IS XXXX:XXXX
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भारतीय मानक

कृषि प्रयोजन के लिए पॉलीविनाइल क्लोराइड के लचीले पिचक जाने वाले होज़ — विशिष्टि

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Indian Standard

FLEXIBLE POLYVINYL CHLORIDE LAY FLAT HOSE FOR AGRICULTURAL USE — SPECIFICATION

Corrections as indicated may be incorporated and page numbering may be done.

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Price Group

Plastic Piping Systems Sectional Committee, CED 50

FOREWORD

(*Formal clauses to be added later*)

This Indian Standard has been formulated to cover requirements and test methods for Flexible Polyvinyl Chloride Lay Flat Hose for Agricultural use.

Flexible polyvinyl chloride lay flat hose is a multipurpose hose for industrial and agricultural use, manufactured by an advance continuous manufacturing technique using a special formulation of polyvinyl chloride (PVC) and high tensile polyester yarn. The process ensures total penetration of PVC into the interstices of the polyester reinforcement and inseparable fusion with the inner and outside walls of PVC. This method of production allows maximum pressure rating maintaining minimum wall thickness. The hose thus produced has high hoop strength, at the same time allowing minimum longitudinal movement. It is lightweight and is rugged enough to take repeated daily rough handling. It has good corrosion resistant and abrasion resistant properties, and is available in long lengths. It assumes circular section under pressure and returns to its flat shape after use, for easy handling and storage. It does not need drying and can be rolled immediately after use.

This standard has been formulated to cover polyester yarn reinforced polyvinyl chloride flexible lay flats hoses for agricultural use, such as, for irrigation, sprinkling, dewatering and grain chutes.

For the purpose of deciding whether a particular requirement of the 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 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

FLEXIBLE POLYVINYL CHLORIDE LAY FLAT HOSE FOR AGRICULTURAL USE — SPECIFICATION

1 SCOPE

This standard covers the requirements, methods of sampling and tests for polyester yarn reinforced polyvinyl chloride flexible lay flats hoses for agriculture use.

2 REFERENCES

The Indian Standards given below 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 agreement based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards listed below:

IS No.	*Title*
IS 4569 : 1968	Methods of test for polyvinyl chloride resins
IS 4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)
IS 4985 : 2021	Unplasticized PVC pipes for water supplies — Specification (*fourth revision*)
IS 7016 (Part 4) : 2005/ISO 7854 : 1995	Methods of test for coated and treated fabrics: Part 4 Rubber- or plastics-coated fabrics — Determination of resistance to damage by flexing
IS 7703	Methods of test for continuous filament polyester and polyamide flat yarn
(Part 1) : 1990	Linear density (*first revision*)
(Part 2) : 1990	Dry and wet tenacity and elongation (*first revision*)
IS 9766 : 1992	Flexible PVC compounds — Specification (*first revision*)
IS 10151 : 2019	Polyvinyl chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water — Specification (*first revision*)
IS 12235	Thermoplastics pipes and fittings — Methods of test (*first revision*)
(Part 1) : 2004	Measurement of dimensions
(Part 3) : 2004	Test for opacity
(Part 4) : 2004	Determining the detrimental effect on the composition of water
(Part 10) : 2004	Determination of organotin as tin aqueous solution
IS 13360 (Part 2/Sec 1) : 2016	Plastics — Methods of testing: Part 2 Sampling and preparation of test specimens, Section 1 Plastics — Compression molding test specimens of thermoplastic materials (*first revision*)
IS 13360 (Part 5/Sec 1) : 2021/ISO 527-1 :	Plastics — Methods of testing: Part 5 Mechanical properties, Section 1 Determination of tensile properties — General requirements (*second revision*)

Remove Highlights

Reference table to be bring in IS 12 formatting

2019	
IS 13360 (Part 5/Sec 11) : 2013	Plastics — Methods of testing: Part 5 Mechanical properties, Section 11 Determination of indentation hardness by means of durometer (shore hardness) (*first revision*)
IS 15907 : 2010	Agro textiles — High density polyethylene (HDPE) woven beds for vermiculture — Specification
IS 17088 : 2019	Textiles — Synthetic filament yarns — Determination of shrinkage in dry-hot air (after treatment)

3 TERMINOLOGY

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

3.1 Nominal Size (DN) — The numerical designation for the size of a hose, which is a convenient round number approximately equal to the manufacturing dimension, in mm.

millimetre

3.2 Nominal Outside Diameter — The specified outside diameter, in mm assigned to a nominal size.

3.3 Bore — Inside of a hose through which the material to be conveyed passes.

3.4 Hose — Flexible tube consisting of a lining, reinforcement and usually, an outer cover.

3.5 Hydrostatic Stability — Ability to resist, within limits, changes in length and/or diameter and/or twist at a specified pressure.

3.6 Hydrostatic Stability Test — Non-destructive test in which the change in length and/or diameter and/or twist of a hose is measured at a specified pressure.

3.7 Internal Diameter — Diameter of the bore of a hose, in mm.

3.8 Mandrel — Rigid or flexible rod or tube of circular cross-section on which certain types of hose are manufactured.

3.9 Wall Thickness at any Point — The value of the measurement of the wall thickness at any point around the circumference of a hose, rounded off to the next higher 0.1 mm.

3.10 Minimum Wall Thickness at any Point — The minimum value for the wall thickness at any point around the circumference of a hose, rounded off to the next higher 0.1 mm.

3.11 Maximum Wall Thickness at any Point — The maximum value of the wall thickness at any point around the circumference of a hose, rounded off to the next higher 0.1 mm.

3.12 Mean Wall Thickness — The arithmetical mean of at least four measurements regularly spaced around the circumference and in the same cross-section of a hose, 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.

3.13 Tolerance — The permitted variation of the specified value of a quantity, expressed as the difference between the permitted maximum value or the permitted minimum value and the specified value.

3.14 Working Pressure (PN) — The numerical designation of a hose related to the mechanical characteristics of that hose used for reference purposes. For plastics piping systems, it corresponds to the allowable operating pressure, in bar, conveying water at 27 °C.

3.15 Tests shift to Next page

3.15.1 *Type Tests* — The 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 hoses.

3.15.2 *Acceptance Test* — The tests carried out on samples selected from a lot for the purpose of acceptance of the lot.

3.16 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 reprocessable or recyclable material(s) have been added.

4 CLASSIFICATION OF HOSES

The hose shall be classified by pressure ratings (working pressures) at 27 °C as given in Table 1.

Table 1 Type of Lay Flat Hose
(*Clause* 4)

Sl No.	Type of Hose	Working Presseure (PN) MPa (kg/cm^2)
(1)	(2)	(3)
i)	Light duty	0.30 (3.0)
ii)	Medium duty	0.50 (5.0)
iii)	Heavy duty	0.70 (7.0)

5 COMPOSITION

5.1 The material from which the hose is produced shall consist substantially of plasticized polyvinyl chloride (PVC) to which may be added only those additives that are needed to facilitate the manufacture of the hose and the production of sound and durable hose of good surface finish, mechanical strength and opacity under conditions of use. However, Di-2-ethylhexyl phthalate/bis(2-ethylhexyl) phthalate (DEHP), dioctyl phthalate (DOP), benzyl butyl phthalate (BBP), dibutyl phthalate (DBP) and di-isobutyl phthalate (DIBP) shall not be used as additives. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic, organoleptic or microbial growth hazard, or materially impair the fabrication or welding properties of the hose, or to impair its chemical and physical or mechanical properties.

5.2 Flexible Polyvinyl Chloride Compound

5.2.1 The flexible PVC compound suitable for extrusion, injection moulding and compression moulding and shall consist of polyvinyl chloride, and/or a copolymer of vinyl chloride, suitably compounded with plasticizers and other ingredients. The compound shall be in the form of random cut chips, regular cubes, regular cylindrical pellets, powder or any other convenient form.

5.2.2 The flexible PVC compound when tested in accordance with the method of test as given in Table 2 shall fulfill the requirements given therein.

5.3 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.

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

5.5 Polyester Yarn

The thermoplastic polyester yarn used for manufacturing hoses shall have high tenacity and regular shrinkage, and when tested shall comply with the requirements given in Table 3.

Table 2 Requirements for Flexible PVC Compounds for Hose
(*Clause* 5.2.2)

Sl No.	Characteristics	Unit	Requirements	Method of Test, Reference to IS/Annex
(1)	(2)	(3)	(4)	(5)
i)	Durometer hardness, *Min*	Shore A	51	13360 (Part 5/Sec 11)
ii)	Tensile strength, *Min*	N/mm^2	8	13360 (Part 5/Sec 1)
iii)	Elongation at break, *Min*	percent	175	13360 (Part 5/Sec 1)
iv)	Volatile loss at 130 °C/3 h, *Max*	percent	1.5	Annex H of IS 9766
v)	Cold bend temperature at which sample does not crack, *Min*		-20	Annex G of IS 9766
vi)	Volume resistivity at 27 °C, *Min*	ohm-cm	NA	Annex E of IS 9766
vii)	Ageing:			
	a) Treatment *Temperature* *Duration*	 °C days	 80 °C 7	Annex D of IS 9766
	b) Tensile strength, Variation, *Max*	percent	± 20 percent of the individual value before ageing	13360 (Part 5/Sec 1)
	c) Elongation at break, Variation, *Max*	Percent	± 20 percent of the individual value before ageing	13360 (Part 5/Sec 1)

Table 3 Requirements for High Tenacity Polyester Yarn
(*Clause* 5.5)

Sl No.	Characteristics	Unit	Requirement	Method of Test, Reference to IS/Annex
(1)	(2)	(3)	(4)	(5)
i)	Titer, *Min*	Dtex Denier	1 100 1 000	IS 7703 (Part 1)
ii)	Filaments, *Min*	F	192	Visual under microscope
iii)	Breaking Strength/ Breaking Tenacity, *Min*	N cN/dtex (gpd)	88 8.0 (9.1)	IS 7703 (Part 2) IS 7703 (Part 2)
iv)	Elongation at break, *Min*	percent	14 ± 2	IS 7703 (Part 2)
v)	Hot air shrinkage at 177 °C, 2 min, 0.05 cN/dtex	percent	7.5 ± 1.5	IS 17088

6 MATERIALS AND CONSTRUCTION

The hose shall be uniform in colour, opacity and other physical and chemical properties. The hose shall consist of a flexible thermoplastic material supported in its mass by a helix of thermoplastic polyester yarn material. The reinforcing and flexible components of the wall shall be fused and free from visible cracks, porosity, foreign inclusion or other defects which are liable to cause failure of the hose in service.

7 DIMENSIONS

7.1 Diameter

The inside diameter of a hose and the tolerance shall be as given in Table 4.

7.2 Wall Thickness

The wall thickness of plain hose and the plain portion shall be as given in Table 4.

Table 4 Dimensions of Light/Medium/Heavy Duty Hose
(*Clauses* 7.1 *and* 7.2)

Sl No.	Nominal Bore	Inner Diameter, *Min*	Wall thickness	Length (*see* **7.4** for tolerance)
	(DN)	mm (inch)	mm	m
(1)	(2)	(3)	(4)	(5)
Light Duty Hose:				
i)	25	25 (1")	1.5 ± 0.2	100
ii)	35	32 (1-1/4")	1.5 ± 0.2	100
iii)	40	38 (1-1/2")	1.5 ± 0.2	100
iv)	50	51 (2")	1.5 ± 0.2	100
v)	65	64 (2.5")	1.5 ± 0.2	100
vi)	75	76 (3")	1.5 ± 0.2	100
vii)	100	102 (4")	1.5 ± 0.2	100
viii)	125	127 (5")	1.5 ± 0.2	50
ix)	150	153 (6")	1.5 ± 0.2	50
Medium Duty Hose:				
x)	25	25 (1")	1.8 ± 0.2	100
xi)	35	32 (1-1/4")	1.8 ± 0.2	100
xii)	40	38 (1-1/2")	1.8 ± 0.2	100
xiii)	50	51 (2")	1.8 ± 0.2	100
xiv)	65	64 (2.5")	1.8 ± 0.2	100
xv)	75	76 (3")	1.8 ± 0.2	100
xvi)	100	102 (4")	1.8 ± 0.2	100
xvii)	125	127 (5")	1.8 ± 0.2	50
xviii)	150	153 (6")	1.8 ± 0.2	50
Heavy Duty Hose:				
xix)	25	25 (1")	2.0 ± 0.2	50
xx)	35	32 (1-1/4")	2.0 ± 0.2	50
xxi)	40	38 (1-1/2")	2.0 ± 0.2	50
xxii)	50	51 (2")	2.0 ± 0.2	50
xxiii)	65	64 (2.5")	2.0 ± 0.2	50
xxiv)	75	76 (3")	2.0 ± 0.2	50
xxv)	100	102 (4")	2.0 ± 0.2	50
xxvi)	125	127 (5")	2.0 ± 0.2	50

xxvii)	150	153 (6")	2.0 ± 0.2	50

7.3 Colour

The colour of the hose shall be given as given in Table 5. Slight variation in the appearance of the colour is permitted.

Table 5 Colour
(*Clauses* 7.3 *and* 11.2)

Sl No.	Type of Hose	Colour
(1)	(2)	(3)
i)	Light Duty	Green
ii)	Medium Duty	Yellow
iii)	Heavy Duty	Blue

7.4 Length

The tolerance on cut length shall be in accordance with Table 6.

Table 6 Tolerance on Cut Length
(*Clause* 7.4)

Sl No.	Length	Tolerances
	m	mm
(1)	(2)	(3)
i)	50-100	± 50
ii)	100-150	± 75
iii)	150-200	± 100

7.5 Hose Ends

The ends of the hose tube shall be cleanly cut, and shall be reasonable square to the axis of the hose tube.

8PHYSICAL AND CHEMICAL CHARACTERISTICS OF HOSE

8.1 Visual Appearance

The internal and external surfaces of the hose shall be smooth, clean and free from grooving and other processing defects. The hose shall be fused and free from visible crack porosity; foreign inclusion and other defects that are liable to cause failure of the hose in service.

8.2 Opacity

When tested in accordance with IS 12235 (Part 3), the wall of the plain hose shall not transmit more than 0.2 percent of the visible light falling on it.

8.3 Internal Mandrel Test

The diameter of test mandrel for internal mandrel test of hose tube shall be as specified in Table 7. The mandrel of 300 mm length shall pass smoothly from both ends of the hose.

Table 7 Internal Mandrel Test
(*Clause* 8.3)

Sl No.	DN	Diameter of Test Mandrel mm
(1)	(2)	(3)
i)	25	24
ii)	35	34
iii)	40	39
iv)	50	49
v)	65	64
vi)	75	74
vii)	100	99
viii)	125	124
ix)	150	149

8. Colour Stability

8. .1 *Fastness to Daylight Exposure*

The colour fastness shall be rated at not less than standard 4 when the pigmented compound is tested in accordance with the method described in Annex A.

8. .2 *Colour Bleeding*

There shall be no staining or marking of the sheet or of the filter paper when the pigmented compound is tested in accordance with the method described in Annex B.

8.5 Effect on Water

The hoses 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 hoses 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 of the Government of India for use of lead stabilizers in PVC pipe and fitting manufacturing shall be borne in mind.

9 PERFORMANCE REQUIREMENTS OF HOSES

9.1 Hydrostatic Test at Standard Atmospheric Conditions

When tested in accordance with method specified in Annex C at (27 ± 2) °C and relative humidity (65 ± 5) percent for a duration of 1 h, the hose shall meet the requirements given in Table 8.

Table 8 Hydrostatic Test at Standard Atmospheric Conditions
(*Clause* 9.1)

Sl No.	Type of Hose	Test Pressure MPa (kg/cm^2)
(1)	(2)	(3)
i)	Light Duty	0.4 (4.0)
ii)	Medium Duty	0.6 (6.0)
iii)	Heavy Duty	0.8 (8.0)

9.2 Hydrostatic Test at (55 ± 2) °C

When tested in accordance with method specified in Annex C at a temperature of (55 ± 2) °C, the hose shall meet the requirements given in Table 9. The test specimen with end plugs shall be kept in a thermostatically controlled water bath for a minimum duration of 1 h at (55 ± 2) °C to adjust the temperature. The above water temperature shall be ensured both inside and outside the test specimen.

Table 9 Hydrostatic Test at (55 ± 2) °C
(*Clause* 9.2)

Sl No.	Type of Hose	Test Pressure, *Min* MPa (kg/cm^2)
(1)	(2)	(3)
i)	Light Duty	0.2 (2.0)
ii)	Medium Duty	0.4 (4.0)
iii)	Heavy Duty	0.6 (6.0)

9.3 Burst Pressure Test at Standard Atmospheric Condition

When tested in accordance with method specified in Annex C at (27 ± 2) °C and relative humidity (65 ± 5) percent, the hose shall meet the requirements given in Table 10.

Table 10 Burst Pressure Test at Standard Atmospheric Condition
(*Clause* 9.3)

Sl No.	Type of Hose	Burst Pressure, *Min* MPa (kg/cm^2)
(1)	(2)	(3)
i)	Light Duty	1.0 (10.0)
ii)	Medium Duty	1.2 (12.0)
iii)	Heavy Duty	1.6 (16.0)

9.4 Loss of Mass on Heating

When tested in accordance with Annex D, the flexible thermoplastic material used in the construction shall have a loss of mass not greater than 4 percent.

9.5 Effect of Sunlight

Two samples each 300 mm long of different lengths of hose shall be prepared. One sample shall be kept covered in thick paper and kept in shade as control sample and the other in sun for not less than 1 600 h at ambient temperature of not less than 20 °C. After the required period of exposure, the two samples when compared shall not show any difference in colour or physical appearance. This test shall be conducted as type test.

9.6 Resistance to Damage by Flexing

The sample shall pass the flex test for minimum 50 000 cycles when tested as per IS 7016 (Part 4).

9.7 Resistance to Chemical Action

The sample shall withstand the chemical resistance test, when tested as per Annex E of IS 15907. The change in mass shall not increase 0.1 percent for each of the chemicals mentioned in the test. The average change in mass of all three specimen in each solution shall not exceed 0.1 percent.

10 SAMPLING AND CRITERIA FOR CONFORMITY

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

11 PACKAGING AND MARKING

11.1 Packing

The hose shall be packed in suitable bag (woven sacks/wooden box/carton box) as agreed between the purchaser and the manufacturer.

11.2 Marking

The hose shall be legibly and indelibly marked either using a contrasting indelible ink/paint or hot embossed on white base at intervals of not more than 3 m in colour as indicated in Table 5. The marking shall show the following information:

a) Manufacturer's name and trade-mark;
b) Type of hose and pressure rating;
c) Nominal bore of the hose; and
d) Lot number/Batch number containing information on date of manufacture.

1.2.1 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

1.3 BIS Certification Marking

Each hose 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 hose may be marked with the Standard Mark.

ANNEX A
(*Clause* 5.3 *and* 8.4.1)

PREPARATION OF MOULDED TEST SPECIMENS FROM FLEXIBLE PVC COMPOUNDS

A-1 GENERAL

The properties of a moulded article depend, amongst other things, on the composition of the moulding material, the shape and the state of anisotropy of the moulding, and on the methods of test used. Preparation of moulded sheet and blocks involves a preparation of a rough sheet from the material to be tested, using a heated two roll mill. The preliminary sheets are subsequently compression moulded to produce sheets of uniform thickness. Test specimens are prepared from these moulded sheets by machining or die-cutting.

A-2 PREPARATION OF PRELIMINARY SHEETS

A- 2.1 Apparatus

Two roll mill capable of operating satisfactorily at temperature up to and including 180 °C, having the following properties:

a) The rolls shall be cylindrical;
b) The surface speed of the rolls shall be approximately 10 m/min; and
c) Rolls shall have differential speed between the two rolls. The preferred ratio is 1 : 12 to 1 : 14, the front (working) roll being the slower.

A-2.2 Milling Conditions

A-2.2.1 The surface temperature of the mill rolls and the moulding temperature used subsequently shall be based on the shore hardness of the material as given below:

Sl No.	*Shore Hardness Scale Value*	*Surface Temperature, in °C (± 5 °C)*	
		Rolls	*Moulds*
(1)	(2)	(3)	(4)
i)	A up to 80	130 to 160	135 to 170
ii)	A > 80	145 to 170	160 to 180

The temperature of the rolls shall be selected to permit the material to bend on the surface of the roll between 1 and 2 min after the commencement of the milling.

A-2.2.2 The nip setting shall be determined by the desired thickness of the milled sheet. The thickness of milled sheet shall be slightly higher than the thickness of the moulded sheet or test specimen.

A-3 PROCEDURE

A-3.1 Add the material to the mill rolls. Any material falling through the nip shall be carefully and quickly collected from the tray and returned to the moving rolls. After sheet is formed, continue milling for approximately 5 min in such a way that optimum dispersion of all material components is obtained. This normally includes cutting the sheet, allowing it to form a roll and refeeding this roll into the nip. Remove the milled sheet from the rolls without stretching.

A-3.2 Preparation of Moulded Sheet

A-3.2.1 *Apparatus*

a) Hydraulic moulding press, capable of developing moulding pressure of at least 0.5 MPa (5 kg/cm^2). The press platen shall be equipped with means of heating and cooling such that the surface can be heated to a temperature of 180 °C and such that the maximum deviation at any point from the temperature at the centre of the platen does not exceed 5 °C within the moulding area.

b) Male/Female mould, or window frame between two metal plates. Parting foils (stainless steel plates as per IS 9766) can be placed between the materials and the metal surfaces.

A-3.2.2 *Moulding Conditions*

The mass of material required to fill a mould is predetermined either by calculation from the known material density, or by making a trial moulding. The moulding temperature shall be in accordance with the requirements given in **A-2.2.1**.

A-3.3 Procedure

A-3.3.1 Place the required mass of pieces cut from the milled sheet in the preheated mould.

Close the preheated platens of the press and maintain a pressure of approximately 0.5 MPa (5 kg/cm^2) to 1.0 MPa (10 kg/cm^2) for a period of 5 min followed by application of pressure of not less than 3.5 MPa (35 kg/cm^2) calculated on the area of moulding. During this time, there shall be sufficient flow of the material between the mould and the metal surfaces to result in formation of a small amount of moulding flash. Cool the mould to approximately 40 °C or, in the case of very soft materials to a lower temperature, while maintaining constant applied pressure. Open the mould and remove the sheet.

A-3.4 Preparation of Test Specimens

Prepare the required test specimens from the moulded sheet by machining or by stamping, using a sharp die of the required shape, the cutting edges of which are free from defects such as notches and burrs.

A-4 CONDITIONING

The conditioning and all standard test determinations shall be made at (27±2) °C and (65±5) percent relative humidity in accordance with the requirements of test method unless the relevant test method specified otherwise. The minimum time between the preparation of a test specimen and the test determination shall be 16 h, except that for electrical properties, it shall be 24 h. If shore hardness values change significantly, a minimum time of 48 h is necessary.

ANNEX B
(*Clause* 8.4.2)

TEST FOR COLOUR BLEEDING

B-1 FORM OF TEST SPECIMEN

For sheet materials, the specimen shall be a piece 50 mm square, cut from the sheet under test. For extrusion compounds the specimen shall be a piece 50 mm square and (1.25 ± 0.15) mm thick cut from sheet moulded under the conditions specified in **A-2.2.1**.

B-2 NUMBER OF TEST SPECIMENS

For compounds and sheet of uniform colour one specimen shall be used for colour bleeding test.

B-3 PROCEDURE

B-3.1 The specimen shall be placed on a square piece of polyvinyl chloride sheet of dimension 75 mm and the following formulation:

	Parts per mass
Polyvinyl chloride	100
Di-(2-ethylbexyl) phthalate	66.6
Lead stearate	1.5
Cadmium stearate	1.5

B-3.2 The specimen shall then be covered with a 75 mm square dry, white Whatman No. 44 or equivalent filter paper. In order to ensure good contact between the filter paper, the specimen and the sheet on which it rests, shall be sandwiched between two pieces of glass plate, 75 mm square and 5 mm thick. The various layers shall be brought into good contact, preferably by rolling. A mass approximately 50 g shall be placed on the top to ensure good contact. The assembly shall be maintained for (72 ± 1) h at (50 ± 2) °C in an air oven. At the end of this time, the assembly shall be removed from the oven, its parts separated and the 75 mm square piece of polyvinyl chloride sheet and the filter paper examined for staining, first over a white and then over a black background; white filter paper and photo black cover paper are suitable for this purpose. If either the filter paper or the polyvinyl chloride sheet is stained it shall be reported that colour bleeding has occurred.

B-4 REPORT

The report shall state whether or not colour bleeding has occurred.

ANNEX C
(*Clauses* 9.1, 9.2 *and* 9.3)

HYDROSTATIC TEST AND BURST PRESSURE TEST

C -1 APPARATUS

The following apparatus shall be used for the test:

a) Pressure source capable of applying pressure at the rate specified in **C-3.2** up to a required test pressure.

b) Calibrated pressure gauge or pressure transducers with digital read-outs chosen for each test so that the test pressure is between 15 percent and 5 percent of the full scale reading.

C 2 TEST PIECES

C 2.1 Hose

The hydrostatic pressure and burst tests shall be carried out on a hose test piece with a minimum free length of 300 mm, excluding end fittings and end reinforcements.

C 2. 2 Number of Test Pieces

At least two test pieces shall be tested.

C-2.3 For the hose under test, water shall be used as the test medium. Hose and hose assemblies pressurized by liquids can fail in a potentially dangerous manner. For this reason, the test shall be performed in a suitable enclosure. Also the use of air and other gases as test media shall be avoided because of the risk to operators. In special cases, where such media are required for the tests, strict safety measures are imperative. Even when a liquid is used as the test medium, it is essential that all air is expelled from the test piece because of the risk of injury to the operator due to the sudden expansion of trapped air released when the hose bursts.

C-3 PROCEDURE

C-3.1 Fill the test piece with test liquid, expelling all air, and connect to the test equipment. Close the valve and apply the hydrostatic pressure at a uniform rate of increase. Measure the pressure using a calibrated pressure gauge or pressure transducer with digital read out [*see* **C-1**(b)].

NOTE – It is important to allow unrestricted movement of the free or plugged end of the test piece during test.

C-3.2 The rate of pressure increase shall be constant and chosen to reach the final pressure after between 30 s and 60 s for hoses with nominal inside diameter up to 50 mm. For hoses with nominal inside diameter greater than 50 mm and less than or equal to 250 mm, the time needed to reach the final pressure shall be between 60 s and 240 s. For hoses with nominal inside diameter larger than 250 mm, the time limit to reach the final pressure shall be decided between the manufacturer and the user.

C-4 BURST PRESSURE TEST

Increase the pressure at a rate in accordance with **C-3.2** until the hose or hose assembly fails. The position and mode of failure shall be recorded in the test report. Any failure caused by blowing off of fittings, leakage or burst within 25 mm of a fitting or within a distance equal to the outside diameter of a hose whichever is greater shall not be interpreted as a true hose burst.

ANNEX D
(*Clause* 9.4)

LOSS OF MASS ON HEATING

D-1 APPARATUS

The following apparatus shall be used for the test:

a) Analytical Balance, having an accuracy of 0.001 g.

b) Micrometer, accurate to 0.01 mm.

c) Thermostatic Bath or Oven, capable of maintaining the temperature to within ± 2 °C of the test temperature in the range of 50 °C to 150 °C, shall be used.

d) Containers, metal cans of cylindrical forms about 100 mm in diameter and 120 mm in height provided with non-airtight cover; a lid with a small vent hole of 3 mm diameter may be suitable.

e) Metal Cages, cylindrical metal cages constructed from bronze gauze having apertures of approximately 500 microns, with a diameter of 60 mm and height of 6 mm, formed by soldering a strip of gauze at right angles to the periphery of disk of the gauze: a similar but slightly larger cylinder acts as a lid.

f) Activated Carbon, with a grain size of 4 to 6 mm, free from powder. The carbon shall be of well determined type and grade, in order to obtain concordant results. Before use, the carbon should be sieved and dried to constant mass at 70 °C preferably under vacuum, and then stored in an air-tight container. Use fresh material for each test.

D-2 TEST SPECIMENS

D-2.1 The test specimens shall be in the form of disks (50 ± 1) mm diameter and (1 ± 0.1 mm) in thickness cut from compression moulded sheet of the appropriate thickness.

D-2.2 If the test is carried out for the determination of characteristics of specific plasticizers, standard compounds of a given composition, as agreed to between the vendor and the purchaser shall be used.

D-2.3 At least 3 test specimens shall be tested for each material.

NOTE — For special purposes, the use of specimens of different shapes and thickness may be necessary. However, comparison of the values obtained is possible only for specimens of the same thickness. Coated fabrics and other supported plastic films may be tested by this method using specimens cut directly from the sample as received.

D-3 PROCEDURE

D-3.1 Weigh each test specimen to the nearest 0.001 g and determine its mean thickness to the nearest 0.01 mm.

D-3.2 On the bottom of metal cage [*see* D-1 (e)] spread about 120 cm of activated carbon [*see* D-1 (f)]. Place the specimen in wire-mesh cage [*see* D-1 (e)] and place the cage on top of the carbon and cover it with the further 1 200 mm of carbon. Finally put the lid on the container.

D-3.3 Place the container in the oven or thermostatic bath controlled at a temperature of (100 ± 2) °C. After 24 h, remove the container from the oven or bath and allow it to cool at room temperature. Remove the wire cage from the container and remove the specimen from the wire cage, carefully brush them free from any trace of carbon particles.

D-3.4 Reweigh each specimen to the nearest 0.001 g.

NOTE — For different materials, different temperature and durations of test may be agreed to between the interested parties, maintaining the same test procedure.

D-3.4 Expression of Results

The change in mass, M, expressed as a percentage, is given by the formula:

$$M = \frac{M_0 - M_1}{M_0} \times 100$$

where

M_0 = mass in g of the test specimen before the test, and

M_1 = mass in g of the test specimen after treatment in the oven or thermostatic controlled bath.

The arithmetic mean of values obtained from the three test specimens is the loss of plasticizers from the material under test.

ANNEX E
(*Clause* 10)

SAMPLING AND CRITERIA FOR CONFORMITY

E-1 LOT

In any consignment, all the rolls of hoses of the same type, colour and finish shall be grouped together and each such group shall constitute a lot.

E-1.1 The conformity of the lot to the requirements of the standard shall be ascertained for each lot separately. The number of rolls, *n* to be selected from a lot shall depend on the size of the lot, *N* and shall be in accordance with Table 11.

Table 11 Number of Rolls of Hose Tubes to be Selected for Sampling
(*Clause* E-1.1)

Sl No.	Lot Size *N*	Number of Rolls to be Selected *n*
(1)	(2)	(3)
i)	Up to 50	2
ii)	51 to 100	3
iii)	101 to 200	4
iv)	201 to 300	5
v)	301 and above	7

E-1.2 The rolls of hose shall be selected at random and to ensure the randomness of selection, a random number table shall be used. For guidance on the 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 subject to agreement between the purchaser and the supplier:

Arrange all the rolls in the lot in a systematic manner and starting from any roll, count them as 1, 2, 3 etc., up to *r* and so on, where r being the integral part of N/n (N being the lot size and n the sample size). Every r^{th} roll thus counted shall be withdrawn till the requisite number of rolls is obtained.

E-1.3 Number of Tests

E-1.3.1 From each of the rolls selected, 1 m length of thermoplastic hose shall be cut, care being taken to exclude not less than 0.25 m length of the material from either end. The test specimens necessary for the various tests specified in the standard shall be cut from the length of thermoplastic hose thus obtained.

E-1.3.2 In case the samples selected passes all the type tests as per **E-1.4.1**, the material in the lot shall then be tested for acceptance tests as per **E-1.4.2**. For this purpose, test specimens of suitable length may be taken.

E-1.4 Criteria for Conformity

E-1.4.1 The lot shall be declared as conforming to the requirements as given in **8.2**, **8.4.1**, **8.5**, **9.5**, **9.6** and **9.7**, if the samples pass all the type tests as per **E-1.5**.

E-1.4.2 The lot having being found satisfactory as per **E-1.4.1** shall be declared as conforming to the requirements of the standard, if all the test specimens pass all the acceptance tests, as listed below:

a) Dimensional requirements and visual appearance (**7** and **8.1**);
b) Internal mandrel test (**8.3**);
c) Colour bleeding (**8.4.2**);
d) Hydrostatic test at standard atmospheric conditions (**9.1**);
e) Hydrostatic test at (55 ± 2) °C (**9.2**);
f) Burst pressure test at standard atmospheric conditions (**9.3**); and
g) Loss of mass on heating (**9.4**).

E-1.4.3 If the specimens taken from the lengths obtained as in **E-1.3.1**, fail in one or more acceptance tests, each such test shall be repeated twice. For this purpose, two further metre lengths shall be cut from the same roll as the failing metre length, and specimens shall be cut from each of them so that

c uplicate tests may be conducted in respect of each f ilure. If all samples pass in these tests, the lot shall b : declared as conforming to the standard, otherwise r ot.

I -1.5 Type Tests

I -1.5.1 Type tests are intended to prove the s itability and performance of a new composition or a new size of pipe. Such tests, therefore, need to be a plied only when a change is made in polymer c mposition or when a new size of pipe is to be i troduced. Type tests for compliance with **8.2**, **8.4.1**, **8 5**, **9.5**, **9.6** and **9.7** (type test only) shall be carried o t as per **E-1.5.2** to **E-1.5.7**.

E 1.5.2 *Opacity*

F r this test, the manufacturer or the supplier shall fi nish to the testing authority one sample of the hose o the thinnest wall section, selected preferably from a egular production lot.

E 1.5.2.1 The sample so selected shall be tested for c mpliance with requirements for opacity as given in **8.** .

E 1.5.2.2 If the sample passes the requirements of the op acity test, the type of the hose under consideration sh ll be considered to be eligible for approval, which sh ll be valid for a period of one year.

E- .5.2.3 In case the sample fails in the test, the te ing authority, at its discretion, may call for a fresh sa ple and subject the same to the opacity test. If the sa ple passes the repeat test, the type of hose under co sideration shall be considered eligible for ap roval. If the sample fails in the repeat test, the ty e of hose shall not be approved. The manufacturer or he supplier may be asked to improve the design an resubmit the product for type approval.

E- .5.2.4 At the end of the validity period (normally on year) or earlier, if necessary, the testing authority ma / call for a fresh sample for opacity test for the pu pose of type approval.

E- .5.3 *Fastness to Daylight Exposure*

Fo this test, the manufacturer or the supplier shall fur ish to the testing authority three samples of the ho : of different diameters and classes, selected pre erably from a regular production lot.

E-1.5.3.1 The sample so selected shall be tested for compliance with requirements for fastness to daylight exposure as given in **8.4.1**.

E-1.5.3.2 If the sample passes the requirements of the fastness to daylight exposure test, the type of the hose under consideration shall be considered to be eligible for approval, which shall be valid for a period of two years.

E-1.5.3.3 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 fastness to daylight exposure test. If the sample passes the repeat test, the type of hose under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of hose shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

E-1.5.3.4 At the end of the validity period (normally two years) or earlier, if necessary, the testing authority may call for a fresh sample for fastness to daylight exposure test for the purpose of type approval.

E-1.5.4 *Test for Effect on Water*

For this type test, the manufacturer or the supplier shall furnish to the testing authority three samples of the smallest size of hose taken from each machine (selected preferably from a regular production lot).

E-1.5.4.1 Three samples so selected shall be tested for compliance with the requirements for effect on water as given in **8.5**.

E-1.5.4.2 If all three samples pass the requirements for effect on water, the type test of the hose under consideration shall be considered to be eligible for approval, which shall be normally valid for a period of one year.

E-1.5.4.3 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 hose shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

E-1.5.4.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for effect on water test for the purpose of type approval.

E-1.5.5 *Effect of Sunlight*

For this test, the manufacturer or the supplier shall furnish to the testing authority three samples of the hose of different diameters and classes, selected preferably from a regular production lot.

E-1.5.5.1 The sample so selected shall be tested for compliance with requirements for effect of sunlight as given in **9.5**.

E-1.5.5.2 If the sample passes the requirements of the effect of sunlight test, the type of the hose under consideration shall be considered to be eligible for approval, which shall be valid for a period of two years.

E-1.5.5.3 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 effect of sunlight test. If the sample passes the repeat test, the type of hose under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of hose shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

E-1.5.5.4 At the end of the validity period (normally two years) or earlier, if necessary, the testing authority may call for a fresh sample for effect of sunlight test for the purpose of type approval.

E-1.5.6 *Resistance to Damage by Flexing Test*

For this test, the manufacturer or the supplier shall furnish to the testing authority three samples of the hose of different diameters and classes, selected preferably from a regular production lot.

E-1.5.6.1 The sample so selected shall be tested for compliance with requirements for fastness to daylight exposure as given in **9.6**.

E-1.5.6.2 If the sample passes the requirements of the resistance to damage by flexing test, the type of the hose under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

E-1.5.6.3 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 resistance to damage by flexing test. If the sample passes the repeat test, the type of hose under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of hose shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

E-1.5.6.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for a fresh sample for resistance to damage by flexing test for the purpose of type approval.

E-1.5.7 *Resistance to Chemical Action*

For this test, the manufacturer or the supplier shall furnish to the testing authority three samples of the hose of different diameters and classes, selected preferably from a regular production lot.

E-1.5.7.1 The sample so selected shall be tested for compliance with requirements for fastness to daylight exposure as given in **9.7**.

E-1.5.7.2 If the sample passes the requirements of the resistance to chemical action test, the type of the hose under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

E-1.5.7.3 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 resistance to chemical action test. If the sample passes the repeat test, the type of hose under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of hose shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

E-1.5.7.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for a fresh sample for resistance to chemical action test for the purpose of type approval.

(Ravenshaw University, Cuttack 753003 Odisha)

ANNEX F
(*Foreword*)

COMMITTEE COMPOSITION

Plastic Piping Systems Sectional Committee, CED 50

Organization	*Representative(s)*
In 'ersonal Capacity (*Cuttack*)	DR S. K. NAYAK (***Chairman***) (Chairperson)
Bc ouge India Pvt Ltd, Mumbai	SHRI PRASHANT D. NIKHADE
Br ıan Mumbai Licensed Plumbers Association, Mumbai	SHRI KISHOR V. MERCHANT SHRI BIJAL M. SHAH (*Alternate*)
Ce tral Institute of Plastic Engineering and Technology, Chennai	DR S. N. YADAV SHRI D. ANJANEYA SHARMA (*Alternate*)
Ce tral Public Health Environmental Engineering Organization, New Delhi	DR RAMAKANT SHRI VIPIN KUMAR PATEL (*Alternate*)
Ce tral Public Works Department, New Delhi	SHRI M. K. MALLICK SHRI DIVAKAR AGRAWAL (*Alternate*)
Ch nnai Metropolitan Water Supply & Sewerage Board, Chennai	ENGINEERING DIRECTOR SUPERINTENDING ENGINEER (P&D) (*Alternate*)
CS R - Central Building Research Institute, Roorkee	DR B. SINGH SHRI RAJIV KUMAR (*Alternate*)
CSI R - National Environmental Engineering Research nstitute, Nagpur	DR (SHRIMATI) ABHA SARGONKAR DR RITESH VIJAY (*Alternate*)
Del i Development Authority, New Delhi	SUPERINTENDING ENGINEER (D) EXECUTIVE ENGINEER (R&D) (*Alternate*)
Del i Jal Board, New Delhi	SHRI Y. K. SHARMA SHRI S. L. MEENA (*Alternate*)
Dep rtment of Chemical & Petrochemicals Govt of ndia, New Delhi	JOINT INDUSTRIAL ADVISOR
Finc ex Industries Limited, Pune	SHRI ARUN SONAWANE SHRI D. J. SALUNKE (*Alternate*)
GAI . India Limited, New Delhi	SHRI MANISH KHANDELWAL SHRI KULDEEPNEGI (*Alternate* I) SHRI NITIN GUPTA (*Alternate* II)
Hald a Petrochemicals Ltd, Kolkata	SHRI RAJ K. DATTA SHRI AMARTYA MAITY (*Alternate*)
HPC . - Mittal Energy Ltd, Noida	SHRI VINEET KUMAR GUPTA SHRI ALAKESH GHOSH (*Alternate*)

Organization	*Representative(s)*
HSIL Ltd (Pipe Divison), Hyderabad	SHRI TUSHARLOKARE SHRI VINOY KUMAR (*Alternate*)
Indian Oil Corporation Ltd, Panipat	SHRI SUMIT BASU SHRI RAJA PODDAR (*Alternate* I) SHRI NAVEEN GARG (*Alternate* II)
Jain Irrigation System Limited, Jalgaon	SHRI S. NARAYANASWAMI SHRI P. H. CHAUDHARI (*Alternate*)
Mahindra EPC Irrigation Ltd, Nashik	SHRI SANKAR KUMAR MAITI SHRI ASHISH KUMAR (*Alternate*)
Military Engineer Services, Engineer-in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi	SHRI N. K. GOEL SHRI RAJIV KHARE (*Alternate*)
Ministry of Drinking Water and Sanitation, New Delhi	SHRI DINESH CHAND SHRI SUMIT PRIYADARSHI (*Alternate*)
NSF Safety and Certification India Pvt Ltd, Gurugram	SHRI B. B. SINGH SHRI NASRIN KASHEFI (*Alternate*)
Panchayati Raj and Drinking Water Department, Govt. of Odisha, Bhubaneswar	CHIEF ENGINEER
Plastindia Foundation, Mumbai	SHRI RAJIV J. RAVAL DR E. SUNDARESAN (*Alternate*)
Public Health Engineering Department, Government of Rajasthan, Jaipur	SUPERINTENDING ENGINEER (D&S) EXECUTIVE ENGINEER (D&S) (*Alternate*)
Reliance Industries Limited, Mumbai	SHRI S. V. RAJU SHRI SAURABH BAGHAL (*Alternate*)
RITES Limited, New Delhi	SHRI PANKAJ AGGARWAL SHRI MUKESH SINHA (*Alternate*)
Shaktiman Extrusions Pvt Ltd, Perumbavoor	SHRI N. SURESH SHRI T. S. MANOJ (*Alternate*)
Supreme Industries Limited, Mumbai	SHRI G. K. SAXENA SHRI ANUP MANDAL (*Alternate*)
Tamil Nadu Water Supply & Drainage Board, Chennai	ENGINEERING DIRECTOR JOINT CHIEF ENGINEER (COM) (*Alternate*)
Tata Consulting Engineers Ltd, Mumbai	REPRESENTATIVE
In Personal Capacity (*A-59, Sector 35, Noida 201301*)	SHRI KANWAR A. SINGH
In Personal Capacity (*L-202 Metrozone, Anna Nagar West, Chennai 600040*)	SHRI G. K. SRINIVASAN

Organization	*Representative(s)*
BI Directorate General	Sc 'E'/Director and SHRI ARUN KUMAR S. /HEAD (CIVIL ENGINEERING DEPARTMENT) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRIMATI MADHURIMA MADHAV
Scientist 'D'/JOINT DIRECTOR
(CIVIL ENGINEERING DEPARTMENT), BIS

Composition of Polyolefins and GRP Piping System Subcommittee, CED 50:1

Organization	*Representative(s)*
In Personal Capacity (*A-59, Sector 35, Noida 201301*)	SHRI KANWAR A. SINGH (***Convener***)
Alo n Poly Extrusion Ltd, Kolkata	SHRI ARNAV JHUNJHUNWALA SHRI ANIK KUMAR CHOWDHURY (*Alternate*)
Ass m Gas Company Limited, Dibrugarh	SHRI SURJAYA TAMULIK SHRI AHIJIT BARUAH (*Alternate*)
Bhi rajka Impex Limited, Mumbai	SHRI V. K. SHARMA SHRI VINOD BHIMRAJKA (*Alternate*)
Cen al Ground Water Board, Faridabad	SHRI D. N. ARUN SHRI K. R. BISWAS (*Alternate*)
Cen al Institute of Plastics Engineering & Technology, hennai	DR K. PRAKALATHAN DR A. K. MOHAPATRA (*Alternate*)
Cent al Public Works Department, New Delhi	SHRI M. K. SHARMA (CSQ) SHRI AMAR SINGH (*Alternate*)
Chen ai Water Supply & Sewerage Board, Chennai	ENGINEERING DIRECTOR CHIEF ENGINEER (O&M) (*Alternate*)
CSIR - National Environmental Engineering Research Institute, Nagpur	DR (SHRIMATI) ABHA SARGAONKAR DR RITESH VIJAY (*Alternate*)
Chen ai Water Supply & Sewerage Board, Chennai	ENGINEERING DIRECTOR CHIEF ENGINEER (O&M) (*Alternate*)
Delh Jal Board, New Delhi	SHRI Y. K. SHARMA SHRI S. L. MEENA (*Alternate*)
Dura ne India Pvt Ltd, Mumbai	SHRI RAJEEV CHATURVEDI SHRI SUNIL SAXENA(*Alternate*)

Organization	*Representative(s)*
Engineers India Ltd, New Delhi	SHRI N. KAUL SHRI R. B. BHUTDA (*Alternate*)
EPP Composite Pipes, Rajkot	SHRI JAYRAJ SHAH SHRIMATI SEEMA VAIDYA (*Alternate*)
GAIL India Limited, New Delhi	DR DEBASISH ROY SHRI MANISH KHANDELWAL (*Alternate* I) SHRI NITIN GUPTA (*Alternate* II)
Godavari Polymers Pvt Limited, Secunderabad	SHRI C. VENKATESHWAR RAO SHRI G. SRIDHAR RAO (*Alternate*)
Government E-Marketplace, New Delhi	REPRESENTATIVE
Indraprastha Gas Limited, New Delhi	REPRESENTATIVE
Industrial Toxicology Research Centre, Lucknow	DR V. P. SHARMA DR VIRENDRA MISRA (*Alternate*)
Jain Irrigation Systems Limited, Jalgaon	SHRI M. R. KHARUL SHRI M. D. CHAUDHARI (*Alternate*)
Kimplas Piping Systems Ltd, Nashik	SHRI KIRAN SARODE SHRI SANTOSH KUMAR (*Alternate*)
KITEC Industries India Limited, Mumbai	SHRI DALIP V. KOLHE SHRI MANORANJAN G. CHOUDHARY (*Alternate*)
Mahanagar Gas Limited, Mumbai	SHRI K. VENUGOPAL SHRIMATI NEHA KHARYA (*Alternate*)
Mahanagar Telephone Nigam Limited, New Delhi	CHIEF ENGINEER (BW)
Maruthi Tubes Pvt Ltd, Secunderabad	SHRI MANCHAALA RAGHAVENDRA SHRI M. NAGESH KUMAR (*Alternate*)
Military Engineer Services, Engineer- in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi	SHRI A. K. DUBEY SHRI R. K. CHAUHAN (*Alternate*)
National Test House, Kolkata	SHRI S. P. KALIA SHRI M. M. PABALKAR (*Alternate*)
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Public Health & Municipal Engineering Department, Hyderabad	SHRI K. SURESH KUMAR SHRI CH. MALLIKARJUNUDU (*Alternate*)
Reliance Industries Limited, Mumbai	SHRI S. V. RAJU SHRI SAURABH BAGHAL (*Alternate* I)

Organization	*Representative(s)*
	SHRI TUSHAR DONGRE (*Alternate* II)
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Composition of PVC and ABS Piping System Subcommittee, CED 50:2

Organization	*Representative(s)*
In ersonal Capacity (*L-202 Metrozone, Anna Nagar West, Chennai 600040*)	SHRI G. K. SRINIVASAN (***Convener***)
As irvad Pipes Pvt Ltd, Bengaluru	SHRI MOHAMMAD NOUFAL SHRI MILIND. B. MAGAR (*Alternate*)
As ral Poly Technik Ltd, Ahmedabad	SHRI SANDEEP ENGINEER SHRI LALIT TRIVEDI (*Alternate*)
Ba rlocher India Additives Pvt Ltd, Mumbai	DR SHREEKANT DIWAN SHRI SACHIN BIDKAR (*Alternate*)
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Ce ntral Institute of Plastic Engineering & Technology, Chennai	SHRI M. NAVANEETHAN
Ce ntral Public Works Department, New Delhi	CHIEF ENGINEER (CSQ) EXECUTIVE ENGINEER (S&S) (*Alternate*)
De hi Jal Board, New Delhi	SHRI Y. K. SHARMA SHRI S. L. MEENA (*Alternate*)
De partment of Telecommunications Ministry of Communications, Govt of India, New Delhi	SHRI V. L. VENKATARAMAN SHRI P. ADINARAYANA (*Alternate*)
Fi olex Industries Limited, Pune	SHRI ARUN SONAWANE SHRI D. J. SALUNKE (*Alternate*)
Go vernment E-marketplace, New Delhi	REPRESENTATIVE
Ja n Irrigation Systems Limited, Jalgaon	SHRI NARAYANASWAMI SHRI M. R. KHARUL (*Alternate*)
K nplas Piping Systems Ltd, Nashik	REPRESENTATIVE
M hanagar Telephone Nigam Limited, New Delhi	SUPERINTENDING ENGINEER (CIVIL) SHRI M. K. SINGHAL (*Alternate*)
N tional Test House, Kolkata	SHRI D. SARKAR

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Reliance Industries Limited, Mumbai	SHRI S. V. RAJU SHRIMATI ARUNA KUMARI (*Alternate* I) SHRI JAYESH DESAI (*Alternate* II)
Rex Polyextrusion Limited, Sangli	SHRI SHASHANK PARGAONKAR SHRI C. B. DANDEKAR (*Alternate*)
RITES Limited, New Delhi	SHRI PANKAJ AGGARWAL SHRI MUKESH SINHA (*Alternate*)
Rural Water Supply & Sanitation Department, Govt of Orissa, Bhubaneswar	CHIEF ENGINEER
Supreme Industries Limited, Jalgaon	SHRI G. K. SAXENA SHRI P. L. BAJAJ (*Alternate*)
Tamil Nadu Water Supply & Drainage Board, Chennai	ENGINEERING DIRECTOR JOINT CHIEF ENGINEER (COM) (*Alternate*)
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