109.4.1
The height of weld reinforcement shall

be kept to a practicable minimum but shall in no case exceed the appropriate limit given in table 4.

109.5

Grinding of welds

109.5.1

Pipes which are not to be field jointed by butt welds shall have the weld reinforcement removed flush with the parent metal for a sufficient distance from the ends of the pipes to suit the particular joint to be used plus allowance for deflection.

110

WELDING PROCEDURE

110.1

Machine welding

110.1.1

General

110.1.1.1

Any combination of welding speed, current and voltage, size and grade of electrode, type and grade of flux, plate-edge preparation, and number and sequence of runs may be used, provided that the welds produced satisfy the requirements of this Standard.

110.1.2

Welding from one side

110.1.2.1

Welds may be made from one side only of the plate, provided that full penetration can be achieved with the welding process proposed.

110.1.3

Starting and stopping of welds

110.1.3.1

If for any reason the welding has to be stopped before a seam is completed, special care shall be taken when welding is resumed to obtain complete penetration and fusion between the new weld metal, the parent metal, and the weld metal previously deposited.

111

WELD DEFECTS AND THEIR REPAIR

111.1

Welds

111.1.1

A weld shall be considered defective if it does not comply with the requirements of this Standard, or if cracks, exposed porosity, injurious undercut, unfilled craters, or lack of fusion are evident on visual examination.

Table 4

HEIGHT OF WELD REINFORCEMENT

<u>Location</u>	<u>Maximum height of reinforcement</u>
	mm
Inside of pipes not to be enamel lined	3
Inside of pipes to be enamel lined	1.5
Outside of pipes to be enamel coated	3

111.1.2

Repairs of undercuts, grooves, scores, unfilled craters, cracks, porosity, and other defects shall be made by welding. Weld defects shall not be closed by hammering.

111.1.3

Undercutting

Except where it is only minor, undercutting shall be repaired in accordance with 111.1.2, 111.1.4 and 111.1.5. Undercutting may be regarded as minor when:

- (a) The undercutting is not in the form of a sharp notch; and
- (b) The maximum depth is not more than 0.8 mm; and
- (c) The length of any single undercut is not more than four times the plate thickness; and
- (d) The clear distance between adjacent undercuts is not less than five times the length of the longer of the undercuts.

111.1.4

Defective material shall first be removed by chipping, machining, grinding, or flame or arc gouging. When the defective material has been removed, a U-shaped groove or slot of suitable dimensions to permit satisfactory re-welding shall be formed. The prepared surfaces shall be cleaned before re-welding is commenced. For repairs carried out by semi-automatic or fully automatic welding methods, the preparation shall be such as to produce welds complying with this Standard.

111.1.5

The profile of repair welds shall, in general, conform to the profile of the adjacent weld or to the shape of the section being repaired as appropriate (see 109.1).

111.1.6

All pipes repaired as in 111.1.2 to 111.1.5 shall subsequently be subjected to the hydrostatic pressure test set out in section 116.

111.1.7

Plate

Injurious surface defects in the plate may be repaired by welding; they shall not be closed by hammering. The following surface defects in the plate shall be considered injurious:

- (a) Rolling defects and pits deeper than $12\frac{1}{2}$ % of the nominal plate thickness
- (b) Scores deeper than $12\frac{1}{2}$ % of the nominal plate thickness or 1.5 mm, whichever is the less.

111.1.8

Repairs to welds and plate defects may be repaired or replaced at the discretion of the pipe manufacturer or fabricator of fittings, or both.

111.1.9

Corrections to the shape of the pipes shall be by pressing, reforming, or by hammering with hammers.

112

INSPECTION

112.1

While the pipes for his order are being manufactured, the purchaser, or his representative, shall have reasonable access to the manufacturer's works for the purpose of inspection at all times.

113

TESTING

113.1

Welding procedure and test plate (see fig. 1)

113.1.1

When so required by the purchaser, the manufacturer shall provide full details of the welding procedure to be used and shall make a test weld using his procedure with plate of the same thickness and quality as is to be used in the pipe. The test weld shall have a minimum length of 300 mm. Alternatively, at the manufacturer's option the test plate may be taken from the pipe at the start of the production run.

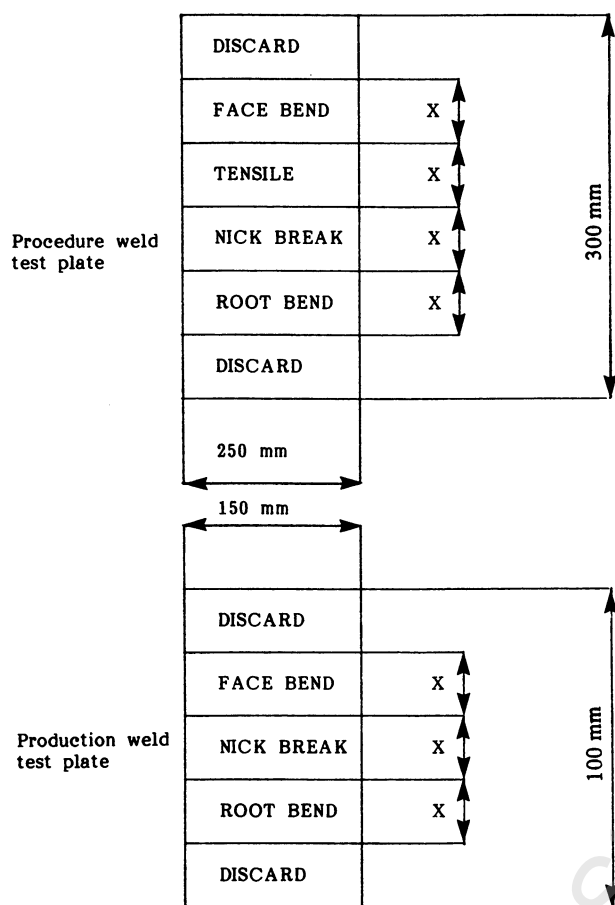


Fig. 1
TEST PLATE AND DISPOSITION OF
PIECES

NOTE -

For calculating dimension "x" in fig. 1 apply the following rules:

- (a) Bend test specimens:
- (i) Width. Parallel with axis of weld, not less than one and a half times the plate thickness with a minimum of 20 mm.
 - (ii) Length. Not less than ten times the plate thickness symmetrical about the axis of the weld.
- (b) Nick break test specimen:
- (i) Width. Not less than $(1.5a + 6 \text{ mm})$ where "a" is the thickness of the plate.
 - (ii) Length. Not less than ten times the plate thickness symmetrical about the axis of the weld.

113.1.2

Tensile, nick break, face bend and root bend tests are to be applied to the test specimens.

113.1.3

The test plate shall be cold cut to the sizes required for the test specimens. Alternatively the test specimens can be flame cut providing the heat affected zone from the cutting is removed by either filing, grinding or machining.

113.1.4

Failure to pass procedure weld test
Should any procedure weld test specimen fail to pass the test requirements in 113.2, production shall not commence until the correct procedure is established and satisfactory test specimens are produced.

113.2

Details of specimens and preparation

113.2.1

The specimens shall be prepared in accordance with BS 709*.

113.3

Test methods and requirements

113.3.1

Test pieces required by the following clauses shall be tested by an approved laboratory with Telarc registered laboratories being deemed to be approved or giving assurance of competency. They shall be tested and reported in accordance with BS 709*. The following requirements shall be met:

113.3.2

Bend test method

113.3.2.1

The guided bend method shall be used for the test. One test piece shall be tested with the surface corresponding to the outer surface of the pipe in tension. The second test piece shall be tested with the surface corresponding to the inner surface of

* See list of Related Documents.

the pipe in tension. The piece shall be mounted on supports, the faces of which are a distance apart not more than 6.2 times the thickness of the piece, and shall be pushed through the supports by a mandrel of diameter equal to four times the thickness of the piece. (See fig. 2).

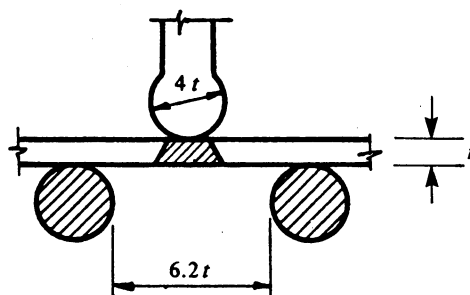


Fig. 2
GUIDED BEND TEST

113.3.2.2

Bend test requirement

On completion of the test, no crack or defect on the weld face shall extend for more than 1.5 mm in any direction, provided that cracks that originate at the edges of the test piece and which are less than 3 mm in length shall not be cause for rejection.

113.3.3

Nick break test method

113.3.3.1

The test piece shall be set in the guided bend test as shown in fig. 3 and the load applied until fracture of the test piece occurs.

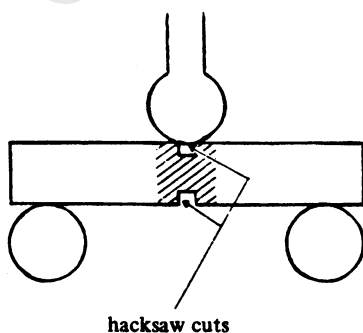


Fig. 3
NICK BREAK TEST

113.3.3.2

Nick break test requirement

The fracture surfaces of the test piece shall be examined and shall show no cracks, slag inclusions, lack of penetration or lack of fusion. Spherical defects may be present up to 2 % of the area of weld metal exposed by the fracture, provided the maximum dimensions of any one defect shall not exceed 1.5 mm in diameter.

113.3.4

Tensile test method

113.3.4.1

The test shall be carried out under the standard tensile test requirement. (See fig. 4).

113.3.4.2

Tensile test requirement

The tensile strength of the weld shall be not less than the specified minimum tensile strength of the parent metal. Where the test specimen breaks in the weld, the fracture surfaces shall be examined and shall show no cracks, slag inclusions, lack of penetration or lack of fusion. Spherical defects may be present up to 2 % of the area of weld metal exposed by the fracture, provided the maximum dimension of any one defect shall not exceed 1.5 mm in diameter.

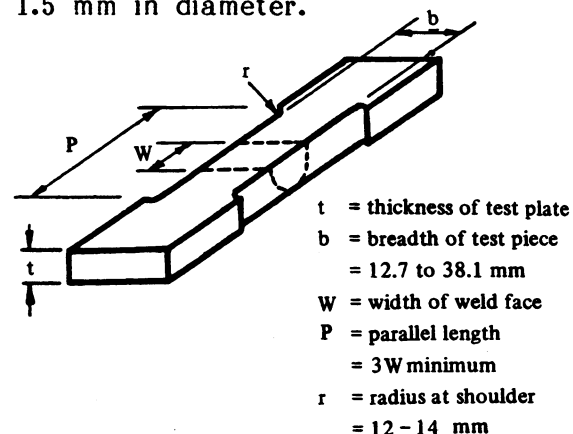


Fig. 4
TENSILE TEST PIECE

114

PRODUCTION WELD TEST

114.1

During the manufacture of the pipes the welds shall be subjected to bend

* See list of Related Documents.

tests and nick break tests as set out in section 113. The test specimens may be prepared, at the option of the manufacturer, from test plates removed from finished pipe or from test plates of the same thickness and quality as were used in the pipes and welded under the same procedure as the pipes.

114.2

Number of test

The minimum number of test plates for weld tests shall be as follows:

- (a) Pipes requiring longitudinal or helical welding only. One test plate per 900 m or part thereof of welding
- (b) Pipes requiring longitudinal and circumferential welding. One test plate for each 900 m of longitudinal welding and one test plate for each 900 m or part thereof of circumferential welding.

114.3

Replacement of test plates cut from pipes

114.3.1

A pipe from which a test plate has been cut and which complies in all other respects with the requirements of this Standard may be subjected to the hydrostatic pressure test specified in section 116 after first having a piece of plate, of the same quality and thickness as used in the manufacture of the pipe, welded into the aperture so that the quality requirements of this Standard are met.

114.4

Failure to pass procedure weld tests
Should a weld test piece fail to pass a specified test, the welding operation shall be discontinued and shall not be recommenced until the cause of failure has been rectified (see section 115).

115

RETESTING OF WELDS

115.1

The pipes represented by any procedure weld test piece that fails to pass a specified weld test (see section 113) shall constitute a batch which

shall be accepted or rejected on the following basis:

- (a) For each test piece that fails in a specified test, a retest piece shall be cut from each of two further pipes in the batch and shall be subjected to the same test as the piece that failed
- (b) The two retest pieces shall include the same type of weld (longitudinal, helical, or circumferential) as the test piece that failed, and the quality of the welding in the pieces shall be representative of the quality of the welding in the pipes from which the pieces are cut
- (c) If both of the retest pieces pass the specified test, the batch shall be deemed to comply with the relevant test requirements
- (d) If either of the retest pieces contains visible injurious defects, or fails to pass the specified test:
 - (i) The welding represented by the test pieces shall be replaced or otherwise treated to the satisfaction of the purchaser; or
 - (ii) The manufacturer may, with the approval of the purchaser, cut a test piece from each of the pipes in the batch, in which case every pipe from which a test piece has been cut and that passes the test shall be deemed to comply with the relevant test requirement.

116

ACCEPTANCE HYDROSTATIC PRESSURE TEST

116.1

General

116.1.1

Every pipe shall be subjected to the hydrostatic pressure test set out in 116.2 before acceptance. The pipes shall be tested after all welding and forming, but before being coated or lined.

116.1.2

The manufacturer shall provide all appliances and facilities necessary for the test.

116.1.3

Suitable gaskets shall be used to seal the pipe ends, and a vent shall be provided to permit the escape of all air from the pipe as it is filled with water.

116.1.4

Two pressure gauges complying with the requirements for concentric scale gauges in BS 1780* shall be provided. The dials shall be of not less than 150 mm diameter and be graduated over a suitable pressure range in accordance with BS 1780*.

116.1.5

The gauges shall be checked for accuracy against a test gauge every six months and whenever the difference in the pressures recorded on the two gauges exceeds 5 % of the greater of the pressures. The test gauge shall be calibrated every two years and a record kept of the calibration.

116.1.6

The gauges may be connected directly to the pipeline conveying the test pressure to the test pipe, but there shall be no stop valve between the pipe being tested and the gauges.

116.2

Test procedure

116.2.1

A test pressure sufficient to induce in the pipe wall a tensile hoop stress equal to 75 % of the minimum specified yield stress of the plate from which the pipe is manufactured, but not exceeding 7 MPa or such lower pressure as the purchaser may specify, shall be applied to the inside of the pipe and be maintained for not less than two minutes. Test pressures shown in table 2 are based on a minimum yield of 245 MPa.

116.2.2

While the pipe is under pressure, the full length of the weld shall be visually inspected for leaks.

116.2.3

When so tested the pipe shall not fail, provided that sweats and leaks may be repaired in accordance with section 111 and the pipe retested.

117

HANDLING AND STORING OF PIPES

117.1

The pipes shall be lifted so that the pipe shell, lining or coating will not be distorted.

117.2

In addition, enamelled pipes shall be lifted and handled by means of wide slings in order to prevent damage to the coating.

117.3

Coated pipes shall be stored in the following manner:

- (a) Supported at the uncoated ends on racks; or
- (b) On padded bolsters or ramps; or
- (c) On padded cradles.

118

FITTINGS

118.1

Wherever possible, fittings shall be made from pipes which have passed all of the appropriate tests and have complied with all other appropriate requirements of this Standard, provided that where pipe shell which has not been tested is used, the fittings shall be subjected to the appropriate tests.

118.2

Dimensions of fittings shall be in accordance with table 5 and diagrams shown in fig. 5.

* See list of Related Documents.

Table 5
DIMENSIONS OF STANDARD FITTINGS

Dimensions in millimetres

Nominal pipe size	Outside diameter of pipe (Refer table 1)		Tee			Taper	Bends		
							0°-35°	36° - 90°	
	(a)	(b)	A	B	C	E	F	G	H
100	122	114	229	$\frac{1}{2}$ o.d. of barrel (D) plus	457	229	229	330	152
150	177	168	305	152	457	229	267	381	203
200	232	219	305	152	457	229	305	432	254
230	259	245	381	203	533	305	305	432	254
250	286	273	381	254	533	305	305	457	279
			$\frac{1}{2}$ o.d. of branch (d) plus						
300	345	324	381	254	533	381	305	483	305
350	-	356							
400	426	406	305	305		457	381	533	356
450	507	457	305	305		457	381	610	406
500	-	508	381	305		457	381	660	457
550	587	559	381	305		457	457	686	508
600	667	610	381	305		457	533	711	559
650	-	660	381	305		457	533	762	610
700	-	711	381	305		457	533	813	660
750	-	762	457	381		457	610	864	711
800	-	813	457	381		457	610	914	762
850	-	864	457	381		457	610	965	813
900	-	914	457	381		457	610	1016	864
1000	-	1016	610	381		457	762	1118	965

NOTES TO TABLE 5 -

(1) Tapers:

- (a) No standard dimensions are offered for tapers where $d < \frac{D}{2}$
- (b) Dimension J = D
- (c) On some applications the addition of a puddle flange near the centre of the taper may assist the anchoring of the fitting.
- (d) Where a taper terminates in a flange, dimensions E, with the agreement of the purchaser may be reduced to 102 mm for outside diameter = 114 mm to 610 mm; and to 203 mm for outside diameter 660 mm or greater, or flanges may be fitted direct to the end or ends of the taper section.
- (e) Where tapers have plain ends, dimension E, with the agreement of the purchaser, may be reduced to not less than the following dimensions:

Outside diameters up to 324 125 mm
 Outside diameters over 324 up to 762 160 mm
 Outside diameters over 762 up to 1016 250 mm

- (2) Dimensions A, B, K, and J are to be calculated from column (b) outside diameter to the nearest millimetre.
- (3) Attention is drawn to the possible need for the addition of stiffening rings or other strengthening on large fittings.

(4) For some applications, considerations of friction loss or space requirements may indicate the use of non-standard or combination fittings.

(5) The unequal leg tee is intended for use where a valve or similar fitting is to be flanged on to one end of the barrel and on to the branch. The additional leg length provides additional clearance between the valves or their surface boxes.

119 TOLERANCES OF DIMENSIONS OF FITTINGS

119.1

The manufacturing tolerances given in table 6 shall be permitted on the dimensions of tees and bends given in table 5 and the accompanying figures in fig. 5.

119.2

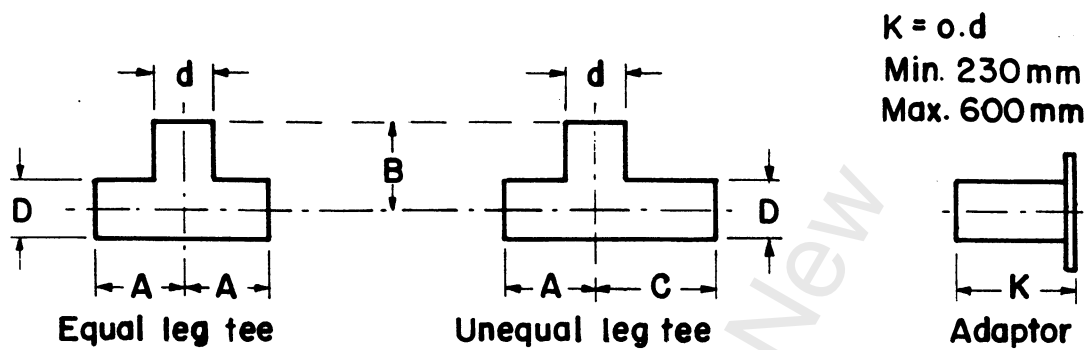
The ends of fittings shall be prepared as specified by the purchaser, including, if necessary, the matching of internal diameter for butt-welded pipes.

120

TESTING

120.1

Welds not previously tested hydraulically shall be tested by the application of hot oil, or paraffin or dye penetrant on the inside of the welds. No trace of the oil or paraffin shall appear on the outside, or if specified by the purchaser, a hydrostatic test to a pressure not exceeding one and a half times the working pressure may be carried out. A radiographic examination may be specified by the purchaser.



89 mm flange (203 mm o.d. x 5 mm thick,
4 holes 18 mm dia. on 165 mm P.C.D.)

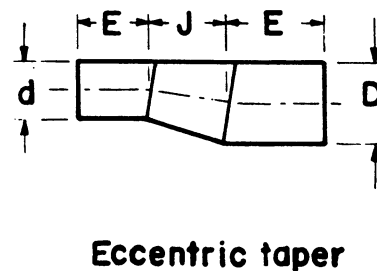
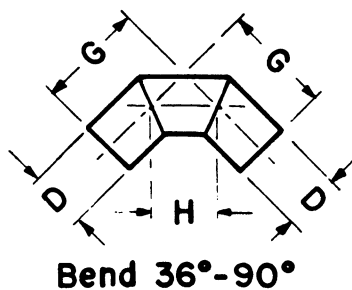
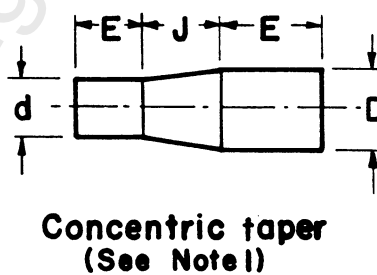
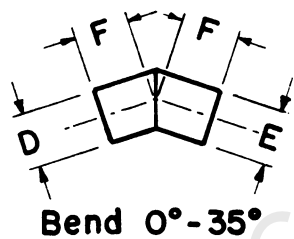
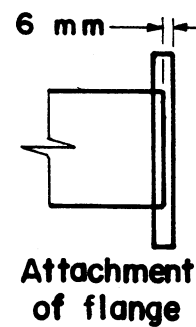
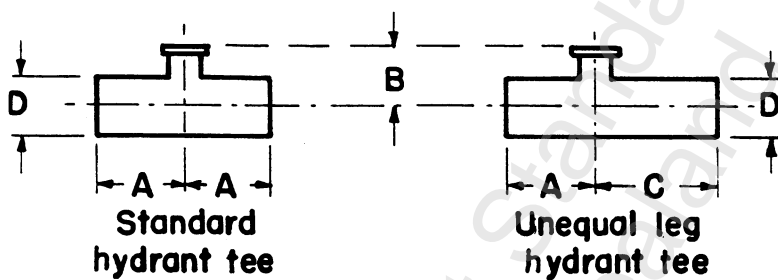


Fig. 5
DIMENSIONS OF STANDARD FITTINGS

Table 6
TOLERANCES OF DIMENSIONS OF FITTINGS

<u>Dimension</u>	<u>Tolerance</u>
Length of mains, branches of tees, and tapers	± 6 mm
Centre line length of bends	± 25 mm
Angles of bends, branches of tees, and "Ys"	$\pm 1^\circ$
Circularity and circumferential tolerance of plain ends of fittings	104.2.2 and 104.3.1 over length to suit joint to be used
Squareness of ends of fittings	Butt welded and flanged joints to 104.6.1 (a). Ends for other types of joint to 104.6.1 (b)

NOTE - Where tighter tolerances are required, the requirement is to be specified by the purchaser at time of inquiry.

Part 2**Coatings and linings****201****GENERAL****201.1**

This Part covers materials used for coatings and linings of steel pipes which shall comply with the requirements set out in sections 202 to 206.

201.2

Unless otherwise specified, the coating applied to the external surface of the pipe shall be either coal-tar enamel complying with AS 2044 or extruded high density polyethylene complying with AS 1518.

201.3

Unless otherwise specified, the lining applied to the internal surface of the pipe shall be either coal-tar enamel complying with AS 2044 or concrete complying with the requirements set out in section 204.

202**COAL-TAR ENAMEL****202.1****Primer****202.1.1**

The primer shall be either Type A (coal-tar) or Type B (fast drying). The primer shall be fully compatible with the coal-tar enamel to be used, and shall be of either of the following types:

- (a) Type A (coal-tar primer) complying with AS 2043
- (b) Type B (fast drying primer) consisting of chlorinated rubber, synthetic plasticizers, and solvents suitably compounded to produce a liquid coating which can readily be applied cold by brushing, spraying or by any other satisfactory methods which will produce a suitable and effective bond between the metal and subsequent coating of coal-tar enamel.

202.2**Enamel****202.2.1**

Coal-tar enamel shall comply with AS 2044.

202.3

Application of enamel coatings and linings

202.3.1

The application of coal-tar enamel coatings and linings shall comply with AS 2046.

202.3.2

The nominal thickness of external enamel coatings shall be 3 mm with a minimum thickness of 2.5 mm at any point. Thicker coatings may be specified by the purchaser.

202.3.3

The thickness of internal enamel linings may be specified by the purchaser.

202.4**Wrapping over enamel coating****202.4.1**

Wrapping over enamel coating shall be applied in accordance with AS 2046*. Materials used for wrapping shall comply with the relevant requirements of AS 2045* with glass-fibre mesh reinforcement being preferred to glass-fibre tissue. Glass-fibre mesh shall have a fibre spacing not exceeding 1.6 mm in both directions and a mass of not less than 65 g/m².

202.4.2

Coatings shall be reinforced only when specified by the purchaser.

202.4.3**Spark testing****202.4.3.1**

The operating voltage for electrical holiday detectors shall be determined from the procedure laid down in section 2.13.12 of AWWA Standard C 203, but in no case shall exceed 15 000 volts.

203 HIGH-DENSITY POLYETHYLENE COATINGS

203.1

This section covers extruded high-density polyethylene coatings used for the protection of steel pipe against corrosion where temperature conditions are in the range +60 °C and -40 °C.

203.2

Polyethylene coating systems are intended for underground services. Above ground storage not exceeding 6 months prior to installation are acceptable.

203.3

Requirements and test methods for high-density polyethylene coatings shall comply in all respects with AS 1518*, except that where the sealant complies with 2.2.4 the weekly factory test may be omitted by agreement between the purchaser and the manufacturer.

204

CONCRETE LINING

204.1

Cement and materials

204.1.1

The concrete used for the lining of steel pipes shall be made from portland cement complying in all respects with NZS 3122* and water

and aggregates shall be as specified in NZS 3121*, provided that the maximum size of aggregate shall not exceed 75 % of the thickness of the concrete lining specified in table 7.

204.2

Concrete strength

204.2.1

Specimens shall be moulded in accordance with section 3 of NZS 3112: Part 2* excepting that the specimen diameter shall not be less than 50 mm.

204.2.2

Specimens shall be cured in accordance with 3.5.2 of NZS 3112:Part 2* and tested in accordance with section 6 of NZS 3112:Part 2*.

204.2.3

The specified compressive strength as defined in NZS 3109* shall be not less than 25 MPa at age 28 days. Compression test results shall be evaluated as specified in NZS 3109*.

204.3

Frequency of testing

204.3.1

Test specimens shall be prepared on the following basis:

- (a) One set of test specimens as defined in NZS 3109* for every

Table 7
THICKNESS OF CONCRETE LININGS

<u>Nominal size of pipe or fitting</u>	<u>Thickness of concrete lining</u>	<u>Tolerance</u>
mm	mm	mm
100 and 150	7	+1
Above 150 and including 300	10	+2
Above 300 and including 600	13	+3
Above 600 and including 1000	16	+4

NOTE - Thicker linings may be specified.

* See list of Related Documents.

50 h of concrete lining production; or

- (b) When standard mixes are altered because of a change in source of sand or aggregate; or
- (c) When sand aggregate or cement proportions in standard mixes are changed.

204.3.2

The specimen shall be prepared by filling the mould with concrete lining material removed from a pipe immediately after the application of the lining.

204.3.3

The specimen shall be compacted by vibration in accordance with 3.4.2 of NZS 3112:Part 2.*

204.3.4

Where accelerated curing of pipe lining is permitted, the specimen from that pipe shall be cured by a similar procedure.

205

APPLICATION OF CONCRETE LININGS

205.1

Unless otherwise specified, the concrete lining shall be applied to the internal surface of the pipe by either the centrifugal method described in 205.2 or by the spinning head method described in 205.3.

205.2

Centrifugal method

205.2.1

The pipe shall be spun at a suitable speed until the minimum thickness specified in table 7 has been obtained over the whole of the inner surface, with the exception of any stop-back required for the joint.

205.2.2

The spinning of the pipe shall be continued until the surplus water has been expressed and a dense lining has been obtained.

205.3

Spinning head method

205.3.1

The spinning head shall be capable of depositing by centrifugal force the concrete lining on the internal surface of the pipe.

205.3.2

Where the minimum thickness specified in table 7 cannot be achieved in one pass, the lining may be applied in multiple passes.

205.3.3

Smoothing of the concrete lining shall be carried out by one of the following methods:

- (a) Centrifugally spraying and subsequent rotating to achieve smoothing
- (b) Centrifugally spraying and simultaneously smoothing by trowelling.

205.3.4

Where smoothing by rotation is utilized the duration and speed of rotation shall be kept to a minimum to prevent separation of the constituents of the concrete.

NOTE -

Vibration can be applied to further shorten the duration of rotation.

205.4

Finish

205.4.1

The lining when completed shall be well finished with a surface free of excessive laitance and surface irregularities. Projections exceeding 1.5 mm measured from the general surface of the lining shall be removed either by trowelling before the mortar has set or by grinding after the lining has cured for five days. The thickness of laitance, if any, shall not exceed 10 % of the thickness of the concrete lining specified in table 7.

205.4.2

Any damage caused to the lining by

* See list of Related Documents.

the removal of the end rings shall immediately be made good by hand before the concrete lining is set.

205.4.3

Fine surface crazing or hair cracks, or cracks which may occur due to flexing of thin wall steel pipes, shall be acceptable, provided that any crack exceeding 75 mm in length into which a flat metal feeler gauge 0.8 mm thick can be inserted to a depth exceeding one half the thickness of the concrete lining specified in table 7, shall not be acceptable.

205.4.4

After being lined, the pipe shall be marked with the date of lining. For the first 14 days following lining particular care shall be exercised during the handling and storing of the pipes to ensure that the lining is not damaged. During this period the lining shall be protected from frost and loss of moisture, either by sealing the ends of the pipes or by sealing the surface of the lining, as soon as possible after the lining has been applied. Water spraying may be used to keep the lining damp from 24 h after lining, provided loss of moisture prior to the application of the sprays is prevented.

205.4.5

No pipes shall be despatched until at least 21 days have elapsed since the date of lining, except by arrangement with the purchaser, but if accelerated curing is carried out, the period of curing shall be dependent upon the method employed, and shall be agreed with the purchaser.

205.5

Concrete lining of fittings

205.5.1

Wherever practicable fittings shall be made from cut lengths of centrifugally lined and cured straight pipes. The concrete lining shall be cut back from the ends or ends to be bevelled and welded for a sufficient distance to

ensure that any concrete which is intended to remain as part of the lining shall not suffer injury by the cutting or welding process. After fabrication of the fitting the lining shall be made good with materials specified in 204, or with other materials approved by the purchaser.

206

COMPLETION OF PROTECTION OF JOINTS

206.1

External protection

206.1.1

If required by the purchaser, there shall be included with each consignment of sheathed or wrapped pipes or fittings a sufficient quantity of primer, coal-tar based composition, also glass tissue or woven glass cloth, where appropriate, to cover the joints after laying and to repair minor damage to the external protection on the body of the pipes.

206.1.2

Where the completion of protection at joints is by a casting process, the supply of a suitable number of moulding boxes shall be the subject of a separate agreement between the purchaser and the manufacturer.

206.2

Internal protection

206.2.1

If required by the purchaser, there shall be included with each consignment of coal-tar lined pipes or fittings a sufficient quantity of coating or lining material, as appropriate, to ensure continuity of the internal protection at the joints and to repair minor damage in transit.

206.2.2

If required by the purchaser, test holes shall be provided in the sockets of double-lap welded spigot and socket pipes in nominal pipe sizes 600 mm diameter and above.



THE NEW ZEALAND STANDARD CERTIFICATION MARK SCHEME

The 'S' Mark appearing on a product, container or label is an assurance that the goods are manufactured under a system of supervision, control, and testing (including periodical inspection at the manufacturer's works by SANZ Certification Officers) designed to ensure compliance of the goods, quality, process, or practice with the relevant New Zealand Standard. The New Zealand Standard Certification Mark, registered as a certification trade mark under the Trade Marks Act 1953, may be used only in terms of a licence issued by SANZ, and must be accompanied by the licence number and the NZS number.

Used correctly in conjunction with advertising the 'S' Mark can provide a strong assurance of product quality for a manufacturer when selling his goods and thus becomes a powerful marketing tool.

Manufacturers may obtain particulars of the conditions of licensing from the Director, Standards Association of New Zealand, Private Bag, Wellington.

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