

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENT ONLY

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Draft Indian Standard

**UNPLASTICIZED POLYVINYL CHLORIDE (PVC-U) PIPES
(SCHEDULE 40, 80 AND 120) FOR DISTRIBUTION OF
PRESSURIZED LIQUIDS — SPECIFICATION**

Plastic Piping System
Sectional Committee, CED 50

Last date for Comment:
20 August 2021

FOREWORD

(Formal clauses to be added later)

This standard has been formulated to lay down the requirements for pipes of unplasticized polyvinyl chloride (PVC-U) made in schedule 40, 80 and 120, and pressure-rated for piping system for pressurized water and fluid transmission.

PVC-U pipes for water supply covered in IS 4985 : 2021 'Unplasticized PVC pipes for water supplies – Specification (*fourth revision*)' have been designed for a hydrostatic strength of 8.6 MPa at 27 °C. It covers metric series pipe dimensions and classification of pipes is based on pressure class. However, plumbing pipes mostly used in the country is in line with the corresponding ASTM standard, which covers inch series (FPS system) pipe dimensions. Further, these pipes are manufactured in three schedules, namely, schedule 40, 80 and 120. Thus, classification of these pipes based on Schedule (predominantly coming from metal piping series) is also different from classification of PVC-U pipes covered in IS 4985 based on pressure class. This results in change in working pressure of every size of pipe in this standard unlike same working pressure for same class of pipe in IS 4985. Also, pipes covered in this standard are designed for a hydrostatic strength of 14.0 MPa at 27 °C. Thus, these pipes of same diameter have higher wall thicknesses than those covered in IS 4985 of the same diameter. PVC-U plumbing pipes are also covered in IS 4985, however, the PVC-U pipes as covered in this standard have been mostly in use as plumbing pipes in the country. The reason being that these pipes with higher wall thicknesses were threaded and used with galvanized iron fittings by the plumbers. Gradually, use of these pipes with PVC-U socket fittings has increased. The standard for PVC-U socket fittings for use with this pipes is also under the consideration of the Committee.

The decision regarding covering plumbing pipes in one standard would be taken by the concerned technical committee of BIS. Keeping all the above in view and current practices followed by majority manufacturers in India as well as user preference, this separate standard for covering PVC-U plumbing pipes and pipes for pressurized liquid transmission has been prepared.

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.

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.

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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1 SCOPE

1.1 This standard covers unplasticized polyvinyl chloride (PVC-U) pipe made in Schedule 40, 80 and 120 sizes, and pressure rated for transmission of water and other liquids. This standard is applicable to pipes of following types:

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

1.2 The pipes covered by this standard are intended for use with the distribution of pressurized liquids only, which are chemically compatible with the piping materials.

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 Pipe 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 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 1.1 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 it corresponds to the allowable operating pressure, in MPa 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-process able 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 pipe 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_{im}	= 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
L_o	= Overall length of pipe
L_e	= Effective length of pipe
L_s	= 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 designed for a hydrostatic design strength of 14 MPa in schedule 40, 80 and 120 wall sizes. The pipes are rated for use at 27°C with maximum internal pressure as given in Table 1.

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.

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.

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

Table 1 Water Pressure Rating of Pipes at 27 °C
(Clause 5)

SI No.	Nominal Pipe Size, DN mm (inch)	Test Pressure, <i>Max</i> ,					
		MPa (Bar)					
		Schedule 40		Schedule 80		Schedule 120	
		Unthreaded	Threaded	Unthreaded	Threaded	Unthreaded	Threaded
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	6 (1/8)	4.91	2.46	7.46	3.70	...	...
ii)	9 (1/4)	4.73	2.37	6.86	3.46	...	...
iii)	12 (3/8)	3.76	1.87	5.58	2.79	...	...
iv)	15 (1/2)	3.64	1.82	5.16	2.55	6.12	3.10
v)	20 (3/4)	2.91	1.45	4.19	2.06	4.67	2.37
vi)	25 (1)	2.73	1.36	3.82	1.94	4.36	2.18
vii)	32 (1-1/4)	2.24	1.12	3.16	1.58	3.64	1.82
viii)	40 (1-1/2)	2.01	1.00	2.85	1.45	3.27	1.64
ix)	50 (2)	1.70	0.84	2.43	1.21	2.85	1.45
x)	65 (2-1/2)	1.82	0.91	2.55	1.28	2.85	1.40
xi)	80 (3)	1.58	0.78	2.24	1.15	2.67	1.34
xii)	90 (3-1/2)	1.45	0.72	2.12	1.03	2.31	1.15
xiii)	100 (4)	1.34	0.67	1.94	0.97	2.60	1.34
xiv)	125 (5)	1.15	0.57	1.76	0.85	2.43	1.21
xv)	150 (6)	1.09	0.55	1.70	0.85	2.24	1.15
xvi)	200 (8)	0.97	0.48	1.51	0.73	2.31	1.09
xvii)	250 (10)	0.85	0.42	1.40	0.73	2.24	1.09
xviii)	300 (12)	0.79	0.40	1.40	0.67	2.06	1.03

NOTE — For Schedule 40, values given against unthreaded pipes are calculated on the basis of other schedules.

6.2.3 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 maximum quantity of the rework material used shall be not more than 5 percent. 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 Tables 2 and 3 when measured in accordance with the method given in IS 12235 (Part 1). 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 with a tolerance of +100 mm. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

8 THREADING OF PIPES

Pipes with male (external) threads at both ends shall be used with threaded sockets. Bell end pipes shall have male (external) thread at one end and female (internal) thread at the other end. Pipes shall have basic thread dimensions as given in Table 4 read with Fig. 1. For threading of these pipes basic thread profile and dimensions (where applicable) are taken from IS 554. The pipes may be supplied with other threads where so agreed upon between the manufacturer and the purchaser.

NOTE— It is not recommended to thread PVC plastic pipe in Schedule 40 dimensions of nominal pipes sizes 6 inches (150 mm) and smaller.

9 PHYSICAL AND CHEMICAL CHARACTERISTICS

9.1 Visual Appearance

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

9.1.1 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.

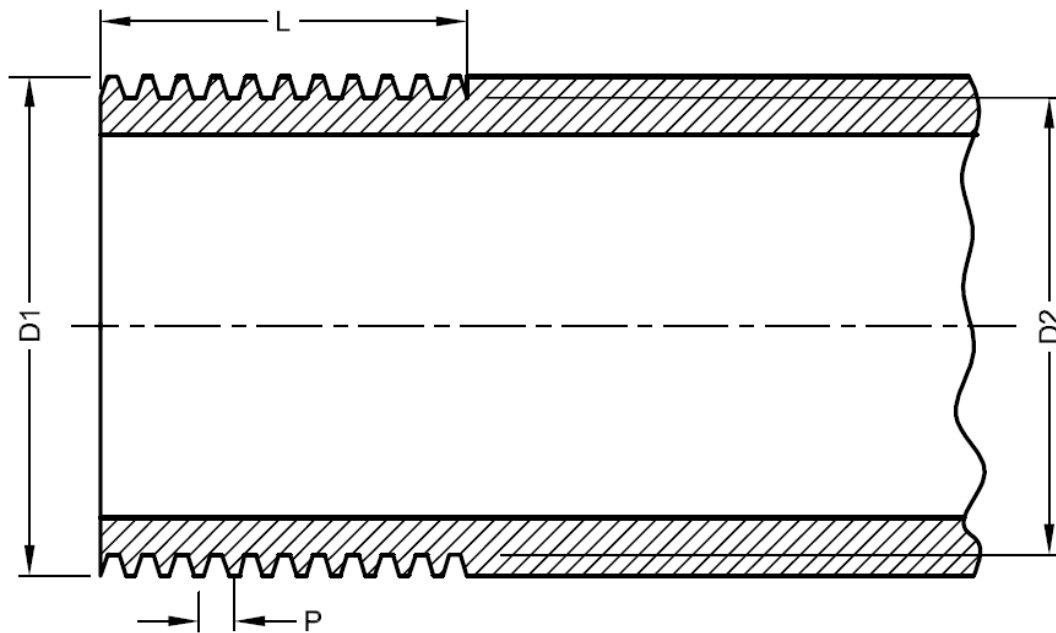


Fig. 1 THREADING IN BELL END PIPES

9.2 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.

9.3 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.

9.4 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.

Table 2 OUTSIDE DIAMETER AND TOLERANCES
(Clause 7.1)

SI No.	Nominal Pipe Size, <i>DN</i>	Mean Outside Diameter of Pipe, <i>d_{em}</i>		Outside Diameter at Any Point, <i>d_e</i>			
		<i>d_{em}, Min</i> mm	<i>d_{em}, Max</i> mm	Schedule 40: Sizes 90 mm (3-1/2 inches) and over; Schedule 80: Sizes 200mm (8 inches) and over		Schedule 40: Sizes 80 mm (3 inches) and less; Schedule 80: Sizes 150 mm (6 inches) and less; Schedule 120: Sizes all	
	mm (inch)			<i>Min</i> mm	<i>Max</i> mm	<i>Min</i> mm	<i>Max</i> mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	6 (1/8)	10.2	10.4	...	...	10.2	10.5
ii)	9 (1/4)	13.6	13.8	...	...	13.5	13.9
iii)	12 (3/8)	17.0	17.2	...	...	16.9	17.3
iv)	15 (1/2)	21.2	21.4	...	...	21.1	21.5
v)	20 (3/4)	26.6	26.8	...	...	26.4	26.9
vi)	25 (1)	33.3	33.5	...	...	33.1	33.6
vii)	32 (1-1/4)	42.0	42.3	...	...	41.9	42.5
viii)	40 (1-1/2)	48.1	48.4	...	...	48.0	48.6
ix)	50 (2)	60.2	60.5	...	...	60.0	60.6
x)	65 (2-1/2)	75.1	75.4	...	...	75.0	75.6
xi)	80 (3)	88.7	89.1	...	...	88.5	89.3
xii)	90 (3-1/2)	101.4	101.8	100.3	102.9	101.2	102.0
xiii)	100 (4)	114.1	114.5	113.0	115.6	113.9	114.7
xiv)	125 (5)	141.0	141.5	140.0	142.6	140.5	142.1
xv)	150 (6)	168.0	168.6	167.0	169.6	167.4	169.2
xvi)	200 (8)	218.7	219.4	217.2	221.0	217.9	220.2
xvii)	250 (10)	272.7	273.4	271.1	274.9	271.8	274.3
xviii)	300 (12)	323.5	324.2	321.9	325.7	323.3	324.4

Table 3 Wall Thickness and Tolerances
(Clause 7.1)

SI No.	Nominal Pipe Size, DN	Wall Thickness					
		Schedule 40		Schedule 80		Schedule 120	
		e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}
	mm (inch)	mm	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	6 (1/8)	1.73	2.24	2.41	2.92	...	...
ii)	9 (1/4)	2.24	2.75	3.02	3.53	...	...
iii)	12 (3/8)	2.31	2.82	3.20	3.71	...	...
iv)	15 (1/2)	2.77	3.28	3.73	4.24	4.32	4.83
v)	20 (3/4)	2.87	3.38	3.91	4.42	4.32	4.83
vi)	25 (1)	3.38	3.89	4.55	5.08	5.08	5.69
vii)	32 (1-1/4)	3.56	4.07	4.85	5.43	5.46	6.12
viii)	40 (1-1/2)	3.68	4.19	5.08	5.69	5.72	6.40
ix)	50 (2)	3.91	4.42	5.54	6.20	6.35	7.11
x)	65 (2-1/2)	5.16	5.77	7.01	7.85	7.62	8.53
xi)	80 (3)	5.49	6.15	7.62	8.53	8.89	9.96
xii)	90 (3-1/2)	5.74	6.42	8.08	9.04	8.89	9.96
xiii)	100 (4)	6.02	6.73	8.56	9.58	11.10	12.42
xiv)	125 (5)	6.55	7.34	9.52	10.66	12.70	14.22
xv)	150 (6)	7.11	7.97	10.97	12.29	14.27	15.97
xvi)	200 (8)	8.18	9.17	12.70	14.22	18.24	20.42
xvii)	250 (10)	9.27	10.39	15.06	16.86	21.41	23.97
xviii)	300 (12)	10.31	11.55	17.45	19.53	25.40	28.45

Table 4 THREAD DIMENSIONS OF PIPE
(Clause 8)

SI No.	Nominal Pipe Size, <i>DN</i>	Number of Threads in 25.4 mm	Pitch, <i>p</i>	Male End		Female End		Length, <i>L</i>	
				Major, <i>D</i> ₁ (Tolerance $\begin{smallmatrix} +0.0 \\ -0.2 \end{smallmatrix}$)	Minor, <i>D</i> ₂ (Tolerance $\begin{smallmatrix} +0.0 \\ -0.2 \end{smallmatrix}$)	Major, <i>D</i> ₁ (Tolerance $\begin{smallmatrix} +0.2 \\ -0.0 \end{smallmatrix}$)	Minor, <i>D</i> ₂ (Tolerance $\begin{smallmatrix} +0.2 \\ -0.0 \end{smallmatrix}$)	Male End (Tolerance $\begin{smallmatrix} +0.0 \\ -2.5 \end{smallmatrix}$)	Female End (Tolerance $\begin{smallmatrix} +3.0 \\ -0.0 \end{smallmatrix}$)
	mm (inch)		mm	mm	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	6 (1/8)	28	0.907	9.7	8.7	9.7	8.7	7.4	7.4
ii)	9 (1/4)	19	1.337	13.2	11.4	13.2	11.4	11.0	11.0
iii)	12 (3/8)	19	1.337	16.7	14.9	16.7	14.9	11.4	11.4
iv)	15 (1/2)	14	1.814	20.9	18.6	20.9	18.6	15.0	15.0
v)	20 (3/4)	14	1.814	26.4	24.1	26.4	24.1	16.3	16.3
vi)	25 (1)	11	2.309	33.2	30.2	33.2	30.2	19.1	19.1
vii)	32 (1-1/4)	11	2.309	41.9	38.9	41.9	38.9	25.0	25.0
viii)	40 (1-1/2)	11	2.309	47.8	44.8	47.8	44.8	25.0	25.0
ix)	50 (2)	11	2.309	59.6	56.6	59.6	56.6	30.0	30.0
x)	65 (2-1/2)	11	2.309	75.2	72.2	75.2	72.2	35.0	35.0
xi)	80 (3)	11	2.309	87.9	84.9	87.9	84.9	40.0	40.0
xii)	90 (3-1/2)	11	2.309	100.3	97.3	100.3	97.3	40.0	40.0
xiii)	100 (4)	11	2.309	113.0	110.0	113.0	110.0	45.0	45.0
xiv)	125 (5)	11	2.309	138.4	135.4	138.4	135.4	60.0	60.0
xv)	150 (6)	11	2.309	163.8	160.8	163.8	160.8	60.0	60.0
xvi)	200 (8)	10	2.540	214.6	211.3	214.6	211.3	70.0	70.0
xvii)	250 (10)	10	2.540	265.4	262.1	265.4	262.1	85.0	85.0
xviii)	300 (12)	8	3.175	316.2	312.2	316.2	312.2	85.0	85.0

9.5 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.

9.6 Density

When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1.40 g/cm³ and 1.46 g/cm³.

9.7 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.

9.8 Effect of Sunlight

Two samples each 300 mm long from different lengths of pipes shall be prepared. One sample shall be kept covered in thick paper and kept in shade as control sample and the other exposed to sun for not less than 1 600 h at ambient temperature. After the required period of exposure the tensile strength of two samples when tested as per IS 12235 (Part 13) shall not show difference of more than 20 percent of their initial tensile strengths.

10 MECHANICAL PROPERTIES

10.1 Hydrostatic Characteristics (Sustained Pressure Test)

When subjected to internal hydrostatic pressure test (sustained 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 5. The minimum test pressure for temperature conditions of 27 °C shall be conform as specified in Tables 6. The test shall be carried out not earlier than 24 h after the pipes have been manufactured. Test specimens shall be obtained from the plain portion of both threaded and plain pipes.

Table 5 Test Temperature and Test Duration for Sustained Pressure Test
(Clause 10.1)

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

Table 6 Test Pressure for Internal Hydrostatic Pressure Test at 27 °C ± 2° C
(Clause 10.1)

SI No.	Nominal Pipe Size, <i>DN</i> mm (inch)	Test Pressure, <i>Min</i> , MPa (Bar)		
		Schedule 40	Schedule 80	Schedule 120
(1)	(2)	(3)	(4)	(5)
i)	6 (1/8)	10.25	15.59	...
ii)	9 (1/4)	9.95	14.38	...
iii)	12 (3/8)	7.95	11.71	...
iv)	15 (1/2)	7.59	10.80	12.93
v)	20 (3/4)	6.12	8.74	9.83
vi)	25 (1)	5.76	8.01	9.16
vii)	32 (1-1/4)	4.67	6.62	7.59
viii)	40 (1-1/2)	4.19	6.01	6.86
ix)	50 (2)	3.52	5.16	6.01
x)	65 (2-1/2)	3.88	5.40	5.95
xi)	80 (3)	3.58	4.80	5.64
xii)	90 (3-1/2)	3.04	4.43	4.91
xiii)	100 (4)	2.85	4.13	5.46
xiv)	125 (5)	2.49	3.70	5.03
xv)	150 (6)	2.25	3.58	4.73
xvi)	200 (8)	2.01	3.16	4.61
xvii)	250 (10)	1.82	2.97	4.67
xviii)	300 (12)	1.70	2.91	4.31

NOTE – The test pressures are applicable for both threaded and plain pipes.

1 MPa = 10 bar

10.2 Hydrostatic Characteristics (Burst Pressure Test)

When subjected to internal hydrostatic pressure test (burst 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 Table 8. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

10.2.1 Specimen Size

For pipe sizes of 150 mm (6 inch) or less, the specimen length between the end closures shall be not less than five times the outside diameter of the pipe, but in no case less than 300 mm. For larger sizes, the minimum length shall be not less than three times the outside diameter, but in no case less than 760 mm.

Table 7 Test Temperature and Test Duration for Burst Pressure Test
(Clause 10.2)

Sl No.	Test	Test Temperature	Test Period, Min
(1)	(2)	(3)	(4)
i)	Acceptance test	27 °C ± 2° C	60 s

NOTE — Times greater than 60 s may be needed to bring large size specimens to burst pressures. The test is more difficult to pass using greater pressurizing times

Table 8 Test Pressure for Burst Pressure Test at 27 °C ± 2° C
(Clause 10.2)

Sl No.	Nominal Pipe Size, DN mm (inch)	Test Pressure, Min, MPa		
		Schedule 40	Schedule 80	Schedule 120
(1)	(2)	(3)	(4)	(5)
i)	6 (1/8)	15.66	23.79	...
ii)	9 (1/4)	15.11	21.96	...
iii)	12 (3/8)	12.07	17.84	...
iv)	15 (1/2)	11.59	16.51	19.72
v)	20 (3/4)	9.35	13.35	14.99
vi)	25 (1)	8.74	12.26	13.96
vii)	32 (1-1/4)	7.16	10.08	11.53
viii)	40 (1-1/2)	6.43	9.16	10.44
ix)	50 (2)	5.40	7.82	9.16
x)	65 (2-1/2)	5.89	8.25	9.04
xi)	80 (3)	5.10	7.28	8.62
xii)	90 (3-1/2)	4.67	6.73	7.46
xiii)	100 (4)	4.31	6.31	8.37
xiv)	125 (5)	3.76	5.64	7.65
xv)	150 (6)	3.40	5.40	7.22

xvi)	200 (8)	3.04	4.80	7.04
xvii)	250 (10)	2.73	4.55	7.10
xviii)	300 (12)	2.55	4.43	6.62

NOTE – The test pressures are applicable for both threaded and plain pipes.

1 Mpa = 10 bar

10.3 Flattening test

Flatten the specimen of pipe of at least 50 mm long, between parallel plates in a suitable press until the distance between the plates is 40 % of the outside diameter of the pipe or the walls of the pipe touch, whichever occurs first. The rate of the loading shall be uniform and such that the compression is completed within 2 to 5 minutes. On removal of load examine the specimen for evidence of splitting, creaking or breaking.

10.3.1 For this test, the method prescribed in IS 12235 (Part 19) may also be referred.

10.4 Resistance to External Blows at 0 °C

When tested by the method described in IS 12235 (Part 9), the pipe shall have a true impact rate of not more than 10 percent. The total mass of the striker and height of free fall shall correspond to the values given in Table 9.

Table 9 Total Mass of Striker and Height of Free Fall for Resistance to External Blows Test at 0 °C
(Clause 10.4)

Sl No.	Nominal pipe Size, DN	Total Mass of Striker	Height of Free Fall	Number of Equidistant Lines to be Drawn
	mm (inch)	kg	mm	Nos.
(1)	(2)	(3)	(4)	(5)
i)	6 (1/8)	0.25 ± 0.5 %	500 ± 10	1
ii)	9 (1/4)	0.25 ± 0.5 %	500 ± 10	1
iii)	12 (3/8)	0.25 ± 0.5 %	500 ± 10	1
iv)	15 (1/2)	0.25 ± 0.5 %	500 ± 10	1
v)	20 (3/4)	0.25 ± 0.5 %	500 ± 10	1
vi)	25 (1)	0.50 ± 0.5 %	1 000 ± 10	1
vii)	32 (1-1/4)	0.50 ± 0.5 %	1 000 ± 10	1
viii)	40 (1-1/2)	0.50 ± 0.5 %	1 000 ± 10	3
ix)	50 (2)	0.50 ± 0.5 %	2 000 ± 10	3
x)	65 (2-1/2)	0.50 ± 0.5 %	2 000 ± 10	4
xi)	80 (3)	0.50 ± 0.5 %	2 000 ± 10	4

xii)	90 (3-1/2)	1.00 ± 0.5 %	2 000 ± 10	6
xiii)	100 (4)	1.00 ± 0.5 %	2 000 ± 10	8
xiv)	125 (5)	1.00 ± 0.5 %	2 000 ± 10	8
xv)	150 (6)	1.00 ± 0.5 %	2 000 ± 10	8
xvi)	200 (8)	1.00 ± 0.5 %	2 000 ± 10	12
xvii)	250 (10)	1.00 ± 0.5 %	2 000 ± 10	12
xviii)	300 (12)	1.00 ± 0.5 %	2 000 ± 10	16

11 FITTINGS

Push type fittings as per IS XXXXX:XXXX (*under preparation*) or threaded fittings as per IS 1239 (Part 2) shall be used.

12 SAMPLING AND CRITERIA FOR CONFORMITY

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

13 MARKING

13.1 Each pipe shall be clearly and indelibly marked in ink/paint at intervals of not more than 3 m to provide the following information:

- a) Manufacturer's name or trademark;
- b) Nominal pipe size;
- c) Schedule of pipe, 40, 80 or 120;
- d) Pressure rating;
- e) The word 'Plumbing' in case of plumbing pipes;
- f) Batch or lot number; and
- g) Word 'UPVC'.

13.1.1 The colour of the marking shall be black and that of the strip for the various schedule of pipes shall be as given below:

<i>Sl No.</i>	<i>Schedule</i>	<i>Colour</i>
(1)	(2)	(3)
i)	Schedule 40	Yellow
ii)	Schedule 80	Grey
iii)	Schedule 120	Red

13.1.2 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

13.2 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 there under, and the pipes may be marked with the Standard Mark.

ANNEX A
(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>
554 : 1999	Pipe threads where pressure — Tight joints are made on the threads — Dimensions, tolerances and designation (<i>fourth revision</i>)
1239 (Part 2) : 2011	Steel tubes, tubulars and other steel fittings — Specification: Part 2 Steel pipe fittings (<i>fifth revision</i>)
4669 : 1968	Methods of test for polyvinyl chloride resins
4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (<i>first revision</i>)
IS 4985 : 2021	Unplasticized PVC pipes for potable water supplies — Specification (<i>fourth revision</i>)
10151 :2019	Polyvinyl chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water - Specification (<i>first revision</i>)
12235	Thermoplastics pipes and fittings — Methods of test (<i>first revision</i>)
(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, Section 1 Determination methods
(Part 5/Sec 2) : 2004	Longitudinal reversion, Section 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 9) : 2004	Resistance to external blows (impact resistance) at 0°C (round-the-clock method)
(Part 10) : 2004	Determination of organotin as tin aqueous solution
(Part 13) : 2004	Determination of tensile strength and elongation
(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 13)

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

B-1.2.1 All UPVC plumbing pipes in a single consignment of the 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 10.

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 r th 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 10, shall be taken from the lot and examined for visual and dimensional requirements given in **7**, **8** and **9.1** 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 10. 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 10. 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 10 Scale of Sampling for Visual Appearance and Dimensional Requirements
(Clauses B-1.4.1 and B-1.4.3)

Sl No.	Number of Pipes in the Lot	Sample Number	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(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 **9.4**.

B-1.5.2 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 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 **9.5**.

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 11.

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 **9.6**.

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 11.

B-1.8 Flattening Test

B-1.8.1 The lot, having satisfied the visual and dimensional requirements, shall be tested for flattening as given in **10.3**.

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 11.

B-1.9 Resistance to External Blows at 0 °C

B-1.9.1 The lot, having satisfied the visual and dimensional requirements, shall be tested for flattening as given in **10.4**.

B-1.9.2 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 11.

Table 11 Scale of Sampling for Reversion Test, Vicat Softening Temperature Test, Density Test , Flattening Test and Resistance to External Blows at 0°C and

(Clauses B-1.5, B-1.6, B-1.7, B-1.8 and B-1.9)

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-1.10 Sulphated Ash content Test

B-1.10.1 The lot having satisfied the visual and dimensional requirements shall be subjected to the sulphated ash content test.

B-1.10.2 For this purpose, the number of pipes given for the first sample in col 4 of Table 12 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 12 Scale of Sampling for Sulphated Ash Content Test
(Clauses B-1.10)

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-1.11 Burst Pressure Test

B-1.11.1 The lot, having been found satisfactory according to **B-1.4, B-1.5, B-1.6, B-1.7, B-1.8, B-1.9** and **B-1.10** shall be subjected to the requirements of the burst pressure test as given in **10.2**. The number of pipes to be taken from the lot shall depend on the size of the lot and shall be according to Table 13.

B-1.11.2 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-1-11.3 Number of Tests and Criteria for Conformity

The number of test samples shall be as given in Table 13. 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 13.

Table 13 Scale of Sampling for Burst Pressure 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 to be introduced. Type tests for compliance with **9.2, 9.3** and **10.1** 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 **9.2**.

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 Test for Effect on Water

B-2.3.1 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-2.3.2 The sample so selected shall be tested for compliance with requirements for effect on water test as given in **9.3**.

B-2.3.3 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-2.3.4 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-2.3.5 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 Sustained Pressure Test

B-2.4.1. For this type test, the manufacturer or the supplier shall furnish to the testing authority, three samples of pipes of different schedule and of the largest and smallest pipe sizes being considered for qualification.

B-2.4.2. The samples so selected shall be tested for compliance with the requirements of type test given as per **10.1**.

B-2.4.3 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-2.4.4 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-2.4.5 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.

B-2.5 Test for Effect of Sunlight

B-2.5.1 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-2.5.2 The sample so selected shall be tested for compliance with requirements for effect of sunlight as given in **9.8**.

B-2.5.3 If all three samples pass the requirements for effect of sunlight, 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-2.5.4 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-2.5.5 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