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BUREAU OF INDIAN STANDARDS

Preliminary Draft for

UNPLASTICIZED POLYVINYL CHLORIDE (UPVC) PLUMBING PIPES (SCHEDULE 40, 80 AND 120) FOR WATER SUPPLIES — SPECIFICATION

(ICS No. 83.140.30, 91.140.60)

FOREWORD

This standard has been formulated to cover the specification for plumbing pipes of unplasticized polyvinyl chloride (UPVC) made in Schedule 40, 80 and 120, and pressure-rated for piping system for pressurized water supplies.

In the formulation of this standard, assistance has been drawn from ASTM D 1785:2012 – Poly (Vinyl Chloride) (PVC) Plastic pipe, Schedule 40, 80, and 120 – Specification. The sizes and other dimensions of plumbing pipes covered in this standard, have been kept as per the ASTM standard, and also as per the practice followed by UPVC plumbing pipe manufacturers in India. All other relevant requirements and performance tests have been covered as per IS 4985 : 2021 'Unplasticized PVC pipes for water supplies – Specification (*fourth revision*)'.

The PVC plumbing pipes as covered in IS 4985 : 2021 are not manufactured and used in the country, and therefore these would be withdrawn from IS 4985 : 2021 after the publication of this standard. The dimensions of plumbing pipes as covered in IS 4985 : 2021 were in line with the following International Standards:

ISO 161-1-1978	Thermoplastic pipes for the transport of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series
ISO/DIS 727-1985(E)	Fittings of unplasticized PVC, chlorinated PVC or ABS with plain sockets for pipes under pressure — Dimensions of sockets — Metric series
ISO 4422 : 1992	Unplasticized polyvinyl chloride pipes and fittings for water supply — Specification

This standard does not purport to address all the safety problems associated with its use. It is responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory safety and health practices and determine the applicability of regulatory limitation prior to use.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 'Rules for rounding of numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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UNPLASTICIZED POLYVINYL CHLORIDE (UPVC) PLUMBING PIPES (SCHEDULE 40, 80 AND 120) FOR WATER SUPPLIES — SPECIFICATION
(ICS No. 83.140.30, 91.140.60)

1 SCOPE

This standard covers unplasticized polyvinyl chloride (UPVC) pipe made in Schedule 40, 80 and 120 sizes, and pressure rated for water supplies. This standard is applicable to pipes of following types:

a) Plain ended pipes for solvent cement jointing; and
b) Pipe threads (male and female) where pressure tight joints are made on the threads.

2 REFERENCES

The standards listed in Annex A contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standard indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Nominal Size (DN)

The numerical designation for the size of a pipe, other than a pipe designated by thread size, which is a convenient round number approximately equal to the manufacturing dimensions in millimetres (mm).

3.2 Nominal Outside Diameter (d_n)

The specified outside diameter in millimetres assigned to a nominal size.

3.3 Outside Diameter at any Point (d_e)

The value of the measurement of the outside diameter of a pipe through its cross section at any point of the pipe, rounded off to the next higher 0.1 mm.

3.4 Mean Outside Diameter (d_{em})

The quotient of the outer circumference of a pipe and 3.142 (π) in any cross section, rounded off to the next higher 0.1 mm.

3.5 Minimum Mean Outside Diameter ($d_{em,\ min}$)

The minimum value for the mean outside diameter as specified for a given nominal size.

3.6 Maximum Mean Outside Diameter ($d_{em,\ max}$)

The maximum value for the mean outside diameter as specified for a given nominal size.

3.7 Mean Inside Diameter at Mid-Point of Socket Length (d_{im})

The arithmetical mean of two measured inside diameters perpendicular to each other at the midpoint of the socket length.

3.8 Out-of-Roundness (Ovality)

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

3.9 Nominal Wall Thickness (e_n)

A numerical designation of the wall thickness of a component which is a convenient round number, approximately equal to the manufacturing dimension in millimetres (mm).

3.10 Wall Thickness at any Point (e)

The value of the measurement of the wall thickness at any point around the circumference of a pipe rounded off to the next higher 0.1 mm.

3.11 Minimum Wall Thickness at any Point (e_{min})

The minimum value for the wall thickness at any point around the circumference of a pipe rounded off to the next higher 0.1 mm.

3.12 Maximum Wall Thickness at any Point (e_{max})

The maximum value for the wall thickness at any point around the circumference of a pipe rounded off to the next higher 0.1 mm.

3.13 Mean Wall Thickness (e_m)

The arithmetical mean of at least four measurements regularly spaced around the circumference and in the same cross-section of a pipe including the measured minimum and the measured maximum values of the wall thickness in that cross-section and rounded off to the next higher 0.1 mm.

3.14 Tolerance

The permitted variation of the specified value of a quantity expressed as the difference between the permitted maximum and the permitted minimum value.

3.15 Working Pressure (PN)

The numerical designation of a pipe related to the mechanical characteristics of that pipe used for reference purposes. For plastics piping system sit corresponds to the allowable operating, pressure, in bar, conveying water at 27 °C.

3.16 Hydrostatic Stress (σ)

The stress induced in the wall thickness of a pipe when a pressure is applied using water as a medium. The hydrostatic stress is related to the applied pressure, P, the wall thickness at any point, e, and the mean outside diameter, d_{em}, of a pipe and calculated using the following approximation equation.

$$\sigma = \frac{P(d_{em} - e)}{2e}$$

Where σ and P are in the same units.

3.17 Tests

3.17.1 *Type Tests*

Tests carried out whenever a change is made in the composition or in the size/series in order to establish the suitability and the performance capability of the pipes.

3.17.2 *Acceptance Tests*

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.18 Virgin Material

Material in such form as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no re-processable or recyclable material(s) have been added.

3.19 Own Rework Material

Material prepared from rejected unused pipes, including trimmings from the production of pipes, which will be reprocessed in a manufacturer's plant by a process such as extrusion and for which the complete formulation is known.

4 NOTATION

The following notation (symbols) shall apply in this standard:

DN = Nominal size
d_n = Nominal outside diameter
d_e = Outside diameter at any point

d_{em} = Mean outside diameter
$d_{em,max}$ = Maximum mean outside diameter
$d_{em,min}$ = Minimum mean outside diameter
d (lm) = Mean inside socket diameter at mid point of socket length
e = Wall thickness at any point
e_m = Mean wall thickness
e_{max} = Maximum wall thickness at any point
e_{min} = Minimum wall thickness at any point
e_n = Nominal wall thickness
Lo = Overall length of pipe
Le = Effective length of pipe
Ls = Minimum socket length
PN = Nominal pressure (working pressure)
f_T = De-rating factor for water temperatures
ρ = Material density
σ = Hydrostatic stress
σ_s = Design stress.

5. CLASSIFICATION OF PIPES

This standard covers PVC pipe made to and marked with one of the six grades/design stress designation PVC 1120, PVC 1220, PVC 2120, PVC 2116, PVC 2112 and PVC 2110 in schedule 40, 80 and 120 wall sizes.

6. COMPOSITION

6.1 The material from which the pipe is produced shall consist substantially of unplasticized polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of the pipe and the production of sound and durable pipe of good surface finish, mechanical strength and opacity under conditions of use. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic, organoleptic or microbial growth hazard or materially to impair the fabrication, or to impair its chemical, physical or mechanical properties (in particular long-term mechanical strength and impact strength) as defined in this standard.

The PVC compound used for the manufacture of pipe shall equal or exceed the requirements of classes PVC 12454 or PVC 14333 of ASTM D1784.

6.1.1 The monomer content (VCM content) in the resin shall be within the limits specified in **4.4.1** of IS 10151, when tested as per Annex A of IS 10151.

6.1.2 The composition shall be based on PVC resin having a K-value of 64 or greater than when tested in accordance with IS 4669.

NOTE — A test report or conformity certificate may be obtained from the resin manufacturer for the VCM content (see 6.1.1) and K-value (see 6.1.2) of the resin being used, unless the same is tested in an independent laboratory. The frequency of this test report or conformity certificate shall be once in every three months.

6.2 The addition of the manufacturer's own rework material is permissible. The quantity of the rework material used is to be declared by the manufacturer.
No other rework material shall be used.

7 DIMENSIONS OF THE PIPES

7.1 Dimensions and Tolerances

Dimensions and tolerances shall be as given in Table 1 and 2 when measured in accordance with the method given in IS 12235 (Part 1) and IS 12235 (Part 2). The tolerances for out-of-roundness shall apply only to the pipe prior to shipment.

7.2 Length

7.2.1 *Effective length* (*L*e)

If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 3, 4, 5 or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

Table 1 Outside Diameters and Tolerances
(*Clause* 7.1)

Sl No.	Nominal Pipe Size	Outside Diameter	Tolerance For Maximum and Minimum Diameter (Out-of-Roundness)		
			Average	Schedule 40 Sizes $3^{1/2}$ inches and over; Schedule 80 Sizes 8 inches and over	Schedule 40 Sizes 3 inches and less; Schedule 80 Sizes 6 inches and less; Schedule 120 Sizes all
	inch	inch (mm)	inch (mm)	inch (mm)	inch (mm)
(1)	(2)	(3)	(4)	(5)	(6)
i)	1/8	0.405 (10.29)	±0.004 (±0.10)	…	±0.008 (±0.20)
ii)	¼	0.540 (13.72)	±0.004 (±0.10)	…	±0.008 (±0.20)
iii)	3/8	0.675 (17.14)	±0.004 (±0.10)	…	±0.008 (±0.20)
iv)	½	0.840 (21.34)	±0.004 (±0.10)	…	±0.008 (±0.20)
v)	¾	1.050 (26.67)	±0.004 (±0.10)	…	±0.010 (±0.25)
vi)	1	1.315 (33.40)	±0.005 (±0.13)	…	±0.010 (±0.25)
vii)	1¼	1.660 (42.16)	±0.006 (±0.13)	…	±0.012 (±0.30)
viii)	1½	1.900 (48.26)	±0.006 (±0.15)	…	±0.012 (±0.30)
ix)	2	2.375 (60.32)	±0.007 (±0.15)	…	±0.012 (±0.30)
x)	2½	2.875 (73.02)	±0.008 (±0.18)	…	±0.015 (±0.38)
xi)	3	3.500 (88.90)	±0.008 (±0.20)	…	±0.015 (±0.38)
xii)	3½	4.000 (101.60)	±0.008 (±0.20)	±0.050 (±1.27)	±0.015 (±0.38)
xiii)	4	4.500 (114.30)	±0.009 (±0.23)	±0.050 (±1.27)	±0.015 (±0.38)
xiv)	5	5.563 (141.30)	±0.010 (±0.25)	±0.050 (±1.27)	±0.030 (±0.76)
xv)	6	6.625 (168.28)	±0.011 (±0.28)	±0.050 (±1.27)	±0.035 (±0.89)
xvi)	8	8.625 (219.08)	±0.015 (±0.38)	±0.075 (±1.90)	±0.045 (±1.14)
xvii)	10	10.750 (273.05)	±0.015 (±0.38)	±0.075 (±1.90)	±0.050 (±1.27)
xviii)	12	12.750 (323.85)	±0.015 (±0.38)	±0.075 (±1.90)	±0.060 (±0.52)

Table 2 Wall Thickness and Tolerances
(*Clause* 7.1)

Sl No.	Nominal Pipe Size	Schedule 40		Schedule 80		Schedule 120	
		Minimum	Tolerance	Minimum	Tolerance	Minimum	Tolerance
	inch	inch (mm)	inch (mm)	inch (mm)	inch (mm)	inch (mm)	inch (mm)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	1/8	0.068 (1.73)	±0.020 (+0.51)	0.094 (2.41)	±0.020 (+0.51)	…	…
ii)	¼	0.088 (2.24)	±0.020 (+0.51)	0.119 (3.02)	±0.020 (+0.51)	…	…
iii)	3/8	0.091 (2.31)	±0.020 (+0.51)	0.126 (3.20)	±0.020 (+0.51)	…	…
iv)	½	0.109 (2.77)	±0.020 (+0.51)	0.147 (3.73)	±0.020 (+0.51)	0.170 (4.32)	±0.020 (+0.51)
v)	¾	0.113 (2.87)	±0.020 (+0.51)	0.154 (3.91)	±0.020 (+0.51)	0.170 (4.32)	±0.020 (+0.51)
vi)	1	0.133 (3.38)	±0.020 (+0.51)	0.179 (4.55)	±0.021 (+0.53)	0.200 (5.08)	±0.024 (+0.61)
vii)	1¼	0.140 (3.56)	±0.020 (+0.51)	0.191 (4.85)	±0.023 (+0.58)	0.215 (5.46)	±0.026 (+0.66)
viii)	1½	0.145 (3.68)	±0.020 (+0.51)	0.200 (5.08)	±0.024 (+0.61)	0.225 (5.72)	±0.027 (+0.68)
ix)	2	0.154 (3.91)	±0.020 (+0.51)	0.218 (5.54)	±0.026 (+0.66)	0.250 (6.35)	±0.030 (+0.76)
x)	2½	0.203 (5.16)	±0.024 (+0.61)	0.276 (7.01)	±0.033 (+0.84)	0.300 (7.62)	±0.036 (+0.91)
xi)	3	0.216 (5.49)	±0.026 (+0.66)	0.300 (7.62)	±0.036 (+0.91)	0.350 (8.89)	±0.042 (+1.07)
xii)	3½	0.237 (5.74)	±0.027 (+0.68)	0.318 (8.08)	±0.038 (+0.96)	0.350 (8.89)	±0.042 (+1.07)
xiii)	4	0.258 (6.02)	±0.028 (+0.71)	0.337 (8.56)	±0.040 (+1.02)	0.437 (11.10)	±0.052 (+1.32)
xiv)	5	0.280 (6.55)	±0.031 (+0.79)	0.375 (9.52)	±0.045 (+1.14)	0.500 (12.70)	±0.060 (+1.52)
xv)	6	0.280 (7.11)	±0.034 (+0.86)	0.432 (10.97)	±0.052 (+1.32)	0.500 (14.27)	±0.067 (+1.70)
xvi)	8	0.322 (8.18)	±0.039 (+0.99)	0.500 (12.70)	±0.060 (+1.52)	0.718 (18.24)	±0.086 (+2.18)
xvii)	10	0.365 (9.27)	±0.044 (+1.12)	0.593 (15.06)	±0.071 (+1.80)	0.843 (21.41)	±0.101 (+2.56)
xviii)	12	0.406 (10.31)	±0.049 (+1.24)	0.687 (17.45)	±0.082 (+2.08)	1.000 (25.40)	±0.120(+3.05)

NOTE — The minimum is the lowest wall thickness of the pipe at any cross-section. The maximum permitted wall thickness at any cross-section is the minimum wall thickness plus the stated tolerance. All tolerances are on the plus side of the minimum required. These dimensions conform to nominal IPS dimensions.

8 PHYSICAL AND CHEMICAL CHARACTERISTICS

8.1 Visual Appearance

The color of the pipes shall be white. Slight variations in the appearance of the color are permitted.

8.1.1 The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. Slight shallow longitudinal grooves or irregularities in the pipe shall be permissible provided the wall thickness remains within the permissible limits.

8.2 Opacity

The wall of the plain pipe shall not transmit more than 0.2 percent of the visible light falling on it when tested in accordance with IS 12235 (Part 3). The convex (outer) surface of the pipe specimen shall face the light source.

8.3 Effect on Water

The pipes shall not have any detrimental effect on the composition of water flowing through them. When tested by the method described in IS 12235 (Part 4) and IS 12235 (Part 10), the quantities of lead, dialkyl tin C4 and higher homologues (measured as tin), and any other toxic substances extracted from the internal walls of the pipes shall not exceed the concentrations as specified in **10.3** of IS 4985 and meet the other requirements given in **10.3.1** of IS 4985.

NOTE — Implementation of the phase out programme for use of lead stabilizers in PVC pipe and fitting of the Government of India shall be borne in mind.

8.4 Reversion Test

When tested by the immersion method prescribed in IS 12235 (Part 5/Sec 1) and IS 12235 (Part 5/Sec 2), a length of pipe 200 ± 20 mm long shall not alter in length by more than 5 percent. In the case of socket end pipes, this test shall be carried out on the plain portion of the pipe taken at least 100 mm away from the root of the socket.

8.5 Vicat Softening Temperature

When tested by the method prescribed in IS 12235 (Part 2), the Vicat softening temperature of the specimen shall not be less than 80 °C.

8.6 Density

When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1.40 gm/cc and 1.46 gm/cc.

8.7 Sulphated Ash Content Test

When tested in accordance with IS 12235 (Part 17), the sulphated ash content in the pipe shall not exceed 11 percent.

9 MECHANICAL PROPERTIES

9.1 Hydrostatic Characteristics

When subjected to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec1), the pipe shall not fail during the prescribed test duration. The temperatures and duration of the test shall conform to the requirements given in Table 3. The minimum test pressure for temperature conditions of 27 °C shall be obtained by applying three percent drop in the test pressure for every one degree Centigrade increase in temperature from the test pressures as specified in Tables 4, 5 and 6 for temperature condition of 23 °C for Schedule 40, 80 and 120, respectively. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

Table 3 Test Temperature and Test Duration for Internal Hydrostatic Pressure Test (Sustained Pressure Test)

(*Clause* 9.1)

Sl No.	Test	Test Temperature, *Min* °C	Test Period, *Min* h
(1)	(2)	(3)	(4)
i)	Type test	27 °C	1 000

Table 4 Test Pressure for Internal Hydrostatic Pressure Test of Schedule 40 Pipes at 23 °C

(*Clause* 9.1)

Sl No.	Nominal Size inch	Test Pressure, *Min* MPa			
		PVC 1120 PVC 1220 PVC 2120	PVC 2116	PVC 2112	PVC 2110
(1)	(2)	(3)	(4)	(5)	(6)
i)	1/8	11.65	9.38	7.79	6.41
ii)	¼	11.31	9.03	7.52	6.21
iii)	3/8	9.03	7.24	6.00	4.96
iv)	½	8.62	6.89	5.79	4.76
v)	¾	6.96	5.58	4.69	3.79
vi)	1	6.55	5.24	4.34	3.59
vii)	1¼	5.31	4.27	3.59	2.90
viii)	1½	4.76	3.86	3.17	2.62
ix)	2	4.00	3.24	2.69	2.21
x)	2½	4.41	3.52	2.96	2.41
xi)	3	4.07	3.03	2.55	2.07
xii)	3½	3.45	2.76	2.34	1.93
xiii)	4	3.24	2.55	2.14	1.79
xiv)	5	2.83	2.28	1.86	1.52
xv)	6	2.55	2.07	1.72	1.38
xvi)	8	2.28	1.79	1.52	1.24
xvii)	10	2.07	1.65	1.38	1.10
xviii)	12	1.93	1.52	1.24	1.03

Table 5 Test Pressure for Internal Hydrostatic Pressure Test of Schedule 80 Pipes at 23 °C

(*Clause* 9.1)

Sl No.	Nominal Size inch	Test Pressure, *Min* MPa			
		PVC 1120 PVC 1220 PVC 2120	PVC 2116	PVC 2112	PVC 2110
(1)	(2)	(3)	(4)	(5)	(6)
i)	1/8	17.72	14.21	11.86	9.72

ii)	¼	16.34	13.10	10.90	8.96
iii)	3/8	13.31	10.62	8.89	7.31
iv)	½	12.27	9.86	8.20	6.76
v)	¾	9.93	8.00	6.62	5.45
vi)	1	9.10	7.31	6.07	4.96
vii)	1¼	7.52	6.00	5.03	4.14
viii)	1½	6.83	4.96	4.55	3.72
ix)	2	5.86	4.69	3.93	3.17
x)	2½	6.14	4.90	4.07	3.38
xi)	3	5.45	4.34	3.59	2.96
xii)	3½	5.03	4.00	3.31	2.76
xiii)	4	4.69	3.72	3.10	2.55
xiv)	5	4.21	3.38	2.76	2.28
xv)	6	4.07	3.24	2.69	2.21
xvi)	8	3.59	2.83	2.34	1.93
xvii)	10	3.38	2.69	2.28	1.86
xviii)	12	3.31	2.62	2.21	1.79

Table 6 Test Pressure for Internal Hydrostatic Pressure Test of Schedule 120 Pipes at f 23 °C

(*Clause* 9.1)

Sl No.	Nominal Size inch	Test Pressure, *Min* MPa			
		PVC 1120 PVC 1220 PVC 2120	PVC 2116	PVC 2112	PVC 2110
(1)	(2)	(3)	(4)	(5)	(6)
i)	1/8	14.69	11.79	9.79	8.07
ii)	¼	11.17	8.96	7.45	6.14
iii)	3/8	10.41	8.27	6.89	5.72
iv)	½	8.62	6.89	5.72	4.69
v)	¾	7.79	6.21	5.17	4.27
vi)	1	6.83	5.45	4.55	3.72
vii)	1¼	6.76	5.38	4.48	3.72
viii)	1½	6.41	5.17	4.27	3.52
ix)	2	5.58	4.41	3.72	3.03
x)	2½	6.21	4.96	4.14	3.38
xi)	3	5.72	4.55	3.79	3.10
xii)	3½	5.38	4.27	3.59	2.96
xiii)	4	5.24	4.21	3.52	2.90
xiv)	5	5.31	4.27	3.52	2.90
xv)	6	4.90	3.93	3.31	2.69

9.2 Burst Pressure Test

When subjected to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec1), the pipe shall not fail during the prescribed test duration. The temperatures and duration of the test shall conform to the requirements given in Table 7, and the test pressure shall be as specified in Tables 8. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

Table 7 Test Temperature and Test Duration for Burst Pressure Test
(*Clause* 9.2)

Sl No.	Test	Test Temperature, *Min* °C	Test Period, *Min* h
(1)	(2)	(3)	(4)
i)	Type test	27 °C	Between 60 s and 70 s

Table 8 Test Pressure for Burst Pressure Test at 27 °C
(*Clause* 9.2)

Sl No.	Nominal Size inch	Burst Pressure, *Min* MPa					
		Schedule 40		Schedule 80		Schedule 120	
		PVC 1120 PVC 1220 PVC 2120	PVC 2110 PVC 2116 PVC 2110	PVC 1120 PVC 1220 PVC 2120	PVC 2110 PVC 2116 PVC 2110	PVC 1120 PVC 1220 PVC 2120	PVC 2110 PVC 2116 PVC 2110
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	1/8	17.79	13.93	27.03	21.10	-	-
ii)	¼	17.17	13.45	24.96	19.52	-	-
iii)	3/8	13.72	10.76	20.27	15.86	-	-
iv)	½	13.17	10.27	18.76	14.62	22.41	17.52
v)	¾	10.62	8.34	15.17	11.86	17.03	13.31
vi)	1	9.93	7.79	13.93	10.89	15.86	12.34
vii)	1¼	8.14	6.34	11.45	8.96	13.10	10.27
viii)	1½	7.31	5.72	10.41	8.14	11.86	9.24
ix)	2	6.14	4.76	8.89	6.96	10.41	8.14
x)	2½	6.69	5.24	9.38	7.31	10.27	8.07
xi)	3	5.79	4.55	8.27	6.48	9.79	7.65
xii)	3½	5.31	4.14	7.65	5.93	8.48	6.62
xiii)	4	4.90	3.86	7.17	5.58	9.51	7.45
xiv)	5	4.27	2.69	6.41	4.96	8.69	6.83
xv)	6	3.86	3.03	6.14	4.83	8.20	6.41
xvi)	8	3.45	2.69	5.45	4.27	8.00	6.27
xvii)	10	3.10	2.41	5.17	4.00	8.07	6.34
xviii)	12	2.90	2.28	5.03	3.93	7.52	5.86

9.3 Flattening test

When tested by the method prescribed in IS 12235 (Part 19), pipe shall show no signs of cracking, splitting and breaking.

10 SAMPLING AND CRITERIA FOR CONFORMITY

The sampling procedure and criteria for conformity shall be as given in Annex B.

11 MARKING

11.1 Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m to provide the following information:

a) Manufacturer's name or trademark or code;
b) Outside diameter;
c) Schedule of pipe, 40, 80 or 120;
d) The word 'Plumbing'; and
e) Batch or lot number.

11.1.1 The lot number/batch number shall include the details of production in the following manner:

Year	Month	Day	Machine No.	Shift
xxxx	xx	xx	xxx	x

11.2 BIS Certification Marking

The pipes conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the pipes may be marked with the Standard Mark.

ANNEX A
(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
4669 : 1968	Method of test for ploy vinyl chloride resins
4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)
IS 4985 : 2021	Unplasticized PVC pipes for water supplies – Specification (*fourth revision*)
10151 :2019	Polyvinyl chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water — Specification (*first revision*)
12235	Thermoplastics pipes and fittings — Methods of test
(Part 1) : 2004	Measurement of dimensions
(Part 2) : 2004	Determination of Vicat softening temperature
(Part 3) : 2004	Test for opacity
(Part 4) : 2004	Determining the detrimental effects on the composition of water
(Part 5/Sec 1) : 2004	Longitudinal reversion, Sec 1 Determination methods
(Part 5/Sec 2) : 2004	Longitudinal reversion, Sec 2 Determination parameters
(Part 8/Sec 1) : 2004	Resistance to internal hydrostatic pressure, Section 1 Resistance to internal hydrostatic pressure at constant internal water pressure
(Part 10) : 2004	Determination of organotin as tin aqueous solution
(Part 14) : 2004	Determination of density/relative density (specific gravity)
(Part 17) : 2004	Determination of ash content and sulphated ash content
(Part 19) : 2004	Flattening test

ANNEX B
(*Clause* 10)

SAMPLING AND CRITERIA FOR CONFORMITY

B-1 ACCEPTANCE TESTS

B-1.1 Acceptance tests are carried out on samples selected from a lot.

B-1.2 Lot

All UPVC plumbing pipes in a single consignment of the same grade, same schedule, same size and manufactured under essentially similar conditions shall constitute a lot.

B-1.3 For ascertaining conformity of the lot to the requirements of the standard, samples shall be tested from each lot separately.

B-1.4 Visual and Dimensional Requirements

B-1.4.1 The number of test samples to be taken from a lot shall depend on the size of the lot and the outside diameter of the pipes, and shall be in accordance with Table 9.

B-1.4.2 These pipes shall be selected at random from the lot and in order to ensure the randomness of selection, a random number table shall be used. For guidance and use of random number tables, IS 4905 may be referred to. In the absence of a random number table, the following procedure may be adopted:

Starting from any pipes in the lot, count them as 1, 2, 3, etc, up to *r* and so on, where *r* is the integral part of *N/n*, *N* being the number of pipes in the lot, and *n* the number of pipes in the sample. Every *rth* pipes so counted shall be withdrawn so as to constitute the required sample size.

B-1.4.3 The number of pipes given for the first sample in col 4 of Table 9, shall be taken from the lot and examined for visual and dimensional requirements given in **7** and **8.1** of this standard. A pipe failing to satisfy any of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 6 of Table 9. The lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in column 7 of Table 9. If, however, the number of defectives found in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7, a second sample of the size given in column 4 shall be taken and examined for these requirements. The lot shall be considered to have satisfied these requirements if the cumulative sample is less than or equal to the corresponding acceptance number given in col 6, otherwise not.

Table 9 Scale of Sampling for Visual Appearance and Dimensional Requirements
(*Clauses B*-1.4.1 *and B*-1.4.3)

Sl No. (1)	Number of Pipes in the Lot (2)	Sample Number (3)	Sample Size (4)	Cumulative Sample Size (5)	Acceptance Number (6)	Rejection Number (7)
i)	Up to 1 000	First	13	13	0	2
		Second	13	26	1	2
ii)	1 001 to 3 000	First	20	20	0	2
		Second	20	40	1	2
iii)	3 001 to 10 000	First	32	32	0	3
		Second	32	64	3	4
iv)	10 001 and above	First	50	50	1	4
		Second	50	100	4	5

B-1.5 Reversion Test

B-1.5.1 The lot, having satisfied visual and dimensional requirements, shall be tested for reversion test as given in **8.4**.

B-1.5.2 For this purpose, the number of pipes given for the first sample in col 4 of Table 10 shall be taken from the lot. The sample pipes failing the reversion test, shall be considered as defective. The lot shall be deemed to have met the requirements given in this standard for the reversion Test, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 6. This lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 7. If, however, the number of defectives in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7, a second sample of size given in col 4 shall be taken and examined for the requirement. The lot shall be considered to have satisfied the requirements, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in column 6, otherwise not.

B-1.6 Vicat Softening Test

B-1.6.1 The lot, having satisfied visual and dimensional requirements shall be tested for Vicat softening temperature as given in **8.5**.

B-1.6.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for reversion test under **B-1.5.2** using Table 10.

B-1.7 Density

B-1.7.1 The lot, having satisfied the visual and dimensional requirements, shall be tested for density as given in **8.6**.

B-1.7.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for stress relief test under **B-1.5.2** using Table 10.

B-1.8 Flattening Test

B-1.8.1 The lot, having satisfied the visual and dimensional requirements, shall be tested for density as given in **9.3**.

B-1.8.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for reversion test under **B-1.5.2** using Table 10.

Table 10 Scale of Sampling for Reversion Test, Vicat Softening Temperature Test, Density Test and Flattening Test

(*Clauses* B-1.5, B-1.6, B-1.7 *and* B-1.8)

Sl No. (1)	Number of Pipes in the Lot (2)	Sample Number (3)	Sample Size (4)	Cumulative Sample Size (5)	Acceptance Number (6)	Rejection Number (7)
i)	Up to 1 000	First	5	5	0	2
		Second	5	10	1	2
ii)	1 001 to 3 000	First	8	8	0	2
		Second	8	16	1	2
iii)	3 001 to 10 000	First	13	13	0	2
		Second	13	26	1	2
iv)	10 001 and above	First	20	20	0	3
		Second	20	40	3	4

B-1.8 Sulphated Ash content Test

B-1.8.1 The lot having satisfied the visual and dimensional requirements shall be subjected to the sulphated ash content test.

B-1.8.2 For this purpose, the number of pipes given for the first sample in col 4 of Table 11 shall be taken from the lot. The sample pipes failing the sulphated ash content test, shall be considered as defective. The lot shall be deemed to have met the requirements given in this standard for the sulphated ash content test, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 6. This lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 7. If, however, the number of defectives in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7, a second sample of size given in col 4 shall be taken and examined for the requirement. The lot shall be considered to have satisfied the requirements, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in column 6, otherwise not.

Table 11 Scale of Sampling for Sulphated Ash content Test
(*Clauses B*-1.8)

Sl No. (1)	Number of Pipes in the Lot (2)	Sample Number (3)	Sample Size (4)	Cumulative Sample Size (5)	Acceptance Number (6)	Rejection Number (7)
i)	Up to 10 000	First	2	2	0	1
		Second	2	4	1	2
ii)	Above to 10 000	First	3	3	0	2
		Second	3	6	1	2

B-1.9 Burst Pressure Test

B-1.9.1 The lot, having been found satisfactory according to **B-1.4, B-1.5, B-1.6** and **B-1.7** shall be subjected to the requirements of the burst pressure test as given in **9.2**. The number of pipes to be taken from the lot shall depend on the size of the lot and shall be according to Table 12.

B-1.9.2 The pipes shall be taken at random from the lot. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

B-1-9.3 Number of Tests and Criteria for Conformity

The number of test samples shall be as given in Table 12. The lot shall be considered to have satisfied the requirements for this test, if the number of test samples failing in this requirement is equal to the corresponding acceptance number given in col 4 of Table 12.

Table 12 Scale of Sampling for Internal Hydrostatic Test
(Clauses B-1.9.1 *and* B-1.9.3*)*

Sl No. (1)	Number of Pipes in the Lot (2)	Sample Size (3)	Acceptance Number (4)
i)	Up to 3 000	2	0
ii)	3 001 to 10 000	3	0
iii)	10 001 and above	5	0

B-2 TYPE TESTS

B-2.1 Type tests are intended to prove the suitability and performance of a new composition or a new size of pipe. Such tests, therefore, need to be applied only when a change is made in polymer composition or when a new size of pipes is be introduced. Type tests for compliance with **6.1.1**, **6.1.2**, **8.2**, **8.3** and **9.1** shall be carried out.

B-2.2 Opacity

For this test, the manufacturer or the supplier shall furnish to the testing authority one sample of the pipe of the thinnest wall section, selected preferably from a regular production lot.

B-2.2.1 The sample so selected shall be tested for compliance with requirements for opacity as given in **8.2**.

B-2.2.2 If the sample passes the requirements of the opacity test, the type of pipe under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

B-2.2.3 In case the sample fails in the test, the testing authority, at its discretion, may call for a fresh sample and subject the same to the opacity test. If the sample passes the repeat test, the type of pipe under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

B-2.2.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for a fresh sample for opacity test for the purpose of type approval.

B-2.3 Internal Hydrostatic Pressure Test

B-2.3.1. For this type test, the manufacturer or the supplier shall furnish to the testing authority, three samples of pipes of different grades and of the largest and smallest pipe sizes being considered for qualification.

B-2.3.2. The samples so selected shall be tested for compliance with the requirements of type test given as per **9.1.**.

B-2.3.3 If all the samples pass the requirements of the test, the type of pipes under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

B-2.3.4 In case any of the samples fail in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original numbers and subject them to the type test. If, in the repeat test no single failure occurs, the type of pipes shall be considered for type approval. If any of the samples fail in the repeat tests, the type of pipes shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

B-2.3.5 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for type test for the purpose of type approval.

B-2.4. Test for Effect on Water

B-2.4.1 For this type test, the manufacturer or the supplier shall furnish to testing authority three samples of the three pipes taken at random from the smallest size and lowest class of pipe (that is, on pipes having the thinnest wall and greatest surface area mass ratio)

B-2.4.2 The sample so selected shall be tested for compliance with requirements for effect on water test as given in **8.6**.

B-2.4.3 If all three samples pass the requirements for effect on water, the type test of the pipe under consideration shall be considered to be eligible for approval, which shall be normally valid for a period of one year.

B-2.4.4 In case any of the samples fails in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number, and subject them to the test for effect on water. If, in the repeat test, no single failure occurs, the type of pipe under consideration shall be considered eligible for type approval. If any of the samples fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

B-2.4.5 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for type test for the purpose of type approval.