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for

AS/NZS 3518:2004 Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications

Australian/New Zealand Standard™

Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications

STANDARDS AUSTRALIA

STANDARDS NEW ZEALAND
Paerewa Aotearoa

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee PL-021, PVC, ABS and Polyamide Pipe Systems. It was approved on behalf of the Council of Standards Australia on 25 June 2004 and on behalf of the Council of Standards New Zealand on 16 July 2004.
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Australian/New Zealand Standard™

Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PL-021: PVC, ABS and polyamide pipe systems to supersede AS 3518.1—1988, *Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications—Pipes* and AS 3518.2—1988, *Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications—Solvent cement fittings.*

The objective of this document is to provide a standard specification for manufacturers and purchasers of these products.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard. Other notes are for information and guidance only.

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Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications

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1.1 SCOPE

This Standard specifies the performance requirements for acrylonitrile butadiene styrene (ABS) compounds (ABS 120, ABS 140 and ABS 160), pipes and fittings for the conveyance of liquids under pressure in applications above and below ground. The Standard contains dimensions for three ranges of pipe sizes, Series 1, Series 2 and Series 3.

Series 1 and 3 pipes are compatible with ISO 161 size series diameters, Series 2 are cast iron compatible sizes in accordance with AS/NZS 2280.

NOTE: Pipes and fittings manufactured to this Standard should be used and installed only in accordance with AS 3690, AS/NZS 2566.2 and AS 4041, as applicable.

Methods of demonstrating compliance with this Standard are given in Appendix A.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1199 Sampling procedures and tables for inspection by attributes

1462 Methods of test for unplasticized PVC (UPVC) pipes and fittings

1462.9 Method 9: Method for hydrostatic pressure testing of UPVC pressure fittings

1646 Elastomeric seals for waterworks purposes

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3691 Solvent cement and priming fluids for use with ABS pipes and fittings

4041 Pressure piping

4087 Metallic flanges for waterworks purposes

4441(Int) Oriented PVC (PVC-O) pipes for pressure applications

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4331.3	Part 3: Copper alloy and composite flanges
4765(Int)	Modified PVC (PVC-M) pipes for pressure applications
SAA	
HB18	Guidelines for third-party certification and accreditation
HB18.28	Guide 28: General rules for a model third-party certification scheme for products (ISO/IEC Guide 28)
ISO	
161	Thermoplastics pipes for the conveyance of fluids – Nominal outside diameters and nominal pressures
727	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly(vinyl chloride) (PVC-C) or acrylonitrile/butadiene/styrene (ABS) with plain sockets for pipes under pressure
2859	Sampling procedures for inspection by attributes
2859-1	Part 1: Sampling schemes indexed by acceptable quality limit (AQL) for lot-by-lot inspection
3951	Sampling procedures and charts for inspection by variables for percent nonconforming
7245	Pipes and fittings of acrylonitrile-butadiene-styrene (ABS)—General specification for moulding and extrusion materials
9080	Plastics piping and ducting systems—Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation
TR 10837	Determination of the thermal stability of polyethylene (PE) for use in gas pipes and fittings
ISO	
12162	Thermoplastics materials for pipes and fittings for pressure applications—Classification and designation – overall service (design) coefficient

15493 Plastics piping systems for industrial applications—Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) chlorinated poly(vinyl chloride)—Specifications for components and the system—Metric systems

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS/NZS 3500.0 and those below apply.

1.3.1 Compounds

ABS compounds shall be either pre-compounded ABS resins or ABS resins to which masterbatch containing additives such as UV inhibitors, heat stabilizers and antioxidants, has been added.

1.3.2 Ductile mode

The type of failure of the material in pipe-form during pressure testing where the pipe exhibits plastic deformation visible to the naked eye (normal or corrected vision).

1.3.3 Elevated temperature

Any temperature above 20°C.

1.3.4 Hoop stress (*S*)

The stress in a pipe or fitting under pressure, acting tangentially to the perimeter of a transverse section.

1.3.5 Hydrostatic design stress (*HDS*)

Hoop stress due to internal hydrostatic pressure, which can be applied continuously at a specified temperature, and which is obtained by the application of a design coefficient to the minimum required strength (*MRS*).

1.3.6 Pressure re-rating

The change in σ_{LPL} of a pipe and fitting material for operation at temperatures above 20°C. This is a direct consequence of the change in the specified temperature.

1.3.7 Lower prediction limit long term hydrostatic strength (σ_{LPL})

The 97.5% lower prediction limit (σ_{LPL}) value of hoop stress, applied at a specified temperature, which the material in pipe form can support for a specified time. This value is calculated using the statistical procedures outlined in the standard extrapolation method of ISO 9080.

1.3.8 Minimum required strength (*MRS*)

The required value of σ_{LPL} for a temperature T of 20°C and a time t of 50 years.

1.3.9 Maximum allowable operating pressure (*MAOP*)

The maximum pressure that can be sustained, with a factor of safety, by the type or class of pipe for its estimated useful life under the anticipated operating conditions.

1.3.10 Nominal pressure (*PN*)

An alphanumeric designation specifying the nominal operating pressure in bar at 20°C which is related to the mechanical characteristics of the components of a piping system and used for reference purposes.

1.3.11 Overall service (design) coefficient (*C*)

Overall coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower prediction limit.

1.3.12 Long-term hydrostatic stress

The continuously applied hoop stress that is estimated will cause failure at a specified time and temperature.

1.3.13 Moulded fittings

A fitting manufactured entirely by injection moulding.

1.3.14 Out-of-roundness (ovality)

The difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-section of the pipe.

1.3.15 Own re-processable material

Material prepared from rejected unused pipes, fittings and valves, including trimmings from the production of pipes fittings or valves, that will be reprocessed in a manufacturers plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion and for which the complete formulation or material specification is known.

1.3.16 Post-formed bend

A bend produced from pipe conforming to this Standard.

1.3.17 Standard dimensions ratio (*SDR*)

A nominal ratio of the pipe outside diameter to its wall thickness.

1.3.18 Test pressure

The pressure applied internally to pipes or fittings when being tested for strength and watertightness.

1.3.19 Virgin material

Material in such a form as granules or powder that has not been subjected to use or processing other than that required for its initial manufacture and to which no reprocessable or recyclable materials have been added.

1.4 NOTATION

The following symbols are used in this Standard:

$A_{min.}$ = minimum socket depth, in millimetres

d = maximum internal dimension of fitting (see Clause 3.2.2.2), in millimetres

DN = nominal size (based on nominal bore), in millimetres

D_m = mean outside diameter, in millimetres

D_i = socket mouth mean inside diameter, in millimetres

D_r = socket root mean diameter, in millimetres

ε_d = maximum diametral strain

F = extrapolated 50-year failure stress, in megapascals

L = socket length, in millimetres

P = maximum static working pressure of the pipe or fitting, in megapascals

PN = nominal working pressure at 20°C, designated in bar but normally referenced in megapascals

t = pipe material temperature range, in degrees

T = wall thickness, in millimetres

HDS = hydrostatic design stress, in megapascals

MRS = minimum required strength in megapascals

MAOP = maximum allowable operating pressure in megapascals

C = 1.6 service design coefficient (ref. ISO 12162)

S = hoop stress, in megapascals

1.5 CLASSIFICATION

1.5.1 Compounds

ABS pipe and fitting compounds extruded into pipe form shall be classified ABS 120 to ABS 160 in accordance with the *MRS* value given in Table 1.1.

TABLE 1.1

COMPOUND CLASSIFICATIONS

Classification	*MRS* MPa
ABS 120	12.0
ABS 140	14.0
ABS 160	16.0

1.5.2 Pipes and fittings

1.5.2.1 *Series 1 and 2 pipe fittings*

Pipe and fittings shall be classified by nominal pressure as follows:

PN 4.5 Nominal pressure of 0.45 MPa at 20°C.

PN 6 Nominal pressure of 0.6 MPa at 20°C.

PN 9 Nominal pressure of 0.9 MPa at 20°C.

PN 12 Nominal pressure of 1.2 MPa at 20°C.

PN 15 Nominal pressure of 1.5 MPa at 20°C.

PN 18 Nominal pressure of 1.8 MPa at 20°C.

PN 20 Nominal pressure of 2.0 MPa at 20°C.

NOTES:

1 Selection of class should be based on consideration of all factors that may affect the operation of the pipe, e.g., temperature of operation, fluctuating pressure, and external loading.

2 Reference should be made to AS 3690 for the design and installation of ABS systems including derating for temperature of operation.

1.5.2.2 *Series 3 pipe and fittings*

Series 3 pipe and fittings shall be classified by nominal pressure as follows:

PN 4 Nominal pressure of 0.4 MPa at 20°C.

PN 6.3 Nominal pressure of 0.63 MPa at 20°C.

PN 8 Nominal pressure of 0.8 MPa at 20°C.

PN 10 Nominal pressure of 1.0 MPa at 20°C.

PN 12.5 Nominal pressure of 1.25 MPa at 20°C.

PN 16 Nominal pressure of 1.6 MPa at 20°C.

NOTES:

1 Selection of class should be based on consideration of all factors that may affect the operation of the pipe, e.g., temperature of operation, fluctuating pressure, and external loading.

2 Reference should be made to AS 3690 for the design and installation of ABS systems including derating for temperature of operation.

1.6 MARKING

1.6.1 Pipes

All pipes shall be legibly and durably marked with letters of a minimum height of 3 mm for pipe of DN 100 or less, and a minimum height of 5 mm for pipes of greater diameter, using a distinctive colour. Such marking shall be repeated at intervals such that the length of any unmarked pipe shall not exceed 1 m.

The marking shall show the following:

(a) Manufacturer's name or registered trademark.

(b) Pipe series number in the form 'S1', as appropriate.

(c) Compound classification in the form 'ABS 160', as appropriate.

(d) Nominal diameter in form 'DN 50' or '50', as appropriate.

(e) Pipe classification in the form 'PN 12', as appropriate.

(f) SDR in the form 'SDR 26', as appropriate.

(g) For pipes designed with deflection joints, the maximum allowable angular deflection in degrees, in the form '3°' as appropriate.

(h) Date of manufacture in the form '010515' (i.e., 2001 May 15), as appropriate.

(i) Identification of place of manufacture. The manufacturer's code is acceptable, e.g., P1.

(j) The number of this Standard, e.g., AS/NZS 3518.

Examples:

TRADE NAME S1 ABS 160 DN 50 PN 12 SDR 26 010515 P1 AS/NZS 3518

or

TRADE NAME S2 ABS 160 DN 50 PN 12 SDR 26 3° 010515 P1 AS/NZS 3518

NOTE: Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

1.6.2 Fittings

All fittings or packaging as appropriate, shall be legibly and durably marked, labelled or moulded with the following information:

(a) Manufacturer's name or registered trademark.

(b) Material in the form 'ABS 160'.

(c) Nominal diameter in the form 'DN 50' or '50', as appropriate.

(d) Fitting classification in the form 'PN 12', as appropriate (see Note 2).

(e) The number of this Standard, e.g., AS/NZS 3518.

(f) For fittings with parallel sockets—

  (i) The words 'Parallel Socket'.

  (ii) A note stipulating the type of gap filling solvent to be used with the fitting.

Example:

Tapered socket fittings: TRADE NAME ABS 160 DN 50 PN 12 AS/NZS 3518

Parallel socket fittings: TRADE NAME ABS 160 DN 50 PN 12 AS/NZS 3518

Parallel socket Gap filler XXX.

NOTES:

1 Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product, packaging or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

2 Fittings produced with deflection joints should have the maximum allowable angular deflection in degrees marked on the socket, using a sticker or other means.

1.6.3 Post-formed bends

All post-formed bends and couplings shall be legibly and durably marked using lettering of 5 mm minimum height, with the following information:

(a) Manufacturer's name or registered trademark.

(b) Material in the form 'ABS 160'.

(c) Nominal diameter in the form 'DN 50' or '50', as appropriate.

(d) Fitting classification in the form 'PN 12', as appropriate.

(e) SDR in the form 'SDR 26', as appropriate.

(f) Angle of bend, for post formed bend only, in the form '45°', as appropriate.

(g) Date of manufacture, in the form '010515' (i.e., 2001 May 15), as appropriate.

(h) Identification of place of manufacture. The manufacturer's code is acceptable, e.g., P1.

(i) The number of this Standard, e.g., AS/NZS 3518.

Example:

TRADE NAME ABS 160 DN 50 PN 12 SDR 26 45° 010515 P1 AS/NZS 3518.

NOTES:

1 Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

2 Post-formed bends produced with deflection joints should have the maximum allowable angular deflection in degrees marked on the socket, using a sticker or other means.

1.7 SOLVENT CEMENTS

Pipes and fittings manufactured to this Standard, suitable for solvent cement jointing, are intended for use with solvent cements and priming fluids complying with AS 3691.

1.8 ELASTOMERIC JOINTING SEALS

The elastomeric jointing seals shall comply with AS 1646.1, and either AS 1646.2 or AS 1646.3.

NOTE: It is recommended that elastomeric jointing seals, for use with pipe and fittings manufactured to this Standard, be obtained only from the pipe or fittings manufacturer.

1.9 STORAGE AND TRANSPORT

All pipes shall be stored and transported in accordance with AS 3690 or AS/NZS 2566.2 while under the manufacturer's control.

SECTION 2 PERFORMANCE REQUIREMENTS

2.1 SCOPE

This section specifies the minimum performance requirements for ABS compound, pipes and fittings at the time of manufacture.

NOTE: Test requirements given in this Section are intended for products at their place of manufacture and not for products in service.

2.2 COMPOSITION

2.2.1 Compounds

ABS pipe and fitting compounds shall be ABS resins to which are added additives that are needed to facilitate the manufacture of pipes, fittings and valves.

ABS pipe and fitting compounds shall comply with the scope, designation of properties and test methods defined in ISO 7245.

The properties chosen to designate ABS plastics include:

(a) Acrylonitrile content in the continuous phase.

(b) Intended application or method of processing.

(c) Vicat softening temperature.

(d) Melt flow rate.

(e) Impact strength.

(f) Flexural modulus.

2.2.2 Colour

The colour of Series 1, 2 and 3 pipes shall be grey.

Other colours may be supplied by agreement between the purchaser and manufacturer.

2.2.3 Additives

2.2.3.1 *Limitations*

If additives are used they shall be evenly dispersed (see Clause 2.2.3.2). The additives shall not be used separately or together in quantities sufficient to:

(a) Impair the fabrication or solvent cementing characteristics of the component; or

(b) Impair the chemical, physical or mechanical characteristics and in particular the long term mechanical strength and impact strength of the compounds (see Clause 2.2.5).

2.2.3.2 *Dispersion of additives*

Anti-oxidants, ultraviolet stabilisers, and pigments including carbon black shall be evenly dispersed in the compounds.

When compounds containing carbon black or other pigments are tested in accordance with AS/NZS 1462.28, the rating of appearance shall not be worse than Micrograph B in Annex B of AS/NZS 1462.28, and the arithmetic average of the maximum sizes of pigment, agglomerations or foreign bodies shall not exceed 60 microns (corresponding to Grade 3 of AS/NZS 1462.28).

NOTE: Because the dispersion of anti-oxidants and ultraviolet stabilizers is difficult to assess, it is assumed that if the pigment is evenly dispersed, the other additives will also be evenly dispersed.

2.2.4 Stabilization

ABS compounds for pipes and fittings shall contain anti-oxidants such that the oxidation induction time shall be equal to or greater than 40 minutes when tested in accordance to ISO/TR 10837 for a specimen taken from the inner pipe wall using an ageing temperature of 180°C.

Techniques such as chemiluminescence, may be used for determining the oxidation induction time, provided that they have been demonstrated to give an accuracy of the same or a higher degree than the method specified in ISO/TR 10837. In the event of a dispute ISO/TR 10837 is the referee method

NOTE: Oxygen induction times of 40 min will ensure that adequate stabilizer is present to ensure a life exceeding 100 years at a constant temperature of 40°C. This calculation is based on a safety factor of 1.75.

2.2.5 Minimum required strength (*MRS*)

ABS compounds for pipes and fittings shall be evaluated at 20°C according to ISO 9080. The 97.5% σ_{LPL} value obtained from ISO 9080 is then used to determine the MRS, by rounding it down to the next lowest level listed in Table 1.1. For the classification of a material intended only for the manufacture of fittings and valves, the test piece shall be an injection moulded or extruded test piece in the form of a pipe.

ABS compounds for pipes and fittings shall be evaluated at 60ºC to validate the presence or otherwise of a knee. A minimum of 10 points shall be established, with at least two points being at a time longer than that required for valid extrapolation to 50 years at 20ºC according to ISO 9080. For this assessment ABS shall be classified as a glassy amorphous polymer. Where a knee is detected at 60ºC a full test regime according to ISO 9080 at three temperatures is required (90 points at the issue date of this Standard).

Prior to establishment of a test point beyond 10 000 h in the determination of the *MRS*, provisional qualification of an ABS compound may be obtained by sustaining a specific hoop stress *(σ)* for 1 000 h at 60°C without failure. The 60°C, 1 000 h hoop stress *(σ)* shall be determined by derating the 20°C, 1000 h mean rupture hoop stress established by regression analysis using Equation 2.2(1). If the full data set for calculating the *MRS* according to ISO 9080 is not available, a regression line shall be generated using a 7 point regression line, with failure points distributed 2,2,2 in the time ranges 3–30, 30–300, and 300+ h and including a point at the 50 year ordinate equal to the *MRS* value targeted plus 5%. Alternatively if the full data set for calculating the $\sigma_{LPL\ at\ 60°C}$ is available, the 99.5% *LPL* value established from analysis of this 60°C test data in accordance with ISO 9080 shall be taken as the specific hoop stress *(σ)*.

Provisional qualification is conditional on the establishment of the longest term tests at all required temperatures required for full qualification, and is limited in time to a maximum of 18 months, and is non-renewable.

Where data is used to establish re-rating factors for elevated service temperatures, a full three temperature 90 point multiple regression is required.

For all analyses, unfailed points may be used provided they improve the long term *LPL* from the simple regression line.

$$\sigma_{60,1000} = 0.33\sigma_{20,1000} \qquad \ldots 2.2(1)$$

where

$\sigma_{60,1000}$ = 1000 h hoop stress at 60°C

$\sigma_{20,1000}$ = 1000 h hoop stress at 20°C

2.2.6 Rework material

Only rework material of the same composition generated from the manufacturer's own production of product made to this Standard may be used. When rework material is added to a production run, the manufacturer shall treat this run as a new batch.

2.3 RERATING AT ELEVATED TEMPERATURES

ABS pipe and fitting compounds may be rerated at elevated temperatures according to their ABS classification. Reference should be made to AS 3690 and the manufacturer for the design and installation of ABS systems including rerating for temperature of operation.

2.4 DIMENSIONS

The dimensions of the pipes and fittings, measured in accordance with AS/NZS 1462.1, shall comply with Section 3 of this Standard.

Out-of-roundness of the outside diameter shall be measured within 24 h from the time of manufacture.

Out-of-roundness tolerances do not apply to *SDR*s ≥26.0. Thinner wall pipes may easily be re-rounded when inserted into sockets.

2.5 FREEDOM FROM DEFECTS

2.5.1 Cleanliness

Pipes and fittings shall be clean and free from any manufacturing debris.

2.5.2 Pipes and fittings

Defects shall not affect the performance or function of the pipes and fittings in service.

Pipes shall not have any blisters and heat marks. When grooves, wrinkles, rippling, dents or projections are present, the pipe shall comply with the dimensional requirements of Section 3, as appropriate.

2.5.3 Pipes and fitting ends

Pipes and fitting ends shall not have any chips and rough edges. Jointing surfaces shall be smooth. The axis of sockets formed on the ends of pipes and fittings shall be parallel within 2° to the axis of the fitting. D_r shall not be greater than D_i.

The jointing surfaces of sockets on pipes for solvent cement jointing shall taper uniformly from the mouth to the root of the socket.

NOTE: The defects described in Clause 2.5.2 and Clause 2.5.3 cannot be completely quantified. Where the presence, size or frequency of any such defects are considered to be of concern, arrangements for acceptable product quality should be made between purchaser/statutory authority/certifying body (as appropriate) and the manufacturer. This may be achieved by the provision of acceptable type samples.

2.5.4 Fitness for purpose

Where defects are present and the product is submitted for acceptance, the manufacturer shall be able to demonstrate fitness for purpose.

2.6 EFFECT ON WATER

ABS pipes, fittings, lubricant and elastomeric jointing seals shall comply with AS/NZS 4020. A scaling factor of 1 shall apply to pipes and a scaling factor of 0.05 shall apply to fittings.

2.7 PIPE TESTS

2.7.1 Short-term hydrostatic pressure

When tested in accordance with AS/NZS 1462.6 at 20°C, ABS pipe shall withstand the hoop stress given below for at least one hour without failure. Failure is defined as weeping, leaking or rupturing of the test specimen.

The hoop stress *(S)* shall be the 99.5% (σ_{LPL}) value (determined in Appendix F) at one hour developed from the 50 year, 20ºC linear regression data determined in accordance with ISO 9080.

NOTE: The stress value used in this analysis is the 99.5% (σ_{LPL}) rather than the 97.5% (σ_{LPL}) normally used in regression analysis.

The test pressure shall be determined from the following equation:

$$P = \frac{2ST_{\text{min.}}}{D_{\text{m}} - T_{\text{min.}}} \qquad \ldots 3.3(1)$$

where

P = internal hydrostatic pressure to be applied, in MPa

S = hoop stress, in MPa

$T_{\text{min.}}$ = minimum wall thickness, in mm

D_{m} = minimum mean outside diameter, in mm

2.7.2 Impact characteristics at 0°C

When tested in accordance with the 0°C impact test procedure of AS/NZS 1462.3, the pipe shall have a true impact rate (*TIR*) below 10% at a confidence level of 90%.

The testing parameters shall be as follows:

(a) Mass shall be as specified in Table 2.1. The tolerance shall be +0.05, –0.0 kg.

(b) Maximum number of impacts per specimen as specified in Table 2.2.

(c) Drop height 2 +0.1, –0.0 m.

TABLE 2.1

TEST MASSES FOR 0°C IMPACT TEST

Series 1 and 2 pipes				Series 3 pipes			
Nominal diameter DN	Total mass kg	Nominal diameter DN	Total mass kg	Nominal diameter DN	Total mass kg	Nominal diameter DN	Total mass kg
10	0.5	80	5.0	12	—	90	5.0
15	1.0	100	6.0	16	0.5	110	6.0
20	1.25	125	6.5	20	1.0	125	6.0
25	2.0	150	7.0	25	1.25	140	6.5
32	2.25	175	8.0	32	2.0	160	7.0
40	2.5	≥ 200	9.0	40	2.25	180	7.0
50	3.0	—	—	50	2.5	200	8.0
65	4.0	—	—	63	3.0	≥ 225	9.0
—	—	—	—	75	4.0	—	—

TABLE 2.2

MAXIMUM NUMBER OF IMPACTS PER SPECIMEN FOR 0°C IMPACT TEST

Series 1 and 2 pipes				Series 3 pipes			
Nominal diameter DN	Maximum number of impacts per specimen	Nominal diameter DN	Maximum number of impacts per specimen	Nominal diameter DN	Maximum number of impacts per specimen	Nominal diameter DN	Maximum number of impacts per specimen
< 50	1	150	8	< 63	1	160	8
50	3	175	10	63	3	180	9
65	3	200	12	75	3	200	10
80	4	225	14	90	4	225	12
100	6	250	16	110	6	250	14
125	8	≥ 300	20	125	6	280	16
—	—	—	—	140	8	≥ 315	20

2.7.3 Reversion

When tested in accordance with AS/NZS 1462.4, at 150 ±4°C, the reversion of the pipe shall not exceed 5.0%, nor shall the pipe show any signs of cracks, cavities or blisters resulting from the immersion.

2.7.4 High temperature

When tested in accordance with AS/NZS 1462.16, at a temperature of 150 ±4°C for 30 minutes for wall thickness ≤3 mm and 60 minutes for wall thickness >3 mm, the pipe shall show no evidence of—

(a) inclusions; or

(b) delamination, damage or porosity at the axially cut surfaces.

The roll back assessment of AS/NZS 1462.16 is not required to be carried out for a pipe to meet the requirements of this Standard.

NOTE: Absorbed water can affect results and, hence, caution is to be used when applying this test to pipes that have been stored or used in service.

2.8 FITTINGS TESTS

2.8.1 Threaded fittings tightening torque

When tested in accordance with AS 2888.1, threaded fittings shall be capable of being tightened to the torque specified in Table 2.3 without damage.

TABLE 2.3

THREAD TIGHTENING TORQUES

Nominal size of thread mm	Thread tightening torque Nm
≤ 32	15
> 32 ≤ 40	20
> 40 ≤ 50	25
> 50 ≤ 65	40
> 65 ≤ 80	50
> 80 ≤ 100	60

2.8.2 Short-term hydrostatic pressure

ABS fittings shall be tested in accordance with AS 1462.9 at 3.2 times the nominal pressure of the appropriate class of fitting at 20 ±2°C, for at least 1 h without failure. Failure is defined as weeping, leaking or rupturing of the test specimen.

Where specimen end caps detailed in AS 1462.9 are not appropriate, specimens may be tested with ABS pipes solvent cemented into the fitting in accordance with Appendix B.

2.8.3 High temperature stress relief

When determined in accordance with AS/NZS 1462.11 at a temperature of 150 ±4°C for 60+3, –1 min, the high temperature stress relief properties of the unrestrained fitting shall comply with the following:

(a) There shall be no evidence of inclusions in the fitting.

(b) Delamination or damage at the injection point shall not have reduced the wall thickness to less than 50% of the minimum wall thickness specified in Clause 3.2.2.

(c) The weld line shall not open to a depth of more than 50% of the wall thickness.

NOTE: The weld line is likely to become prominent, and the fitting distorted; however, this does not constitute a failure.

(d) Not more than 5% of the total internal and external surface of the fitting shall exhibit blisters and/or surface delamination

2.9 ELASTOMERIC SEAL JOINT TESTS

2.9.1 Joint hydrostatic tests

2.9.1.1 *Proof test*

When tested at 20°C in accordance with the hydrostatic test of AS/NZS 1462.17, the joint shall withstand without observable leakage a hydrostatic pressure equal to 2.0 times the nominal pressure of the pipe for a period of 24 h. There shall be no restraint on the elastomeric seal and the pipe will be tested with controlled offset.

2.9.1.2 *Socket performance*

Sockets formed on pipe ends shall be tested in accordance with AS/NZS 1462.17 at a temperature of 20 ±2°C without offset for a period of 1 h at a pressure to provide the appropriate hoop stress level as determined in Clause 2.7.1. The elastomeric seal may be restrained within the joint. Sockets shall withstand the hoop stress level as determined without failure. Failure is defined as weeping, leaking or rupturing of the test specimen.

2.9.1.3 *Elastomeric Seal Joint performance*

When tested at 20°C in accordance with the hydrostatic test of AS/NZS 1462.6, joints shall withstand hydrostatic pressures equal to the nominal pressure of the pipe used in the joint assembly multiplied by factors of α and β for periods of 1000 h and 1 h respectively. Factors α and β shall be determined in accordance with Appendix C. Joints shall be prepared without pipe offset and there shall be no observable leakage.

2.9.2 Joint infiltration

When tested in accordance with the infiltration test of AS/NZS 1462.8, the joint shall withstand an internal vacuum corresponding to a negative gauge pressure of –80 kPa to –85 kPa or an external hydrostatic pressure of 80 +5,–0 kPa, at ambient for a period of 2 +0.1,–0.0 h without leakage.

2.10 TESTING SUMMARY

Table 2.4 summarizes the testing requirements for ABS pressure pipe system components.

TABLE 2.4
TEST SUMMARY

Test	Clause	Method	Pipe	Bend	Moulded fitting	Seal
Pipes and fittings						
Dimensions	2.4	AS/NZS 1462.1	R	R	R	R
Effect on water	2.6	AS/NZS 4020	R	R	R	R
Dispersion of additives	2.2.3.2	AS/NZS 1462.28	R	R	R	—
Pipes						
Short-term hydrostatic pressure	2.7.1	AS/NZS 1462.6	R	—	—	—
Impact characteristics at 0°C	2.7.2	AS/NZS 1462.3	R	—	—	—
Reversion	2.7.3	AS/NZS 1462.4	R	—	—	—
High temperature	2.7.4	AS/NZS 1462.16	R	—	—	—
Fittings						
Tightening torque	2.8.1	AS 2888.1	—	—	R	—
Short-term hydrostatic pressure	2.8.2	AS 1462.9	—	—	R	—
High temperature stress relief	2.8.3	AS/NZS 1462.11	—	—	R	—
Elastomeric seal joints						
Joint hydrostatic	2.9.1	AS/NZS 1462.17,	R	R	R	R
		AS/NZS 1462.6	—	—	—	—
Joint infiltration	2.9.2	AS/NZS 1462.8	R	R	R	R

R = Required test

SECTION 3 DESIGN REQUIREMENTS

3.1 PIPES

3.1.1 Dimensions

This Standard contains dimensions for three ranges of pipe sizes, Series 1, Series 2 and Series 3.

Series 1 and 3 pipes are compatible with ISO 161 size series diameters, Series 2 are cast iron compatible pipe sizes. These series have dimensions that are compatible with pressure pipe and fittings manufactured to, AS/NZS 1477, AS/NZS 2280, AS/NZS 2544, AS 4441(Int), AS/NZS 4765(Int), ISO 727 and ISO 15493.

The wall thicknesses for the pipes specified have been calculated using the Barlow equation which takes into account the working pressure and diameter of the pipe and the hydrostatic design stress of the ABS compound series 120, 140 and 160 based on their minimum required strength *(MRS)* values (see Appendix D).

In the interest of serviceability of the pipe and irrespective of the calculated minimum wall thickness, this Standard does not provide for a wall thickness less than 1.6 mm.

3.1.2 Diameter and wall thickness

*SDR*s for Series 1, Series 2 and Series 3 pipe are given in Tables 3.1 and 3.2. Series 1 pipe dimensions are given in Table 3.3, Series 2 pipe dimensions are given in Table 3.4 and Series 3 pipe dimensions are given in Table 3.5.

The minimum and maximum pipe outside diameter limits shall apply to the unchamfered pipe barrel only.

For non-solvent cement sockets, the minimum pipe wall thickness shall not fall below the value of $T_{min.}$, except on the non-pressure side of the joint seal and the chamfered section of the pipe spigot end. For solvent cement sockets the minimum wall thickness must be at least equal to 90% of $T_{min.}$.

The average pipe wall thickness must not exceed $T_{max.}$, except for the pipe socket, the pipe barrel within 150 m of the socket root and the pipe barrel within 150 mm from the pipe spigot end. At any point within these exception zones, the maximum wall thickness at any point may exceed $T_{max.}$ by up to 30%.

All measurements are to be determined in accordance with AS/NZS 1462.1.

TABLE 3.1

***SDRs* FOR SERIES 1 AND SERIES 2 PIPES MADE FROM ABS 120, ABS 140, ABS 160 COMPOUNDS**

Hydrostatic design stress *(HDS=MRS/C)* MPa	Compound	*SDR* PN 4.5	PN 6	PN 9	PN 12	PN 15	PN 18	PN 20
7.5	ABS 120	34.3	26	17.7	13.5	11	9.3	—
8.75	ABS 140	39.9	30.2	20.4	15.6	12.7	10.7	—
10	ABS 160	45.4	34.3	23.2	17.7	14.3	12.1	11

TABLE 3.2

***SDRs* FOR SERIES 3 PIPES MADE FROM ABS 140 AND ABS 160 COMPOUNDS**

SDR

Hydrostatic design stress *(HDS=MRS/C)* MPa	Compound	PN 4	PN 6.3	PN 8	PN 10	PN 12.5	PN 16
8.75	ABS 140	41	—	—	17	—	—
10	ABS 160	—	33	26	21	17	13.6

3.1.3 Length

3.1.3.1 *Effective length*

The effective length, defined in Figure 3.1, of pipe shall be 6 +0.05, –0.0 m at 20°C unless otherwise specified.

The effective length shall be determined by subtracting the insertion length from the overall length, measured in accordance with AS/NZS 1462.1, and then, if necessary, making an adjustment for temperature.

NOTE: The coefficient of thermal expansion of ABS pipe may be taken for reference as 10.1×10^{-5} per °C (see AS 3690).

3.1.3.2 *Witness mark*

Spigoted and socketed pipes for elastomeric seal jointing shall carry a witness mark such that when the spigot is inserted into a matching pipe socket to the witness mark, the jointing requirements of Clause 3.4 are met (see Figure 3.1(b)).

3.1.3.3 *Spigoted and socketed pipe for solvent cement jointing*

The effective length of spigoted and socketed pipe for solvent cement jointing shall be determined by subtracting the socket length from the overall length, both measured in accordance with AS/NZS 1462.1, and then if necessary, making an adjustment for temperature (see Figure 3.1(c)).

3.1.3.4 *Plain-ended pipe*

The overall length of plain-ended pipes, measured in accordance with AS/NZS 1462.1, shall be the effective length (see Figure 3.1(a)).

3.1.4 Pipe spigot ends

Pipe spigot ends, measured in accordance with AS/NZS 1462.1, shall be normal to the main axis of the pipe spigot within the tolerances for end squareness given in Tables 3.3, 3.4 and 3.5.

3.1.5 Sockets formed on pipes

3.1.5.1 *Tolerances*

Sockets, measured in accordance with AS/NZS 1462.1 shall be normal to the main axis of the pipe socket within the tolerances for end squareness given in Tables 3.3, 3.4 and 3.5 Sockets on the ends of pipe shall be parallel within ±2° to the axis of the pipe. Sockets shall be concentric with the pipe to within 2.5% of pipe outside diameter for pipes up to and including nominal diameter *DN* 150, and 1.0% for larger pipes. Sockets shall not have a dimension $D_r > D_1$.

3.1.5.2 *Series 1, and 2 pipes for solvent cement jointing*

3.1.5.2.1 *Socket length on pipe for solvent cement jointing*

Socket length shall comply with the requirements of Tables 3.6 and 3.7.

3.1.5.2.2 *Socket taper on pipe for solvent cement jointing*

The jointing surface of pipe sockets for solvent cement joints shall have a taper that conforms with the following requirements:

(a) An interference fit that occurs where the maximum pipe diameter enters the socket more than 0.1L and the minimum pipe diameter enters the socket less than 0.9L.

(b) The maximum diametral strain does not exceed 3.5% when calculated from the following equation:

$$\varepsilon = \frac{D_{m\ max.} - D_{\text{r min.}}}{D_{\text{r min.}}} \times 100 \qquad \ldots 3.1(1)$$

where

ε = percent maximum diametral strain

$D_{\text{m max.}}$ = maximum mean diameter of pipe, in millimetres

$D_{\text{r min.}}$ = minimum socket root mean diameter, in millimetres

L = depth from pipe end to $D_{\text{r min.}}$, in millimetres (see Figure 3.2)

(c) The socket dimensions shall comply with Tables 3.6 and 3.7.

3.1.5.3 *Series 1 and 2 pipes for elastomeric seal jointing*

Sockets on pipes used for elastomeric seal jointing shall be in accordance with the requirements of Clause 3.4.

3.1.5.4 *Deflection joints*

Where manufacturers produce elastomeric seal components designed for deflection joints in pipes, such components shall conform to the requirements of Clause 3.4.

TABLE 3.3(A)

DIMENSIONS FOR SERIES 1 PIPES FOR STANDARD DIMENSION RATIOS

millimetres

Nominal diameter *DN*	Outside diameter			Wall thickness T_{min} and wall thickness tolerance						Tolerance on end squareness
	Mean outside diameter		Maximum out of roundness	*SDR* 45.4	*SDR* 39.9	*SDR* 34.3	*SDR* 30.2	*SDR* 26	*SDR* 23.2	
	$D_{m\ min}$	$D_{m\ max.}$		$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	
10	17.0	17.3	0.5	—	—	—	—	—	—	—
15	21.2	21.5	0.5	—	—	—	—	—	—	—
20	26.6	26.9	0.5	—	—	—	—	—	—	—
25	33.4	33.7	0.5	—	—	—	—	—	—	—
32	42.1	42.4	0.5	—	—	—	—	—	1.8 + 0.4	2
40	48.1	48.4	0.5	—	—	—	—	—	2.1 + 0.4	2
50	60.2	60.5	0.6	—	—	—	2.0 + 0.4	2.3 + 0.4	2.6 + 0.5	2
65	75.2	75.5	0.7	—	—	—	2.5 + 0.5	2.9 + 0.5	3.2 + 0.5	2
80	88.7	89.1	0.9	2.0 + 0.4	2.2 + 0.4	2.6 + 0.5	2.9 + 0.5	3.4 + 0.5	3.8 + 0.6	2
100	114.1	114.5	1.2	2.5 + 0.5	2.9 + 0.5	3.3 + 0.5	3.8 + 0.6	4.4 + 0.6	4.9 + 0.7	2
125	140.0	140.4	1.4	3.1 + 0.5	3.5 + 0.6	4.1 + 0.6	4.6 + 0.7	5.4 + 0.7	6.0 + 0.8	2
150	168.0	168.5	1.7	3.7 + 0.6	4.2 + 0.6	4.9 + 0.7	5.6 + 0.8	6.5 + 0.9	7.2 + 0.9	2
175	200.0	200.5	2.0	4.4 + 0.6	5.0 + 0.7	5.8 + 0.8	6.6 + 0.9	7.7 + 1.0	8.6 + 1.1	2
200	225.0	225.6	2.2	5.0 + 0.7	5.6 + 0.8	6.6 + 0.9	7.5 + 1.0	8.7 + 1.1	9.7 + 1.2	2
225	250.0	250.7	2.5	5.5 + 0.8	6.3 + 0.8	7.3 + 0.9	8.3 + 1.0	9.6 + 1.2	10.8 + 1.3	2
250	280.0	280.8	2.8	6.2 + 0.8	7.0 + 0.9	8.2 + 1.0	9.3 + 1.1	10.8 + 1.3	12.1 + 1.4	2
300	315.0	315.9	3.1	6.9 + 0.9	7.9 + 1.0	9.2 + 1.1	10.4 + 1.2	12.1 + 1.4	13.6 + 1.6	3
350	355.0	356.0	3.6	7.8 + 1.0	8.9 + 1.1	10.3 + 1.2	11.8 + 1.4	13.7 + 1.6	15.3 + 1.7	3
375	400.0	401.0	4.0	8.8 + 1.1	10.0 + 1.2	11.7 + 1.4	13.2 + 1.5	15.4 + 1.7	17.2 + 1.9	4
400	450.0	451.0	4.5	9.9 + 1.2	11.3 + 1.3	13.1 + 1.5	14.9 + 1.7	17.3 + 1.9	19.4 + 2.1	4
450	500.0	501.0	5.0	11.0 + 1.3	12.5 + 1.5	14.6 + 1.7	16.6 + 1.9	19.2 + 2.1	21.6 + 2.4	4
500	560.0	561.0	5.6	12.3 + 1.4	14.0 + 1.6	16.3 + 1.8	18.5 + 2.1	21.5 + 2.4	24.1 + 2.6	5
575	630.0	631.2	6.3	13.9 + 1.6	15.8 + 1.8	18.4 + 2.0	20.9 + 2.3	24.2 + 2.6	27.2 + 2.9	6
650	710.0	711.4	7.1	15.6 + 1.8	17.8 + 2.0	20.7 + 2.3	23.5 + 2.6	27.3 + 2.9	30.6 + 3.3	6
750	800.0	801.6	8.0	17.6 + 2.0	20.1 + 2.2	23.3 + 2.5	26.5 + 2.9	30.8 + 3.3	34.5 + 3.7	7
850	900.0	902.0	9.0	19.8 + 2.2	22.6 + 2.5	26.2 + 2.8	29.8 + 3.2	34.6 + 3.7	38.8 + 4.1	8
950	1000.0	1002.0	10.0	22.0 + 2.4	25.1 + 2.7	29.2 + 3.1	33.1 + 3.5	38.5 + 4.1	43.1 + 4.5	9

NOTES:

1 Dimensions apply to barrel of pipe exclusive of end treatment (see Clause 2.4).

2 Tolerances on wall thickness 0.1 *T*min + 0.2 mm rounded up to the nearest 0.1 mm.

TABLE 3.3(B)

DIMENSIONS FOR SERIES 1 PIPES FOR STANDARD DIMENSION RATIOS

millimetres

Nominal diameter *DN*	Outside diameter			Wall thickness $T_{min.}$ and wall thickness tolerance						Tolerance on end squareness
	Mean outside diameter		Maximum out of roundness	*SDR* 20.4	*SDR* 17.7	*SDR* 15.6	*SDR* 14.3	*SDR* 13.5	*SDR* 12.7	
	$D_{m\ min.}$	$D_{m\ max.}$		$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	
10	17.0	17.3	0.5	—	—	—	—	—	—	–
15	21.2	21.5	0.5	—	—	—	—	1.6 + 0.4	1.7 + 0.4	2
20	26.6	26.9	0.5	—	—	1.7 + 0.4	1.9 + 0.4	2.0 + 0.4	2.1 + 0.4	2
25	33.4	33.7	0.5	1.6 + 0.4	1.9 + 0.4	2.1 + 0.4	2.3 + 0.4	2.5 + 0.5	2.6 + 0.5	2
32	42.1	42.4	0.5	2.1 + 0.4	2.4 + 0.4	2.7 + 0.5	2.9 + 0.5	3.1 + 0.5	3.3 + 0.5	2
40	48.1	48.4	0.5	2.4 + 0.4	2.7 + 0.5	3.1 + 0.5	3.4 + 0.5	3.6 + 0.6	3.8 + 0.6	2
50	60.2	60.5	0.6	3.0 + 0.5	3.4 + 0.5	3.9 + 0.6	4.2 + 0.6	4.5 + 0.7	4.7 + 0.7	2
65	75.2	5.5	0.7	3.7 + 0.6	4.2 + 0.6	4.8 + 0.7	5.3 + 0.7	5.6 + 0.8	5.9 + 0.8	2
80	88.7	89.1	0.9	4.3 + 0.6	5.0 + 0.7	5.7 + 0.8	6.2 + 0.8	6.6 + 0.9	7.0 + 0.9	2
100	114.1	114.5	1.2	5.6 + 0.8	6.4 + 0.8	7.3 + 0.9	8.0 + 1.0	8.5 + 1.1	9.0 + 1.1	2
125	140.0	140.4	1.4	6.9 + 0.9	7.9 + 1.0	9.0 + 1.1	9.8 + 1.2	10.4 + 1.2	11.0 + 1.3	2
150	168.0	168.5	1.7	8.2 + 1.0	9.5 + 1.2	10.8 + 1.3	1.7 + 1.4	12.4 + 1.4	13.2 + 1.5	2
175	200.0	200.5	2.0	9.8 + 1.2	11.3 + 1.3	12.8 + 1.5	14.0 + 1.6	14.8 + 1.7	15.7 + 1.8	2
200	225.0	225.6	2.2	11.0 + 1.3	12.7 + 1.5	14.4 + 1.6	15.7 + 1.8	16.7 + 1.9	17.7 + 2.0	2
225	250.0	250.7	2.5	12.3 + 1.4	14.1 + 1.6	16.0 + 1.8	17.5 + 2.0	18.5 + 2.1	19.7 + 2.2	2
250	280.0	280.8	2.8	13.7 + 1.6	15.8 + 1.8	17.9 + 2.0	19.6 + 2.2	20.7 + 2.3	22.0 + 2.4	2
300	315.0	315.9	3.1	15.4 + 1.7	17.8 + 2.0	20.2 + 2.2	22.0 + 2.4	23.3 + 2.5	24.8 + 2.7	3
350	355.0	356.0	3.6	17.4 + 1.9	20.1 + 2.2	22.8 + 2.5	24.8 + 2.7	26.3 + 2.8	28.0 + 3.0	3
375	400.0	401.0	4.0	19.6 + 2.2	22.6 + 2.5	25.6 + 2.8	28.0 + 3.0	29.6 + 3.2	31.5 + 3.4	4
400	450.0	451.0	4.5	22.1 + 2.4	25.4 + 2.7	28.8 + 3.1	31.5 + 3.4	33.3 + 3.5	35.4 + 3.7	4
450	500.0	501.0	5.0	24.5 + 2.7	28.2 + 3.0	32.1 + 3.4	35.0 + 3.7	37.0 + 3.9	39.4 + 4.1	4
500	560.0	561.0	5.6	27.5 + 3.0	31.6 + 3.4	35.9 + 3.8	39.2 + 4.1	41.5 + 4.4	44.1 + 4.6	5
575	630.0	631.2	6.3	30.9 + 3.3	35.6 + 3.8	40.4 + 4.2	44.1 + 4.6	46.7 + 4.9	49.6 + 5.2	6
650	710.0	711.4	7.1	34.8 + 3.7	40.1 + 4.2	45.5 + 4.8	49.7 + 5.2	52.6 + 5.5	—	6
750	800.0	801.6	8.0	39.2 + 4.1	45.2 + 4.7	51.3 + 5.3	—	—	—	7
850	900.0	902.0	9.0	44.1 + 4.6	50.8 + 5.3	—	—	—	—	8
950	1000.0	1002.0	10.0	49.0 + 5.1	—	—	—	—	—	9

NOTES:

1 Dimensions apply to barrel of pipe exclusive of end treatment (see Clause 2.4).

2 Tolerances on wall thickness 0.1 *T*min + 0.2 mm rounded up to the nearest 0.1 mm.

TABLE 3.3(C)

DIMENSIONS FOR SERIES 1 PIPES FOR STANDARD DIMENSION RATIOS

millimetres

Nominal diameter *DN*	Outside diameter Mean outside diameter		Maximum out of roundness	Wall thickness T_{min}. and wall thickness tolerance				Tolerance on end squareness
				SDR 12.1	*SDR* 11	*SDR* 10.7	*SDR* 9.3	
	$D_{m\ min.}$	$D_{m\ max.}$		$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	
10	17.0	17.3	0.5	—	—	.6 + 0.4	1.8 + 0.4	2
15	21.2	21.5	0.5	1.8 + 0.4	1.9 + 0.4	2.0 + 0.4	2.3 + 0.4	2
20	26.6	26.9	0.5	2.2 + 0.4	2.4 + 0.4	2.5 + 0.5	2.9 + 0.5	2
25	33.4	33.7	0.5	2.8 + 0.5	3.0 + 0.5	13.1 + 0.5	3.6 + 0.6	2
32	42.1	42.4	0.5	3.5 + 0.6	3.8 + 0.6	3.9 + 0.6	4.5 + 0.7	2
40	48.1	48.4	0.5	4.0 + 0.6	4.4 + 0.6	4.5 + 0.7	5.2 + 0.7	2
50	60.2	60.5	0.6	5.0 + 0.7	5.5 + 0.8	5.6 + 0.8	6.5 + 0.9	2
65	75.2	75.5	0.7	6.2 + 0.8	6.8 + 0.9	7.0 + 0.9	8.1 + 1.0	2
80	88.7	89.1	0.9	7.3 + 0.9	8.1 + 1.0	8.3 + 1.0	9.5 + 1.2	2
100	114.1	114.5	1.2	9.4 + 1.1	10.4 + 1.2	10.7 + 1.3	12.3 + 1.4	2
125	140.0	140.4	1.4	11.6 + 1.4	12.7 + 1.5	13.1 + 1.5	15.1 + 1.7	2
150	168.0	168.5	1.7	13.9 + 1.6	15.3 + 1.7	15.7 + 1.8	18.1 + 2.0	2
175	200.0	200.5	2.0	16.5 + 1.9	18.2 + 2.0	18.7 + 2.1	21.5 + 2.4	2
200	225.0	225.6	2.2	18.6 + 2.1	20.5 + 2.3	21.0 + 2.3	24.2 + 2.6	2
225	250.0	250.7	2.5	20.7 + 2.3	22.7 + 2.5	23.4 + 2.5	26.9 + 2.9	2
250	280.0	280.8	2.8	23.1 + 2.5	25.5 + 2.8	26.2 + 2.8	30.1 + 3.2	2
300	315.0	315.9	3.1	26.0 + 2.8	28.6 + 3.1	29.4 + 3.1	33.9 + 3.6	3
350	355.0	356.0	3.6	29.3 + 3.1	32.3 + 3.4	33.2 + 3.5	38.2 + 4.0	3
375	400.0	401.0	4.0	33.1 + 3.5	36.4 + 3.8	37.4 + 3.9	43.0 + 4.5	4
400	450.0	451.0	4.5	37.2 + 3.9	40.9 + 4.3	42.1 + 4.4	—	4
450	500.0	501.0	5.0	41.3 + 4.3	45.5 + 4.8	46.7 + 4.9	—	4
500	560.0	561.0	5.6	46.3 + 4.8	—	—	—	5
75	630.0	631.2	6.3	52.1 + 5.4	—	—	—	6
650	710.0	711.4	7.1	—	—	—	—	—
750	800.0	801.6	8.0	—	—	—	—	—
850	900.0	902.0	9.0	—	—	—	—	—
950	1000.0	1002.0	10.0	—	—	—	—	—

NOTES:

1 Dimensions apply to the barrel of pipe exclusive of end treatment (see Clause 2.4).

2 Tolerance on wall thickness 0.1 *T*min + 0.2 mm rounded up to the nearest 0.1 mm.

TABLE 3.4(A)

DIMENSIONS FOR SERIES 2 PIPES FOR STANDARD DIMENSION RATIOS (C.I. OUTSIDE DIAMETERS)

millimetres

Nominal diameter *DN*	Outside diameter			Wall thickness $T_{min.}$ and wall thickness tolerance						Tolerance on end squareness
	Mean outside diameter		Maximum out of roundness	*SDR* 34.3	*SDR* 30.2	*SDR* 26	*SDR* 23.2	*SDR* 20.4	*SDR* 17.7	
	$D_{m\ min.}$	$D_{m\ max.}$		$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	
100	121.8	122.2	1.2	—	—	—	5.3 + 0.7	6.0 + 0.8	6.9 + 0.9	2
150	176.7	177.3	1.8	—	—	—	7.6 + 1.0	8.7 + 1.1	10.0 + 1.2	2
200	231.7	232.3	2.3	—	—	—	10.0 + 1.2	11.4 + 1.3	13.1 + 1.5	2
225	258.6	259.4	2.5	7.5 + 1.0	8.6 + 1.1	9.9 + 1.2	11.1 + 1.3	12.7 + 1.5	14.6 + 1.7	2
250	285.6	286.5	2.8	8.3 + 1.0	9.5 + 1.2	11.0 + 1.3	12.3 + 1.4	14.0 + 1.6	16.1 + 1.8	3
300	344.5	345.5	3.5	10.0 + 1.2	11.4 + 1.3	13.3 + 1.5	14.8 + 1.7	16.9 + 1.9	19.5 + 2.2	3
375	425.5	426.5	4.2	12.4 + 1.4	14.1 + 1.6	16.4 + 1.8	18.3 + 2.0	20.9 + 2.3	24.0 + 2.6	4
450	506.5	507.5	5.0	14.8 + 1.7	16.8 + 1.9	19.5 + 2.2	21.8 + 2.4	24.8 + 2.7	28.6 + 3.1	4
500	560.0	561.0	5.6	16.3 + 1.8	18.5 + 2.1	21.5 + 2.4	24.1 + 2.6	27.5 + 3.0	31.6 + 3.4	5
600	666.5	667.5	6.6	19.4 + 2.1	22.1 + 2.4	25.6 + 2.8	28.7 + 3.1	32.7 + 3.5	37.7 + 4.0	6
750	824.7	826.5	8.2	24.0 + 2.6	27.3 + 2.9	31.7 + 3.4	35.5 + 3.8	40.4 + 4.2	46.6 + 4.9	7

NOTES:

1 Dimensions apply to barrel of pipe exclusive of end treatment (see Clause 2.4).

2 Tolerance on wall thickness 0.1 $T_{min.}$ + 0.2 mm rounded up to the nearest 0.1 mm.

TABLE 3.4(B)

DIMENSIONS FOR SERIES 2 PIPES FOR STANDARD DIMENSION RATIOS (C.I. OUTSIDE DIAMETERS)

millimetres

Nominal diameter *DN*	Outside diameter			Wall thickness $T_{min.}$ and wall thickness tolerance						Tolerance on end squareness
	Mean outside diameter		Maximum out of roundness	*SDR* 15.6	*SDR* 14.3	*SDR* 13.5	*SDR* 12.7	*SDR* 12.1	*SDR* 11	
	$D_{m\ min.}$	$D_{m\ max.}$		$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	
100	121.8	122.2	1.2	7.8 + 1.0	8.5 + 1.1	9.0 + 1.1	9.6 + 1.2	10.1 + 1.2	11.1 + 1.3	2
150	176.7	177.3	1.8	11.3 + 1.3	12.4 + 1.4	13.1 + 1.5	13.9 + 1.6	14.6 + 1.7	16.1 + 1.8	2
200	231.7	232.3	2.3	14.9 + 1.7	16.2 + 1.8	17.2 + 1.9	18.2 + 2.0	19.1 + 2.1	21.1 + 2.3	2
225	258.6	259.4	2.5	16.6 + 1.9	18.1 + 2.0	19.2 + 2.1	20.4 + 2.2	21.4 + 2.3	23.5 + 2.6	2
250	285.6	286.5	2.8	18.3 + 2.0	20.0 + 2.2	21.2 + 2.3	22.5 + 2.5	23.6 + 2.6	26.0 + 2.8	3
300	344.5	345.5	3.5	22.1 + 2.4	24.1 + 2.6	25.5 + 2.8	27.1 + 2.9	28.5 + 3.1	31.3 + 3.3	3
375	425.5	426.5	4.2	27.3 + 2.9	29.8 + 3.2	31.5 + 3.4	33.5 + 3.6	35.2 + 3.7	38.7 + 4.1	4
450	506.5	507.5	5.0	32.5 + 3.5	35.4 + 3.7	37.5 + 4.0	39.9 + 4.2	41.9 + 4.4	46.0 + 4.8	4
500	560.0	561.0	5.6	35.9 + 3.8	39.2 + 4.1	41.5 + 4.4	44.1 + 4.6	46.3 + 4.8	50.9 + 5.3	5
600	666.5	667.5	6.6	42.7 + 4.5	46.6 + 4.9	49.4 + 5.1	52.5 + 5.5	—	—	6
750	824.7	826.5	8.2	52.9 + 5.5	—	—	—	—	—	7

NOTES:

1 Dimensions apply to barrel of pipe exclusive to end treatment (see Clause 2.4).

2 Tolerance on wall thickness 0.1 $T_{min.}$ + 0.2 mm rounded up to the nearest 0.1 mm.

TABLE 3.5

DIMENSIONS FOR SERIES 3 PIPES FOR STANDARD DIMENSION RATIOS

millimetres

Nominal diameter *DN*	Outside diameter			Wall thickness $T_{min.}$ and wall thickness tolerance						Tolerance on end squareness
	Mean outside diameter		Maximum out of roundness	*SDR* 41	*SDR* 33	*SDR* 26	*SDR* 21	*SDR* 17	*SDR* 13.6	
	$D_{m\ min.}$	$D_{m\ max.}$		$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	$T_{min.}$ + tol	
12	12.0	12.2	0.5	—	—	—	—	—	—	2
16	16.0	16.2	0.5	—	—	—	—	—	1.6 + 0.4	2
20	20.0	20.2	0.5	—	—	—	—	—	1.6 + 0.4	2
25	25.0	25.2	0.5	—	—	—	—	1.6 + 0.4	1.9 + 0.4	2
32	32.0	32.2	0.5	—	—	—	1.6 + 0.4	1.9 + 0.4	2.4 + 0.5	2
40	40.0	40.2	0.5	—	—	1.6 + 0.4	1.9 + 0.4	2.4 + 0.5	3.0 + 0.5	2
50	50.0	50.2	0.5	—	1.6 + 0.4	2.0 +0.4	2.4 + 0.5	3.0 + 0.5	3.7 + 0.6	2
63	63.0	63.3	0.6	1.6 + 0.4	2.0 + 0.4	2.5 + 0.5	3.0 + 0.5	3.8 + 0.6	4.7 + 0.7	2
75	75.0	75.3	0.7	1.9 +0.4	2.3 + 0.5	2.9 + 0.5	3.6 + 0.6	4.5 + 0.7	5.6 + 0.8	2
90	90.0	90.3	0.9	2.2 + 0.5	2.8 + 0.5	3.5 + 0.6	4.3 + 0.7	5.4 + 0.8	6.7 + 0.9	2
110	110.0	110.4	1.1	2.7 + 0.5	3.4 + 0.6	4.2 + 0.7	5.3 + 0.8	6.6 + 0.9	8.1 + 1.1	2
125	125.0	125.4	1.2	3.1 + 0.6	3.9 + 0.6	4.8 + 0.7	6.0 + 0.8	7.4 + 1.0	9.2 + 1.2	2
140	140.0	140.4	1.4	3.5 + 0.6	4.3 + 0.7	5.4 + 0.8	6.7 + 0.9	8.3 + 1.1	10.3 + 1.3	2
160	160.0	160.5	1.6	4.0 + 0.6	4.9 + 0.7	6.2 + 0.9	7.7 + 1.0	9.5 + 1.2	11.8 + 1.4	2
180	180.0	180.6	1.8	4.4 + 0.7	5.5 + 0.8	6.9 + 0.9	8.6 + 1.1	10.7 + 1.3	13.3 + 1.6	2
200	200.0	200.5	2.0	4.9 + 0.7	6.2 + 0.9	7.7 + 1.0	9.6 + 1.2	11.9+ 1.4	14.7 + 1.7	2
225	225.0	225.6	2.2	5.5 + 0.8	6.9 + 0.9	8.6 + 1.1	10.8 + 1.3	13.4 + 1.6	16.6 + 1.9	2
250	250.0	250.7	2.5	6.2 + 0.9	7.7 + 1.0	9.6 + 1.2	11.9 + 1.4	14.8 + 1.7	18.4 + 2.1	2
280	280.0	280.8	2.8	6.9 + 0.9	8.6 + 1.1	10.7 + 1.3	13.4 + 1.6	16.6 + 1.9	20.6 + 2.3	2
315	315.0	315.9	3.1	7.7 + 1.0	9.7 + 1.2	12.1 + 1.5	15.0 + 1.7	18.7 + 2.1	23.2 + 2.6	3
355	355.0	356.0	3.6	8.7 + 1.1	10.9 + 1.3	13.6 + 1.6	16.9 + 1.9	21.1 + 2.4	26.1 + 2.9	3
400	400.0	401.0	4.0	9.8 + 1.2	12.3 + 1.5	15.3 + 1.8	19.1 + 2.2	23.7 + 2.6	29.4 + 3.2	4

NOTES:

1 Dimensions apply to barrel of pipe exclusive to end treatment (see Clause 2.4).

2 Tolerance on wall thickness 0.1 $T_{min.}$ + 0.2 mm rounded up to the nearest 0.1 mm.

TABLE 3.6

DIMENSIONS OF SOCKETS FORMED ON PIPE ENDS FOR SOLVENT CEMENT JOINTING SERIES 1 ABS PIPES (SEE FIGURE 3.2)

Pipe dimensions		Socket dimensions			
Nominal size	Min. socket length	Mean root diameter		Mean mouth diameter	
DN	*L*	$D_{r\ min.}$	$D_{r\ max.}$	$D_{i\ min.}$	$D_{i\ max.}$
10	14.5	16.7	16.9	17.4	17.6
15	16.5	20.9	21.1	21.6	21.8
20	19.5	26.2	26.5	27.0	27.3
25	22.5	33.0	33.3	33.8	34.1
32	27	41.7	42.0	42.5	42.8
40	30	47.7	48.0	48.5	48.8
50	36	59.8	60.1	60.6	60.9
65	44	74.8	75.1	75.6	75.9
80	50.5	88.3	88.6	89.2	89.5
100	63	113.5	113.8	114.6	114.9
125	76	139.5	139.8	140.6	140.9
150	90	167.4	167.8	168.7	169.1
175	106	199.2	199.6	200.7	201.1
200	118.5	224.2	224.6	225.9	226.3
225	131	249.1	249.5	250.9	251.3
250	146	279.0	279.4	281.0	281.4
300	163.5	314.0	314.5	316.1	316.6
350	183.5	354.0	354.4	356.2	356.6
375	206	398.8	399.4	401.2	401.8
400	231	448.8	449.3	451.3	451.8
450	256	498.6	499.3	501.3	502.0
500	270	558.5	559.2	561.3	562.0
575	285	628.3	629.1	631.4	632.2
650	305	708.2	709.0	711.8	712.6
750	330	797.8	798.6	802.0	802.8

TABLE 3.7

DIMENSIONS OF SOCKETS FORMED ON PIPE ENDS FOR SOLVENT CEMENT JOINTING SERIES 2 ABS PIPES (SEE FIGURE 3.2)

Pipe dimensions		Socket dimensions			
Nominal size	Min. socket length	Mean root diameter		Mean mouth diameter	
DN	*L*	$D_{r\ min.}$	$D_{r\ max.}$	$D_{i\ min.}$	$D_{i\ max.}$
100	67	121.0	121.4	122.4	122.8
150	95	175.9	176.3	177.5	177.9
200	122	230.9	231.3	232.5	232.9
225	136	257.7	258.1	259.6	260.0
250	149	284.6	285.0	286.7	287.1
300	179	343.5	343.9	345.7	346.1
375	219	424.3	424.8	426.8	427.3
450	260	505.1	505.8	507.8	508.5
500	270	558.5	559.2	561.3	562.0
600	305	664.8	665.6	667.8	668.6
750	330	822.2	823.0	827.5	828.3

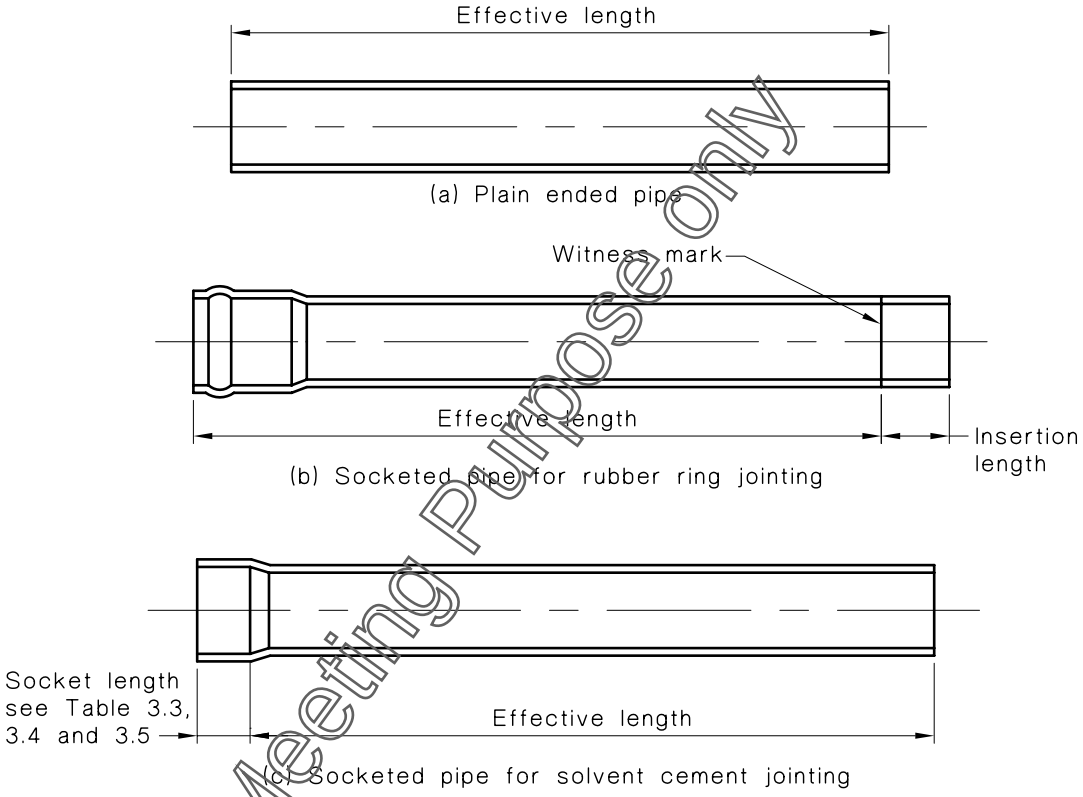

FIGURE 3.1 EFFECTIVE LENGTHS OF PIPE

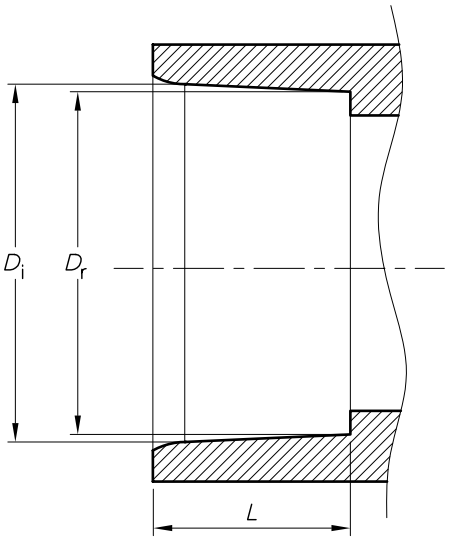

FIGURE 3.2 TYPICAL PIPE OR FITTING TAPERED SOCKETS FOR SOLVENT CEMENT JOINTING

3.2 MOULDED FITTINGS

3.2.1 Dimensions

3.2.1.1 *Spigot ends on moulded fittings*

The dimensions of spigot ends on moulded fittings, measured in accordance with AS/NZS 1462.1, shall meet the outside diameter requirements of Tables 3.3, 3.4 or 3.5. Where the spigot end is intended to be used in solvent cement jointing, the length of the spigot shall be not less than the minimum socket length specified in Tables 3.8 and 3.9 of this Standard.

3.2.1.2 *Sockets on moulded fittings to be used in conjunction with Series 1 pipes*

3.2.1.2.1 *Socket length on fittings for solvent cement jointing*

Socket length shall comply with the requirements of Table 3.8.

3.2.1.2.2 *Socket taper on fittings for solvent cement jointing*

The jointing surface of sockets for solvent cement joints shall have a taper that conforms with the following requirements:

(a) An interference fit that occurs where the maximum pipe diameter enters the socket more than $0.1L$ and the minimum pipe diameter enters the socket less than $0.9L$.

(b) The maximum diametral strain does not exceed 3.5% when calculated from the following equation:

$$\varepsilon = \frac{D_{m\,max.} - D_{r\,min.}}{D_{r\,min.}} \times 100 \qquad \ldots 3.2(2)$$

where

ε = percent maximum diametral strain

$D_{m\,max.}$ = maximum mean diameter of pipe, in millimetres

$D_{r\,min.}$ = minimum socket root mean diameter, in millimetres

L = depth from pipe end to $D_{r\,min.}$, in millimetres (see Figure 3.2)

3.2.1.3 *Parallel sockets on moulded fittings to be used in conjunction with Series 3 pipes.*

3.2.1.3.1 *Socket dimensions on fittings for solvent cement jointing*

Socket dimensions shall comply with the requirements of Table 3.9 and Figure 3.3.

3.2.1.3.2 *Socket taper*

The maximum included angle of the socket portion of fittings shall not exceed 0°40′ for $DN \leq 63$ and 0°30′ for $DN > 63$ mm.

3.2.1.4 *Sockets on fittings for elastomeric seal joints*

Sockets on fittings for elastomeric seal joints shall be in accordance with the requirements of Clause 3.4.

TABLE 3.8

MINIMUM LENGTH OF MOULDED ABS TAPER SOCKETS ON FITTINGS FOR SOLVENT CEMENT JOINTING WITH SERIES 1 PIPES

Nominal diameter *DN*	Socket length *L*	Nominal diameter *DN*	Socket length *L*
10	14.5	100	63.0
15	16.5	125	76.0
20	19.5	150	90.0
25	22.5	175	106.0
32	27.0	200	118.5
40	30.0	225	131.0
50	36.0	250	146.0
65	44.0	300	163.5
80	50.5	350	183.5
—	—	375	206.0

TABLE 3.9

DIMENSIONS OF MOULDED ABS PARALLEL SOCKETS IN FITTINGS FOR SOLVENT CEMENT JOINTING WITH SERIES 3 PIPES

Nominal diameter	Socket dimensions mean inside diameter		Out of roundness	Length
DN	min.	max.		*L*
12	12.1	12.3	0.25	12.0
16	16.1	16.3	0.25	14.0
20	20.1	20.3	0.25	16.0
25	25.1	25.3	0.25	18.5
32	32.1	32.3	0.25	22.0
40	40.1	40.3	0.25	26.0
50	50.1	50.3	0.3	31.0
63	63.1	63.3	0.4	37.5
75	75.1	75.3	0.5	43.5
90	90.1	90.3	0.6	51.0
110	110.1	110.4	0.7	61.0
125	125.1	125.4	0.8	68.5
140	140.2	140.5	0.9	76.0
160	160.2	160.5	1.0	86.0
180	180.2	180.6	1.1	96.0
200	200.3	200.6	1.2	106.0
225	225.3	225.7	1.4	118.5
250	250.4	250.8	1.5	131.0
280	280.4	280.9	1.7	146.0
315	315.5	316.0	1.9	163.5
355	355.5	356.0	2.2	183.5
400	400.5	401.3	2.4	206.0

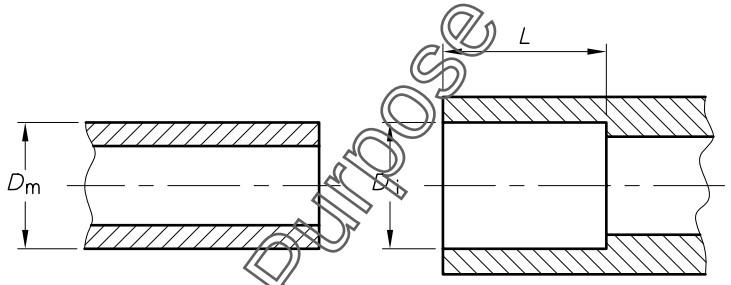

FIGURE 3.3 DIAMETERS AND LENGTHS OF PARALLEL SOCKETS FOR SOLVENT CEMENT JOINTING

3.2.2 Wall thickness

3.2.2.1 *Minimum thickness*

The minimum wall thickness of fittings, measured in accordance with AS/NZS 1462.1, for all sections subject to hoop stress developed under internal pressure, but excluding any socket lead-in, taper or radius, shall be not less than the greater of the thickness calculated from the following equations:

$$T_{min.} = \frac{PD_{m\,max.}}{(2HDS - P)} \quad \ldots 3.2(3)$$

$$HDS = \frac{F}{1.6} \quad \ldots 3.2(4)$$

where

$T_{min.}$ = minimum wall thickness, in millimetres

P = maximum allowable working pressure of the fitting, in megapascals (Appendix E)

$D_{m\ max.}$ = maximum mean external diameter of the pipe for which the fitting is intended, in millimetres

HDS = hydrostatic design stress, in megapascals

F = extrapolated 50-year failure stress specified by the manufacturer, in megapascals

3.2.2.2 *Special fittings of varying, tapered or non-circular cross-section*

The minimum wall thickness of fittings of varying, tapered or non-circular cross-section, at any point on the body, shall not be less than the thickness calculated from the following equation:

$$T_{min.} = \frac{Pd}{2HDS - P} \quad \ldots 3.2(5)$$

where

$T_{min.}$ = minimum wall thickness, in millimetres

P = maximum allowable working pressure of the fitting, in megapascals

d = the maximum internal dimension over the cross-section of the fitting, formed by the intersecting plane that produces the cross-section of minimum area, through the point of the fitting under consideration, in millimetres

HDS = hydrostatic design stress, in megapascals

3.2.3 Threaded fittings

3.2.3.1 *General*

All threads shall be of Whitworth form, right hand, and the number of threads engaged shall conform with Table 3.10, except that fittings ends required to connect to pipes or fittings of other materials shall comply with the appropriate Standard that applies to the connection.

TABLE 3.10

MINIMUM THREAD ENGAGEMENT

Thread size		Minimum number of full threads engaged
Fastening threads nominal diameter, mm	Sealing threads major diameter, mm	
≤ 25	≤ 32	3
>25 ≤ 50	>32 ≤ 65	4
>50 ≤ 80	>65 ≤ 90	5
>80	>90	6

3.2.3.2 *Fastening pipe threads*

Fastening pipe threads shall comply with the relevant requirements of AS 1722.2, to ensure compatibility of threads.

Internal threads shall be series G.

External threads shall be series GB.

3.2.3.3 *Sealing pipe threads*

Sealing pipe threads shall comply to the relevant requirements of AS 1722.1.

3.3 POST-FORMED BENDS AND COUPLINGS

3.3.1 General

Bends shall be formed from pipe complying with this Standard. The wall thickness, when thinned down by bending, measured in accordance with AS/NZS 1462.1, shall be not less than the minimum wall thickness required for the rated nominal pressure of the pipeline. Couplings shall be formed from pipes complying with this Standard.

3.3.2 Sockets

All sockets formed on post-formed bends and couplings shall comply with the requirements of Clause 3.1.5.

3.3.3 Bend radius and angle

The radius of any post-formed bend, measured to the centre-line, shall not be less than two and a half times the outside diameter. The angle of bends shall be within ±5° of the nominated value.

3.3.4 Spigots

The spigot ends of post-formed bends shall be straight and of sufficient length to satisfy the depth of engagement requirements specified for integral joints.

3.4 ELASTOMERIC SEAL JOINTS

3.4.1 Joint design

The joint design requirements are confined to the socket and the jointing seal, so that the performance requirements laid down in this Standard may be met by using parallel spigots within the dimensions for pipes specified in Clause 3.1.

3.4.2 Wall thickness

When measured in accordance with AS/NZS 1462.1, the minimum wall thickness of sockets for elastomeric seal jointing, on the pressure side of the joint, shall be not less than the minimum pipe wall thickness specified in Clause 3.1.

3.4.3 Socket depth

The minimum depth of socket engagement ($A_{min.}$) (see Figure 3.4), shall be in accordance with Table 3.11 for Series 1, Series 2 and Series 3 pipes, and shall be measured in accordance with AS/NZS 1462.1.

TABLE 3.11

MINIMUM DEPTH OF SOCKETS FOR ELASTOMERIC SEAL JOINTING

millimetres

Series 1		Series 2		Series 3	
Nominal diameter *DN*	Minimum socket depth $A_{min.}$	Nominal diameter *DN*	Minimum socket depth $A_{min.}$	Nominal diameter *DN*	Minimum socket depth $A_{min.}$
≤ 50	43	100	49	≤ 50	42
65	44	150	54	63	43
80	45	200	60	75	44
100	48	225	62	90	46
125	50	250	64	110	47
150	52	300	64	125	49
175	55	375	70	140	50
200	57	450	76	160	51
225	59	500	81	180	53
250	62	600	89	200	55
300	62	750	101	225	57
350	65	—	—	250	59
375	69	—	—	280	62
400	72	—	—	315	62
450	76	—	—	355	65
500	81	—	—	400	69
575	86	—	—	—	—
650	92	—	—	—	—
750	99	—	—	—	—
850	107	—	—	—	—
950	114	—	—	—	—

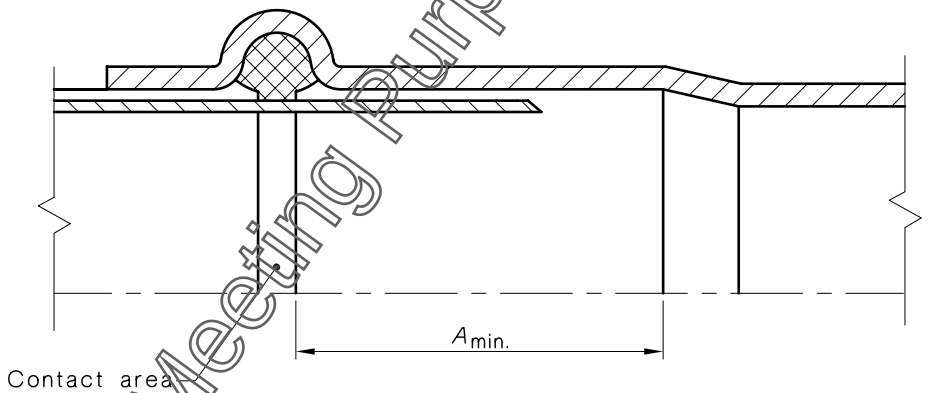

FIGURE 3.4 ELASTOMERIC SEAL JOINT WITH GROOVE IN SOCKET (½ SECTION)

3.5 FLANGED ENDS ON FITTINGS

Flanges and flange adaptors required to connect to Series 1,2 or 3 pipe, shall comply with AS 2129, AS 4087, AS/NZS 4331 or ISO 15493 as required, and shall conform to the relevant performance and design requirements of Section 2 and Section 3.

APPENDIX A

MEANS OF DEMONSTRATING COMPLIANCE WITH THIS STANDARD

(Normative)

A1 SCOPE

This Appendix sets out two means by which compliance with this Standard shall be demonstrated by a manufacturer:

(a) The use of a product certification scheme.

(b) The use of a minimum sampling and testing frequency plan.

A2 RELEVANCE

The long-term performance of pipeline systems is critical to the operating efficiency of water agencies in terms of operating licences and customer contracts. The long-term performance of plumbing systems is similarly critical to the durability of building infrastructure, protection of public health and safety and protection of the environment.

A3 BATCH DEFINITIONS

A3.1 Acceptable quality level (AQL)

When a continuous series of lots or batches is considered, the quality level which for the purpose of sampling inspection is the limit of a satisfactory process average (see ISO 2859-1 and ISO 3951)

NOTE: The designation of an AQL does not imply that a manufacturer has the right to knowingly supply any non-conforming unit of product.

A3.2 Batch

A3.2.1 *Material or compound batch*

A defined quantity of a homogeneous material or compound produced under uniform conditions. The batch is defined and identified by the material or compound producer.

A3.2.2 *Pipes or fittings batch*

Schedule of pipes or fittings, all the same nominal diameter, wall thickness and marking, manufactured from the same material or compound on the same machine. The batch is defined and identified by the pipe or fitting manufacturer.

A3.3 Batch release test

A test performed on a sample from the batch or lot to confirm conformance to the requirements of this Standard before the batch can be released.

A3.4 Inspection level

The relationship between the lot or batch size and the sample size (see ISO 2859-1).

A3.5 Lot

A clearly identifiable subdivision of a batch for inspection purposes.

A3.6 New formulation

A change in material or compound formulation that exceeds the limits given in Paragraph A6

A3.7 Production batch

A clearly identifiable collection of units, manufactured consecutively or continuously under the same conditions, using material or compound to the same specification.

A3.8 Process verification test (PVT)

A test performed by the manufacturer on materials, components, joints or assemblies at specific intervals, to confirm that the process continues to be capable of producing components conforming to the requirements given in the System Standard. Such tests are not required to release batches of components and are carried out as a measure of process control.

A3.9 Sample

One or more units of product drawn from a batch or lot, selected at random without regard to quality. The number of units of product in the sample is the sample size.

A3.10 Sampling plan

A specific plan which indicates the number of units of components or assemblies to be inspected or tested.

A3.11 Type testing (TT)

Testing performed to prove that a material, component, joint or assembly is capable of conforming to the requirements given in the relevant Standard.

A4 PRODUCT CERTIFICATION

The purpose of product certification is to provide independent assurance of the claim by the manufacturer that products comply with this Standard.

The certification scheme shall meet the criteria described in SAA HB 18.28/SANZ HB 18.28 (ISO/IEC Guide 28) in that, as well as full type testing from independently sampled production and subsequent verification of conformance, it requires the manufacturer to maintain effective planning to control production.

The certification scheme serves to indicate that the products consistently conform to the requirements of this Standard.

Product certification shall be conducted by a certification body accredited by the Joint Accreditation System for Australia and New Zealand (JAS-ANZ) or by another certification body that is acceptable to JAS-ANZ.

The frequency of the sampling and testing plan as detailed in Paragraph A5 shall be used by the certifying body for product compliance auditing. However, where the manufacturer can demonstrate adequate process control to the certifying body, the frequency of sampling and testing nominated in the manufacturer's quality and/or documented procedures shall take precedence for the purpose of product certification.

A5 MINIMUM SAMPLING AND TESTING FREQUENCY PLAN

A5.1 General

Table A1 sets out the minimum sampling and testing frequency plan for a manufacturer to demonstrate compliance of product(s) to this Standard.

A5.2 Retesting

In the event of a test failure, the products manufactured since the previous test(s) conforming to the requirements outline in Table A1 shall be quarantined as a batch. A further set of samples shall be selected randomly from the quarantined batch using a sampling plan to AS 1199 for an AQL of 2.5 and an inspection level of S3, unless otherwise

specified. If the retest requirements are met, the batch may be released and compliance with this Standard for the quarantined batch may be claimed.

Should a failure occur on retesting, then the quarantined batch shall be rejected and claims and/or marking indicating compliance to this Standard shall be suspended until the cause of the failure has been identified and corrected.

A5.3 Rejection after test

In the event of a quarantined batch being rejected after retesting in accordance with the procedures set out in Paragraph A5.2, it may be subjected to 100% testing for the failed requirement(s), and only those items found to comply may be claimed and/or marked as complying with this Standard.

A6 RE-EVALUATION OF MATERIAL / COMPOUND

A6.1 Change in material/compound

If a material type is changed or any level exceeds the tolerance band specified, this constitutes a change in material/compound and the relevant characteristics in Table A1 have to be retested. For the purpose of this Standard, the following definitions of changes to compound formulation apply.

(a) *Change of base polymer* Change of polymer manufacturer, polymerization process or chemical nature of co-monomer.

(b) *Change of grade* Any change of the proportion of styrene, acrylonitrile or butadiene within the tolerance of ±2%.

(c) *Change of additives* Any of the following:

(i) Change of chemical nature or addition or deletion of any additive.

(ii) Change of any additive (other than UV stabilizers) level by > 30%.

(iii) Decrease of UV stabilizers by >30% or increase by >50%.

TABLE A1

MINIMUM SAMPLING AND TESTING FREQUENCY PLAN

Characteristics	Clause	Requirement	Test Method	Frequency
TYPE TEST (TT) - PIPES				
Material property	2.2.1	Compound	ISO 7245	Any new material formulation or design, or once every 5 years—whichever occurs first
	2.2.3.2	Pigment dispersion	AS/NZS 1462.28	
	2.2.4	Stabilization	ISO TR 10837	
Performance	2.2.5	*MRS*	ISO 9080	
	2.6	Effect on water	AS/NZS 4020	
	2.7.1	Short term hydrostatic pressure	AS/NZS 1462.6	
	2.7.2	Impact characteristics at 0°C	AS/NZS 1462.3	
	2.7.3	Reversion	AS/NZS 1462.4	
	2.7.4	High temperature	AS/NZS 1462.16	
	2.9.1	Joint hydrostatic tests	AS/NZS 1462.17	
	2.9.2	Joint infiltration	AS/NZS 1462.8	
Freedom from defects	2.5	Freedom from defects	Visual inspection	
Dimensions	3.1, 3.4	Dimensions	AS/NZS 1462.1	
TYPE TEST (TT) - MOULDED FITTINGS				
Material property	2.2.1	Compound	ISO 7245	Any new material formulation or design, or once every 5 years—whichever occurs first
	2.2.3.2	Pigment dispersion	ISO 18553	
Performance	2.2.5	*MRS*	ISO 9080	
	2.6	Effect on water	AS/NZS 4020	
	2.8.1	Tightening torque	AS 2888.1	
	2.8.2	Short term hydrostatic pressure	AS 1462.9	
	2.8.3	High temperature stress relief	AS/NZS 1462.11	
	2.9.1	Joint hydrostatic tests	AS/NZS 1462.17 AS/NZS 1462.6	
	2.9.2	Joint infiltration	AS/NZS 1462.8	
Freedom from defects	2.5	Freedom from defects	Visual inspection	
Dimensions	3.2-3.5	Dimensions	AS/NZS 1462.1	
PROCESS VERIFICATION TESTS (PVT) - PIPES AND FITTINGS				
Performance	2.7.1	Pipe short term hydrostatic pressure	AS/NZS 1462.6	To manufacturer's sampling plan. Samples to be evenly selected from all pressure groups in such a way that units of each *DN* produced are tested regularly and continuously but at least once per 3 years
	2.8.2	Fittings short term hydrostatic pressure	AS 1462.9	
	2.2.3.2	Pigment dispersion	AS/NZS 1462.28	

(continued)

TABLE A1 (*continued*)

Characteristics	Clause	Requirement	Test Method	Frequency
BATCH RELEASE TEST (BRT) - PIPES				
Performance	2.7.1	Short term hydrostatic pressure	AS/NZS 1462.6	Once per batch
	2.7.2	Impact characteristics at 0°C	AS/NZS 1462.3	Once per batch
	2.7.3	Reversion	AS/NZS 1462.4	Beginning of run
	2.7.4	High temperature test	AS/NZS 1462.16	Once per batch
Dimensions	3.1.2	Diameter and wall thickness	AS/NZS 1462.1	Once per hour
	3.1.3	Length	AS/NZS 1462.1	Once per 4 h
	3.1.4	Pipe spigot ends	AS/NZS 1462.1	Once per 4 h
	3.1.5, 3.4.2, 3.4.3	Pipe sockets	AS/NZS 1462.1*	Once per 4 h
	1.6	Marking	Visual inspection	Once per 4 h
Freedom from defects	2.5	Freedom from defects	Visual inspection	Once per 4 h
BATCH RELEASE TEST (BRT) - MOULDED FITTINGS				
Performance	2.8.1	Thread tightening torque	AS 2888.1	Once per batch per cavity
	2.8.2	Short term hydrostatic pressure	AS 1462.9	Once per batch per cavity
	2.8.3	High temperature stress relief	AS/NZS 1462.11	Once per 8 h per cavity
Dimensions	3.2 – 3.5	Dimensions	AS/NZS 1462.1*	Once per 4 h per cavity
	3.2.3	Threads	AS 1722.1* or AS 1722.2*	Once per 4 h per cavity
	1.6	Marking	Visual inspection	Once per 4 h per cavity
Freedom from defects	2.5	Freedom from defects	Visual inspection	Once per cavity per hour

* May also test by attributes (e.g., go and no-go gauges).

APPENDIX B

PREPARATION OF TEST SPECIMEN FOR SHORT-TERM PRESSURE TEST

(Normative)

B1 SCOPE

This Appendix sets out a method for preparing solvent-cemented fitting specimens for short-term pressure testing.

B2 PROCEDURE

Each test specimen shall be prepared as follows:

(a) All ABS pipe used in preparing the pipe/fittings specimen shall be of the same class as the fitting, and shall comply with Section 2 of this Standard. If pipe lengths are solvent cemented into the fitting for testing, pipe lengths shall be a minimum of two times the nominal outer diameter of the fitting.

(b) Clean and degrease the jointing surfaces with the priming fluid recommended by the solvent cement manufacturer.

(c) Evenly apply a single coating of solvent cement to the jointing surfaces by means of a brush. For each joint the socket or coupling shall be coated first and then the pipe. The total coating time shall not exceed 60 s.

(d) Make the joint immediately after application of the solvent cement, and wipe off the excess solvent cement from the outside of the joint.

(e) Restrain the joint to prevent springing, and cure at 20 ±2°C for not less than 24 h.

(f) Fit the end caps at the completion of the curing period avoiding any shear stress on the joint.

APPENDIX C

DETERMINATION OF MULTIPLIERS FOR ELASTOMERIC SEAL JOINT HYDROSTATIC PRESSURE TEST

(Normative)

C1 SCOPE

This Appendix sets out a procedure to determine the appropriate multipliers of working pressure used in the overall hydrostatic pressure assessment of elastomeric seal joints, to predict the performance of the joints at 50 years after testing for 1 h and 1 000 h.

C2 PRINCIPLE

C2.1 Creep behaviour

Both the pipe and elastomer used in the seal joint will exhibit a form of creep behaviour. Extensive creep of either the pipe or the elastomer material may cause leakage of the joint assembly and thus failure.

It is necessary to determine the creep behaviour of both the pipe compound and the elastomeric seal, and use either working pressure multipliers of the pipe compound, or compression stress relaxation multipliers of the seal, defined as:

(a) α =1 000 h multiplier; and

(b) β =1 h multiplier

as required to predict the long term performance of the joint. The multipliers used will be based on the greater of the two creep behaviours.

C2.2 Elastomeric seals

Creep behaviour is based on the rate of compression stress relaxation and is determined using the following formula:

$$\sigma = \sigma_{0_o}(1 - R_r \log t) \qquad \ldots \text{C2(1)}$$

where

σ = Compression stress on the elastomeric seal at time t

σ_0 = Compression stress applied to the elastomeric seal at time $t = 0$

R_r = rate of compression stress relaxation of the seal defined in AS 1646.3 Table 2.1 per 10 years, based on the nominal hardness of elastomeric seal materials

T = time (in hours) that the seal is under compression stress

Compression stress multipliers are defined as the ratios of stress at specific time t over stress at 100 years.

Thus from formula C2(1):

For t = 1 000 h, compression stress multiplier α is defined as:

$$\alpha = \left(\frac{\sigma_{1\,000\ \mathrm{h}}}{\sigma_{50\ \mathrm{years}}} \right) \quad \ldots \text{C2(2)}$$

or

$$\alpha = \frac{1 - 3R_r}{1 - 5.64R_r} \quad \ldots \text{C2(3)}$$

For t = 1 h, compression stress multiplier β is defined as:

$$\beta = \left(\frac{\sigma_{1\,\mathrm{h}}}{\sigma_{50\ \mathrm{years}}} \right) \quad \ldots \text{C2(4)}$$

or

$$\beta = \frac{1}{1 - 5.64R_r} \quad \ldots \text{C2(5)}$$

C2.3 Pipe

A strain value (ε) for the ABS pipe compound (i.e., ABS 120, ABS 140 or ABS 160) using isochronous stress/strain diagrams, is determined at the design stress of the compound (σ_s) after 100 years. A strain safety factor (ε_A) which is equivalent to half ε is added to give ε_T (therefore $\varepsilon_T = \varepsilon + \varepsilon_A$). Based on a strain value of ε_T, test stress values for 1 h (σ_1) and 1000 h (σ_{1000}) are determined from the isochronous stress/strain diagrams. The values α and β are calculated from the ratios as follows:

$$\alpha = \frac{\sigma_{1\,000\ \mathrm{h}}}{\sigma_s} \quad \ldots \text{C2(6)}$$

and

$$\beta = \frac{\sigma_{1\,\mathrm{h}}}{\sigma_s} \quad \ldots \text{C2(7)}$$

C3 EXAMPLE

As an example, the multipliers α and β are determined for both seal X and pipe X in an elastomeric seal joint:

For the elastomeric seal X:

From AS 1646.3, Table 2.1, R_r = 6%, thus from equations C2(3) and C2(5):

$$\alpha = \frac{1 - 3R_r}{1 - 5.64R_r} = \frac{1 - 3 \times 0.06}{1 - 5.64 \times 0.06} = 1.24$$

$$\beta = \frac{1}{1 - 5.64R_r} = \frac{1}{1 - 5.64 \times 0.06} = 1.51$$

For pipe X:

(a) σ_s = 10.0 MPa, ε = 0.633 (for example purposes only see C2.3 Pipe).

(b) thus, ε_A = 0.317 and therefore $\varepsilon_T = \varepsilon + \varepsilon_A$ = 0.95.

(c) At ε_T, σ_1= 22.4 MPa and σ_{1000} = 16.1 MPa.

(d) Therefore multipliers determined on the pipe compound,

$$\alpha = \frac{\sigma_{1\,000}}{\sigma_s} = \frac{16.1}{10.0} = 1.61$$

and

$$\beta = \frac{\sigma_1}{\sigma_s} = \frac{22.4}{10.0} = 2.24$$

Therefore the multipliers determined for the pipe are greater than those for the elastomeric seal.

By multiplying the nominal working pressure of the joint by the multipliers α and β determined for the pipe, the performance of the joint with the expected creep after 100 years of service may be assessed at 1 000 h and 1 h respectively.

APPENDIX D

DESIGN WALL THICKNESS FOR SERIES 1, SERIES 2 AND SERIES 3 PIPES FOR SPECIAL APPLICATIONS

(Normative)

For special applications, the pipe wall thickness requirements shall be calculated from the following equations:

$$T_{\min.} = \frac{PD_{m\,\min.}}{2HDS + P} \quad \ldots \text{D1}$$

where

P = maximum design operating pressure of pipe, in megapascals

$D_{\text{m min.}}$ = minimum mean outside diameter from Tables 3.3, 3.4 or 3.5, as appropriate, in millimetres

$T_{\max.}$ = $1.1\ T_{\min.} + 0.2$

HDS = MRS/C

All other provisions of this Standard shall apply.

APPENDIX E

CALCULATION OF MAXIMUM ALLOWABLE OPERATING PRESSURE (*MAOP*) AT 20°C FOR SERIES 1, SERIES 2 and SERIES 3 PIPES

(Normative)

E1 SCOPE

This Appendix sets out equations to calculate *MAOP* at 20°C for Series 1, Series 2 and Series 3 pipes.

E2 PROCEDURE

For Series 1, Series 2 and Series 3 pipes, *MAOP* shall be calculated from the *MRS* of the compound used to make the pipe and the *SDR* of the pipe, thus:

$$MAOP = \frac{2MRS}{C(SDR-1)}$$

where

MRS = minimum required strength, in MPa

SDR = standard dimension ratio

C = overall service (design) coefficient, use 1.6 for this Standard

APPENDIX F

DETERMINATION OF 99.5% LOWER PREDICTION LIMIT OF THE ONE HOUR HYDROSTATIC STRENGTH ($\sigma_{1\ hr,\ LPL,\ 0.995}$)

(Normative)

F1 SCOPE

This Appendix sets out the procedure for the determination of 99.5% lower prediction limit of the 1 h hydrostatic strength

F1.1 Notation

n = number of observations

f_i = $\log_{10}$ of stresses (in MPa) of observation i; $i = 1, \ldots, n$

h_i = $\log_{10}$ of time (in hours) of observation i; $I = 1, \ldots, n$

$h_{1\ hr}$ = $\log_{10}$ of time (in hours) of 1 hour test (Note: Log 1 = 0)

t_v = Student's t for $_v = n–2$ degrees of freedom, as given in Table F1 which gives the upper 0.5% points

$\sigma_{LPL,\ 0.995}$ = 99.5% lower prediction limit of the 1 h hydrostatic strength ($\sigma_{1\ hr,\ LPL,\ 0.995}$)

(a) Calculate the arithmetic mean of all f_i and h_i:

$$\bar{f} = \frac{1}{n}\sum_{i=1}^{n} f_i \qquad \ldots F1$$

$$\bar{h} = \frac{1}{n}\sum_{i=1}^{n} h_i \qquad \ldots F2$$

(b) Calculate the following three quantities:

$$S_{ff} = \sum_{i=1}^{n} f_i^2 - n(\bar{f})^2 \qquad \ldots F3$$

$$S_{hh} = \sum_{i=1}^{n} h_i^2 - n(\bar{h})^2 \qquad \ldots F4$$

$$S_{fh} = \sum_{i=1}^{n} f_i h_i - n\bar{f}\bar{h} \qquad \ldots F5$$

$$b = \frac{S_{fh}}{S_{ff}} (< 0) \qquad \ldots F6$$

(c) Calculate the following quantities:

$$S_r^2 = \frac{1}{n-2}\left(S_{hh} - \frac{S_{fh}^2}{S_{ff}}\right) \qquad \ldots F7$$

$$C = b^2 - \frac{t_v^2 S_r^2}{S_{ff}} (> 0) \qquad \ldots F8$$

$$D = \frac{b(h_{1\,hr} - \bar{h})}{C} - \frac{t_v S_r}{C}\sqrt{\frac{(h_{1\,hr} - \bar{h})^2}{S_{ff}} - \frac{C}{n}} \qquad \ldots F9$$

$$f_{LPL} = \bar{f} + D \qquad \ldots F10$$

Test results shall be rejected if the quantity C is not greater than zero as it is not possible to calculate the lower prediction limit if this is the case.

(d) Calculate the 99.5% lower prediction limit of the 1 h hydrostatic strength ($\sigma_{LPL, 0.995}$) by the following anti-log:

$$\sigma_{LPL} = 10^{f_{LPL}} \quad \ldots \text{F11}$$

TABLE F1

PERCENTAGE POINTS OF STUDENT'S *t* DISTRIBUTION (UPPER 0.5% POINTS)

v (= *n*-2)	t_v
1	63 657
2	9 925
3	5 841
4	4 604
5	4 032
6	3 707
7	3 499
8	3 355
9	3 250
10	3 169
11	3 106
12	3 055
13	3 012
14	2 977
15	2 947
16	2 921
17	2 898
18	2 878
19	2 861
20	2 845
21	2 831
22	2 819
23	2 807
24	2 797
25	2 787
26	2 779
27	2 771
28	2 763
29	2 756
30	2 750
40	2 704
60	2 660
120	2 617
∞	2 576

NOTES

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