Singapore Standard 272 : 1983

SPECIFICATION FOR UNPLASTICIZED PVC PIPES BELOW GROUND FOR DRAINLINES AND SEWERS

AMENDMENT NO. 1

February 1996

1. **Page 3, Contents**

Under ‘Appendices’, *delete* ‘C. Method of test for resistance to acid and alkali’ and *substitute* with ‘C. Method for determining the PVC and titanium dioxide content of uPVC pipes and fittings.’

2. **Page 4, Foreword**

Delete the list of reference standards and *substitute* with the following:

‘1.	AS 1260:Parts 1 to 4:1984	Unplasticized PVC (UPVC) pipes and fittings for sewerage applications
2.	BS 4660:1989	Unplasticized polyvinyl chloride (PVC-U) pipes and plastics fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage
3.	BS 5481:1977	Unplasticized PVC pipe and fittings for gravity sewers
4.	SS 213:1979	Specification for unplasticized PVC pipes and fittings for soil, waste and vent applications
5.	SS 270 (Draft)	Specification for elastomeric seals for joints in pipework and pipelines’

3. **Page 5, Subclause 3.1**

Delete the 2nd paragraph and *substitute* with the following:

‘The PVC content of the pipe and fittings shall be not less than 83.3 percent.

Total additives shall not exceed 20 parts per 100 parts by mass of PVC content.

These additives shall include a minimum of 1 part of rutile titanium dioxide pigment per 100 parts by mass of PVC content.’

4. **Page 6, Subclause 8.1**

Delete ‘BS 2494’ and *substitute* with ‘SS 270’.

5. **Page 6, Subclause 8.2**

At the 4th line, *insert* the words ‘for the stress relief test’ after the words ‘except that for polyethylene components, the test temperature’

6. Page 8, Tables 2 and 3

Delete Tables 2 and 3 and *substitute* with tables given in Appendix 1.

7. Page 9, Figure 1

(a) *Delete* 3rd paragraph of the text and *substitute* with the following:

'If a ring seal is retained by means of a snap cap there are no requirements to be complied with in respect of dimensions B and dimensions e_3 where there is no overlap of the snap cap with the body of the socket.'

(b) *Insert* after Figure 1, a new Figure 1a as follows:

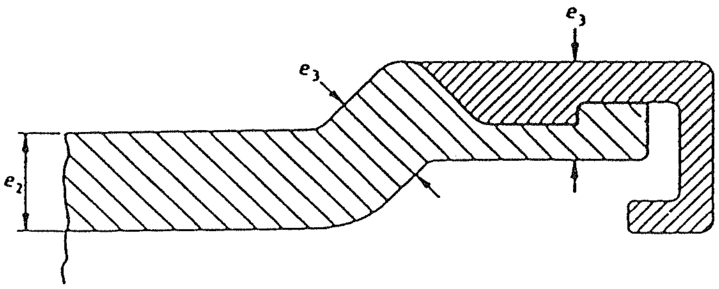


Figure 1a. Positions for measurement of snap cap wall thickness.

8. Page 10, Table 4

Delete '195' and '245' for 110 mm and 160 mm nominal size respectively and *substitute* with 200 mm for both sizes.

9. Page 11, Figures 3.1 to 3.3

Delete the existing figures and *substitute* with figures given in Appendix 2.

10. Page 12, Figures 3.4 to 3.6

Delete the existing figures and *substitute* with figures given in Appendix 3.

11. Page 13, Figures 3.7 to 3.14

Delete the existing figures and *substitute* with figures given in Appendix 4.

12. Page 14, Figure 4

Delete the existing figures and *substitute* with figures given in Appendix 5.

13. **Page 15, Subclause 9.1.2 'Resistance to acid and alkali'**

Delete the entire subclause and *substitute* with the following:

'**9.1.2 PVC and titanium dioxide content.** When tested by the method described in Appendix C, the PVC and titanium dioxide content of the pipe shall comply with the requirements in Subclause 3.1.'

14. **Page 15, subclause 9.2.2 'Resistance to acid and alkali'**

Delete the entire subclause and *substitute* with the following:

'**9.2.2 PVC and titanium dioxide content.** When three samples of fittings are tested by the described methods in Appendix C, the PVC and titanium dioxide content shall comply with the requirements in Subclause 3.1.'

15. **Page 21, Appendix C 'Method of test for resistance to acid and alkali'**

Delete the existing appendix and *substitute* with the new Appendix C 'Method of test for PVC and titanium dioxide content' as in Appendix 6.

16. **Page 22, Appendix D 'Tensile test'**

Insert the following at the end of the D.2:

'The tensile strength of the specimen shall be calculated from the maximum load and the original area of cross section and shall be expressed in force per unit area'

17. **Page 23, Appendix E 'Heat reversion test for pipe'**

(a) *Delete* '120° ± 2°C' and *substitute* with '150° ± 2°C'.

(b) *Delete* the last paragraph.

18. **Page 25, Clause F.4 'Number of test specimens'**

(a) At the 2nd line, *insert* the words 'or production run' after the words 'per extrusion'.

(b) *Insert* the following paragraph at the end of Clause F.4 on Page 26 :

'The working shift is defined as a continuous extrusion or production run of one size of pipe from one extrusion compound up to a maximum of 8 hours duration.'

19. **Pages 37 and 38, Tables 7 and 8**

Delete the existing tables and *substitute* with tables given in Appendices 7 and 8.

APPENDIX 1

Table 2. Dimensions of spigots and sockets with sealing rings (See Figure 1)

Nominal size (outside diameter d_e)	Socket							Spigot end (see Figure 2) E min
	d_1 min	A min	B min	C max	e min	e_2 min	e_3 min	
110	110.7	40	6	22	3.4[4]	3.1	2.6	69
160	160.7	50	9	32	4.1	3.7	3.1	91
200	200.7	50	12	40	4.9	4.4	3.7	99
250	250.8	55	18	70	6.1	5.5	4.6	134
315	316.0	62	20	70	7.7	6.9	5.8	144
400	401.1	70	24	70	9.8	8.8	7.3	155
500	501.1	80	28	80	12.2	11.0	9.1	178
630	631.1	93	34	93	15.4	13.0	11.5	209

Note. 1) All dimensions are in millimetres.

2) d_1 maximum depends on the shape, the dimensions and the hardness of the elastomeric ring, which are designed and fixed by the manufacturer.

3) Where the elastomeric ring is firmly fixed in the groove of the socket the requirement for a minimum value for dimension B shall not apply.

4) The minimum body wall thickness of junctions of nominal size 110 mm is 3.8 mm.

Table 3. Dimensions of solvent cement sockets (See Figure 1)

Nominal size (outside diameter d_e)	Socket					Spigot end (see Figure 2) E min
	d_2 min	d_2 max	A_1 min	e min	e_2 min	
110	110.3	110.8	48	3.4[3]	3.1	69
160	160.3	160.9	58	4.1	3.7	91
200	200.1	200.6	76	4.9	4.4	99
250	250.1	250.7	94	6.1	5.5	134
315	315.3	315.9	116	7.7	6.9	144

Note. 1) All dimensions are in millimetres.

2) It is possible for the solvent weld technique to be used on pipes fittings of larger diameters but is essential that the manufacturer's special jointing instructions are strictly adhered to construction.

3) The minimum body wall thickness of junctions of nominal size 110 mm is 3.8 mm.

APPENDIX 2

TYPICAL RANGE OF MOULDED uPVC FITTING

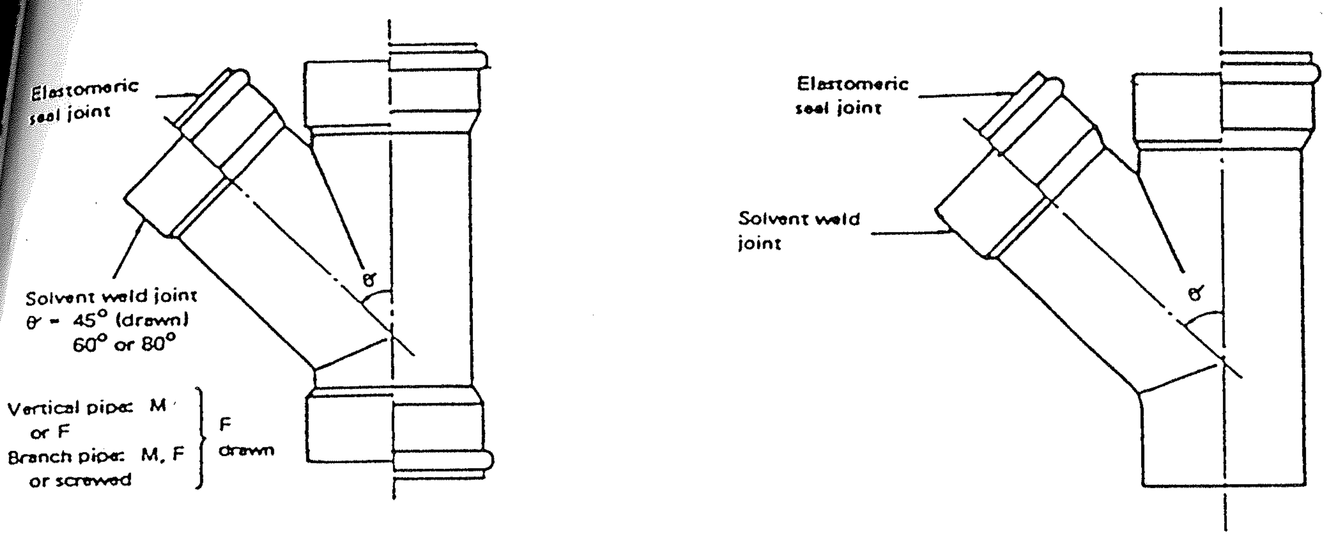
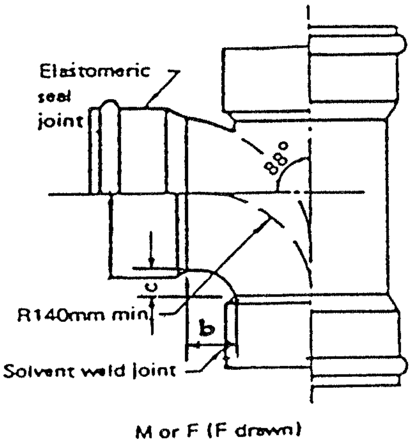


Figure 3.1. Single junction



Dimensions of 'b' and 'c' for sweep junctions and bends

Nominal size	b min and c min
110	30
160	50
250	60
315	60

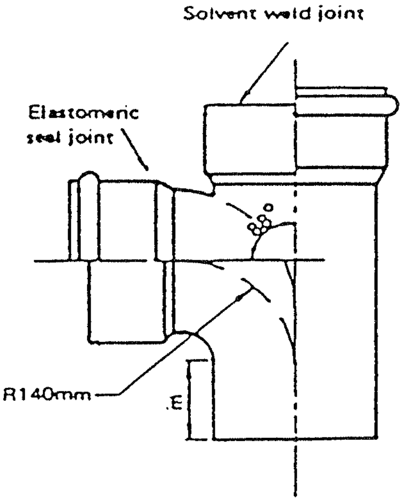


Figure 3.2. Single sweep junction

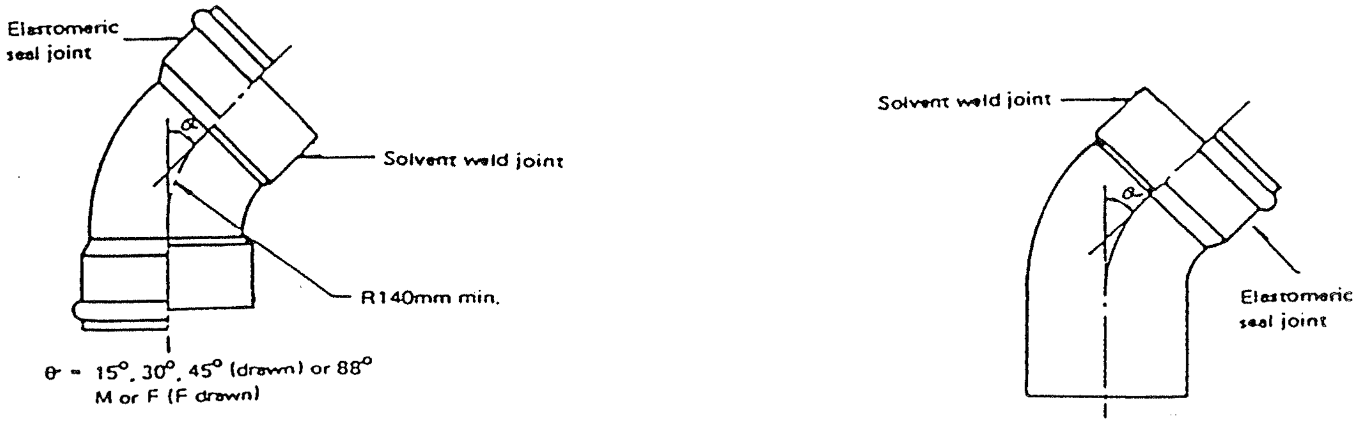


Figure 3.3. Bend

(**NOTE.** All angles in Figures 3.1 to 3.14 are to tolerance of ± 1°)

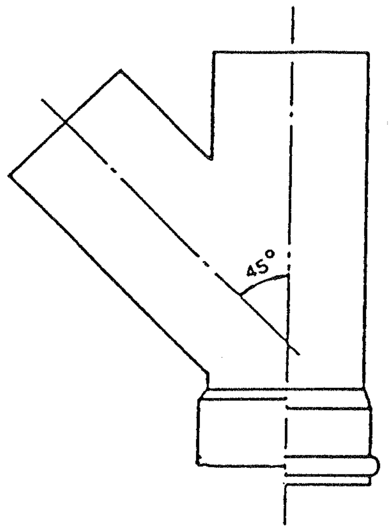


Figure 3.4. Tumbling bay junction

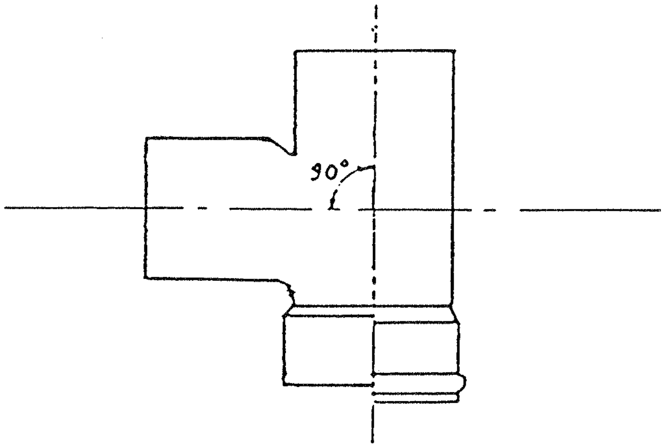
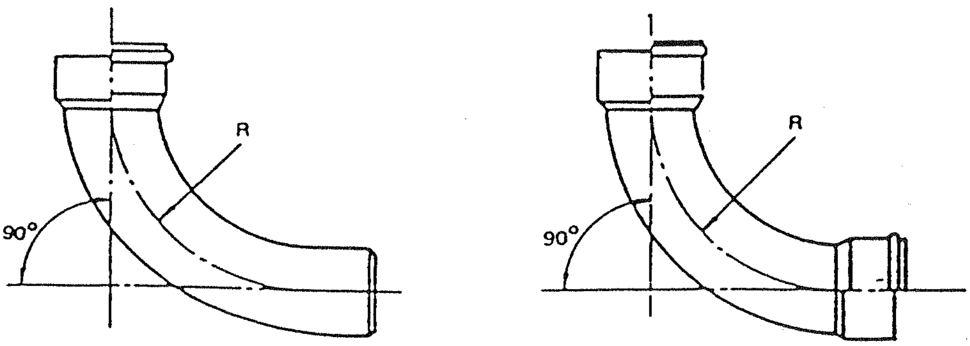


Figure 3.5. Back drop junction



min R200 mm for ϕ 110 mm
min R200 mm for ϕ 160 mm

Figure 3.6. Long radius bends

APPENDIX 4

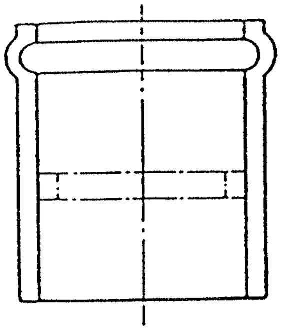


Figure 3.7. Single socket (with or without register)

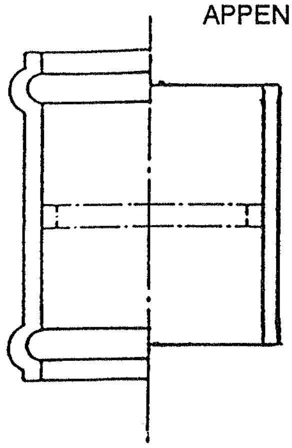
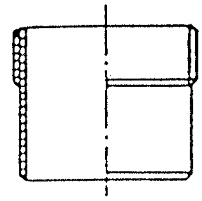
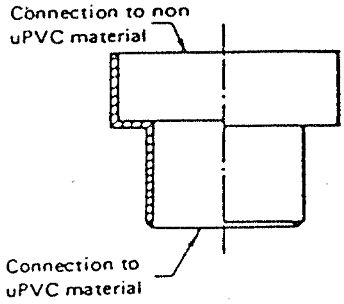


Figure 3.8. Double socket (with or without register)



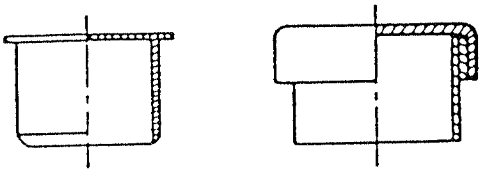
Lower end M or F (F drawn)

Figure 3.9. Coupling for screwed cap



Bottom connection M or F (M drawn)

Figure 3.10. Adaptor non uPVC spigot cap to uPVC



(a) Push fit

(b) With screwed access cap

Figure 3.11. Socket plug

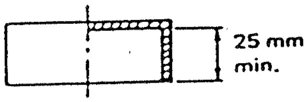
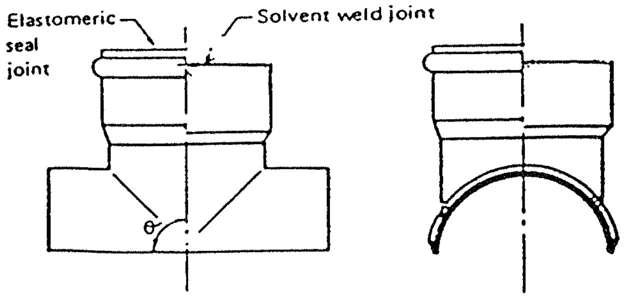


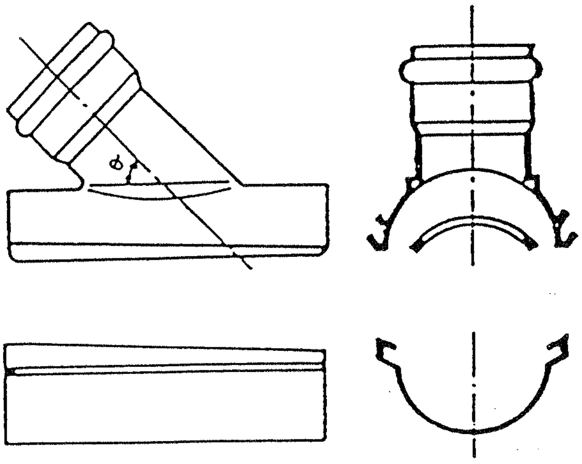
Figure 3.12. Cap (loose)



θ = 45°, 60° or 88°

SADDLE

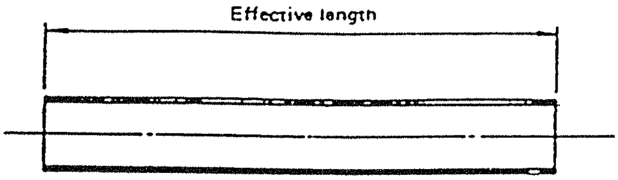
Figure 3.13. Saddle solvent cement



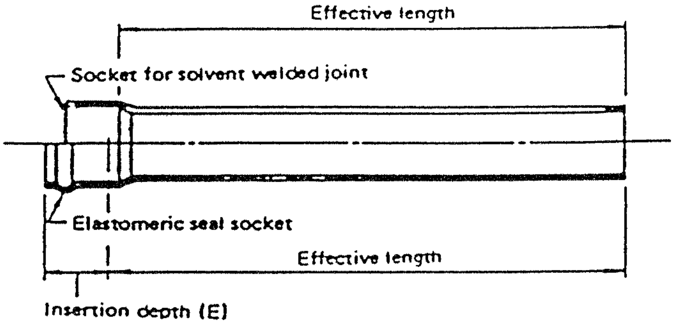
Mechanical saddle

Figure 3.14. Mechanical saddle

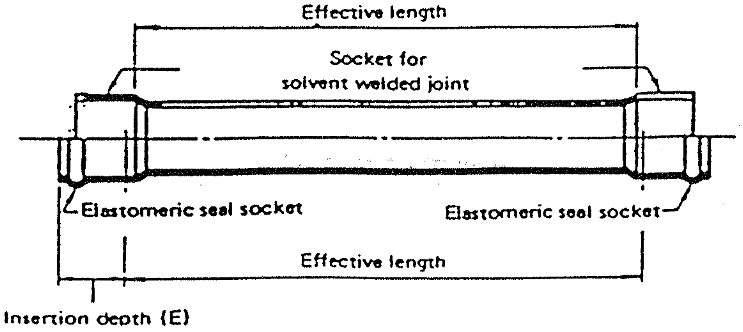
APPENDIX 5



(a) Plain ended pipe



(b) Single socket pipe



(c) Double socket pipe

Figure 4. Effective length of pipe

APPENDIX 6

APPENDIX C

METHOD FOR DETERMINING PVC AND TITANIUM DIOXIDE CONTENT OF UPVC PIPES AND FITTINGS

C.1. SCOPE

This standard sets out the method for determing the PVC and titanium dioxide content of unplasticized PVC (UPVC) pipes and fittings.

C.2. PRINCIPLE

C.2.1 PVC Content. A sample of UPVC pipe or fitting is dissolved in tetrahydrofuran (THF) and centrifuged. The supernatant is decanted and absolute ethanol is added to precipitate the PVC which is dried and weighed.

C.2.2 Titanium Dioxide Content. A sample of UPVC pipe or fitting is ignited in a furnace and the resulting ash is boiled with sodium sulphate and sulphuric acid. This solution is diluted with distilled water and the concentration of titanium dioxide determined by spectrophotometry.

C.3. REFERENCED DOCUMENTS

The following standards are referred to in this standard:

(a)	AS 2162	Code of practice for the use of volumetric glassware.
(b)	AS 2163	Graduated measuring cylinders
(c)	AS 2164	One-mark volumetric flasks
(d)	AS 2166	One-mark pipettes
(e)	AS 2850	Chemical analysis - Interlaboratory test programs - Guide to the planning and conduct - For determining precision of analytical method(s).

C.4. APPARATUS AND REAGENTS

C.4.1 Reagents. Except where otherwise specified, only reagents of recognized analytical grade and only distilled water or water of an equivalent purity shall be used.

C.4.1.1 Tetrahydrofuran (THF)

NOTE 1. CAUTION - Extremely flammable
- May form explosive peroxide
- Irritating to eyes and respiratory system

NOTE 2. Work with this solvent is to be carried out in a well-ventilated fume cupboard.

C.4.1.2 Sulphuric acid (e201840 kg/m^3)

C.4.1.3 Anhydrous sodium sulphate

C.4.1.4 Hydrogen peroxide (30 percent)

C.4.1.5 Sulphuric acid. 10 percent solution (1 part of concentrated sulphuric acid added to 9 parts of distilled water).

C.4.1.6 Rutile titanium dioxide. Tioxide R-PP25 (average assay 97.2% TiO_2).

C.4.1.7 Absolute ethanol

C.4.2 Apparatus. The following apparatus is required:

(a) Ultraviolet/visible spectrophotometer set to read at 408.0 ± 0.2 mm;

(b) Centrifuge capable of providing a relative centrifugal force (RCF) of approximately 3000;

(c) 100 mL glass thick-walled centrifuge tubes;

(d) Oven capable of being maintained at 50 ± 5°C;

(e) Thermometers capable of indicating the required temperature to an accuracy of ± 2°C;

(f) Muffle furnace capable of being maintained at 850 ± 10°C;

(g) Balance capable of weighing to 0.1 mg;

(h) Whatman GF/c glass fibre filters;

(i) Porcelain or silica crucibles - 50 mL volume;

(j) Ultrasonic bath;

(k) Water bath capable of being maintained at 60 ± 5°C;

(l) Glassware complying with AS 2162, AS 2163, AS 2164, or AS 2166, as appropriate;

(m) Hotplate.

C.5. PREPARATION OF TEST PORTION

A bulk sample shall be prepared by finely milling a suitable length of pipe or section of fitting and then mixing to obtain uniformity.

NOTE. Fragments or pieces obtained from an impact test may be used.

Test portions for analysis are randomly selected from this bulk sample. No preconditioning of test portions is necessary.

C.6. PROCEDURE

C.6.1 PVC Content. The procedure shall be as follows:

(a) Weigh and record the mass of a 100 mL thick-walled glass centrifuge tube to the nearest 0.1 mg. Add approximately 0.3 g of the test portion sample into the centrifuge tube and then weigh and record the total mass to the nearest 0.1 mg.

(b) Add 30 mL of THF to the tube and allow it to stand for approximately 5 min.

(c) Ensure that the centrifuge tube is stoppered and clamped and then immerse it in hot water at 60 ± 5°C contained in an ultrasonic bath until complete dissolution has been achieved. The tube shall not touch the bottom of the bath.

(d) Centrifuge the tube and contents at an RCF of 3000 until a clear supernatant liquid is obtained. This could take up to 30 min. Decant and keep the liquid.

(e) Carry out a further three extractions on the test portion sample using 10 mL THF each time and retain the supernatant liquid on each occasion.

(f) Combine the decanted PVC solutions and add absolute ethanol slowly, dropwise from a burette until there is no further precipitation. An excess of 10 mL of ethanol is then added.

(g) Filter the precipitate, under gentle suction using a water pump, through a GF/c glass fibre filter preweighed to the nearest 0.1 mg.

(h) Dry the filter and precipitate at 50 ± 5 °C, then allow it to cool before weighing. Repeat this procedure until constant mass is achieved and record the mass obtained to the nearest 0.1 mg. This could take up to 4 h.

C.6.2 Titanium Dioxide Content

C.6.2.1 Standards preparation. The procedure shall be as follows:

(a) Weigh out approximately 100 mg of titanium dioxide R-PP25 to the nearest 0.1 mg and record the mass determined. Transfer the TiO_2 to a 250 mL beaker and add 1.5 g of anhydrous sodium sulphate and 50 mL of concentrated sulphuric acid. Add boiling chips, cover the beaker with a watch glass, and heat to boiling point on a hotplate until the solid material has dissolved.

(b) When the solution has cooled, add it to approximately 100 mL of distilled water, stirring continuously. After cooling, transfer the solution to a 500 mL volumetric flask containing approximately 200 mL of distilled water, and make up to volume with distilled water.

C.6.2.2 Preparation of standard curve. The procedure shall be as follows:

(a) Prepare standard TiO solutions with the following concentrations: 0.00, 0.02, 0.04, 0.06, 0.08 and 0.10 mg/mL by transferring 0, 5.0, 10.0, 15.0, 20.0 and 25.0 mL of the standard solution into separate 50 mL volumetric flasks and dilute almost to volume with 10 percent sulphuric acid solution. Add 2.0 mL of 30 percent hydrogen peroxide solution to each of the volumetric flasks, dilute to volume with 10 percent sulphuric acid solution, shake and leave in a dark cupboard for approximately 30 min, with occasional further shaking.

(b) Using the spectrophotometer determine the absorbance of each solution at a wavelength of 408 nm using 1.0 cm cells with a blank of 2.0 mL 30 percent hydrogen peroxide in 50 mL sulphuric acid solution.

(c) From these results construct the standard curve (absorbance vs concentration in mg/mL).

C.6.2.3 Sample preparation. The procedure shall be as follows:

(a) For samples containing in the region of 5 percent TiO_2, weigh out approximately 1.5 g of the test portion.

(b) For samples containing in the region of 0.6 percent TiO_2, weigh out approximately 3.0 g of the test portion

(c) Weigh the appropriate amount of sample (Step (a) or (b) above) to the nearest 0.1 mg into a 50 mL porcelain or silica crucible and record the mass.

(d) Heat the crucible, gently at first, with a bunsen burner until charring is complete and the evolution of copious white fumes has ceased.

(e) Transfer the crucible to a muffle furnace maintained at 850 ± 10°C and ignite to a white or pale grey ash (this takes approximately 4 h).

(f) Allow the crucible to cool, then add 1.5 g of anhydrous sodium sulphate and 50 mL of concentrated sulphuric acid, followed by boiling chips. Cover the crucible with a watchglass and bring the contents to the boil on a hotplate. A clear solution should result.

NOTE. Sometimes the solution is slightly cloudy, but this has no effect upon the final result.

(g) Allow the crucible to cool and then carefully transfer the contents to a beaker containing 200 mL of distilled water. Thoroughly wash the crucible with further aliquots of distilled water.

(h) After cooling transfer the solution to a 500 mL volumetric flask and make up to volume with distilled water.

C.6.2.4 Determination of titanium dioxide in sample solution. The procedure shall be as follows:

(a) Transfer 20.0 mL of the sample solution prepared in Subclause 6.2.3 to a 50 mL volumetric flask and dilute almost to volume with a 10 percent sulphuric acid solution. Add 2.0 mL of 30 percent hydrogen peroxide, dilute to volume with 10 percent sulphuric acid solution, shake and leave in a dark cupboard for 30 min, with occasional further shaking.

(b) Determine the absorbance of the samples as in Subclause 6.2.2(b). Should the absorbance fall outside the calibration range, repeat the determination using a suitable aliquot of sample solution.

(c) Determine the concentration in mg/mL of TiO_2 in the final solution form standard curve.

C.7. CALCULATIONS

C.7.1 **PVC Content.** The percent PVC in the sample shall be calculated as follows:

$$\text{Percent PVC} = \frac{M \times 100}{S_1}$$

where:

M = mass residue (PVC resin), in grams (Subclause 6.1(h))

S_1 = mass of test portion sample, in grams (Subclause 6.1(a))

$$\text{Parts of } TiO_2 \text{ per hundred by mass} = \frac{C \times V_1 \times V_2 \times 10^4}{S_2 \times Z \times P}$$

where:

C = concentration of TiO_2 in mg/mL in final solution (Subclause 6.2.4 (c))
S_2 = mass of test portion sample, in milligrams (Subclause 6.2.3 (c))
V_1 = total volume of sample solution, in millilitres (Subclause 6.3.2 (h))
Z = volume of solution, in millilitres (Subclause 6.2.4 (a) or (b))
P = percent PVC
V_2 = volume of solution prepared in Subclause 6.2.4 (a)

C.8. REPORT

The following information shall be reported:

(a) Type and/or class, size, and configuration of pipe or fitting tested;

(b) PVC content;

(c) Titanium dioxide content per 100 parts by mass of PVC.

APPENDIX 7

Table 7. Test requirements and frequency of sampling for pipes

S/No.	Subclause	Test	Frequency of sampling based on production time					
			110 to 160 mm ND			200 mm to 630 mm ND		
			8 hourly	24 hourly	Type test	8 hourly	24 hourly	Type test
1		Dimensions	X			X		
2	9.1.1	Softening point			X			X
3	9.1.2	PVC and titanium dioxide content			X			X
4	9.1.3	Tensile	X			X		
5	9.1.4	Heat reversion	X			X		
6	9.1.5	Impact requirement	X			X		
7	9.1.6	Hydrostatic		X			X	
8	9.1.7	Opacity			X			X

APPENDIX 8

Table 8. Test requirements and frequency of sampling for fittings and joint assembly

S/No.	Subclause	Test	Frequency of sampling based on production time					
			80 to 160 mm ND			200 mm to 630 mm ND		
			8 hourly	24 hourly	Type test	8 hourly	24 hourly	Type test
	9.2	Fittings						
1		Dimensions	X			X		
2	9.2.1	Softening point			X			X
3	9.2.2	PVC and titanium dioxide content			X			X
4	9.2.3	Hydrostatic pressure requirement		X			X	
5	9.2.4	Stress relief requirement	X			X		
6	9.2.5	Brine test			X			X
7	9.2.6	Opacity			X			X
	9.3	Joint assemblies						
1	9.3.1	Angular deflection			X			
2	9.3.2	Hydrostatic pressure*			X			X
3	9.3.3	Diameter distortion			X			X
4	9.3.4	Negative pressure						X

* For solvent cement joints only.