भारतीय मानक
Indian Standard

IS 14885 : 2022

गैसीय ईंधन की आपूर्ति के लिए पॉलीइथाईलिन पाइप — विशिष्टि

(पहला पुनरीक्षण)

Polyethylene Pipes for the Supply of Gaseous Fuels — Specification

(First Revision)

ICS 83.140.30, 75.200

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February 2022 **Price Group 9**

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastic Piping System Sectional Committee had been approved by the Civil Engineering Division Council.

This standard covers requirements and test methods for polyethylene pipes for supply of gaseous fuels.

Polyethylene is being used to produce pipes for carrying natural gas for a number of years. Due to extensive research evaluation programme in the developed countries, gas distribution technology has made appreciable progress, and with the introduction of new generation of polyethylene compounds presenting very high performance, the confidence in the use of PE pipes for gas distribution is also very high and it has achieved commendable results. The usage of polyethylene as piping material has gained favour since it offers advantages in costs as well as in technical requirements such as lower permeation of gas constituents compared to competitive piping, lack of corrosion effects, flexibility of the material allowing supplying of gas in long tube lengths, relining operation of old gas networks and the possibility of use with directed drilling earthworks methods. These methods reduce the interruption in traffic flow, excavation and annoyance to general public. The use of electro fusion jointing techniques enables repairs or modification intervention under faster and more economical conditions than for steel.

Further, the Government of India has accorded high priority for adoption of piped natural gas (PNG) networks for domestic and commercial properties. Liquefied petroleum gas (LPG) pipe networks are also coming up in big way. Also, the identification of new coal bed methane fields and their commercial viability in industrial application has increased the usage of polyethylene gas piped networks in India.

This Indian Standard was published in 2001. The Indian Standard specification was prepared in line with International Standards and included additional tests/precautions (165 h acceptance test) necessary for Indian field conditions and industry practice to further enhance the confidence of the end users through stringent measures in the processing and field practices. Since testing facilities as per ISO 9080 'Plastic piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation' was not available in the country, 10 000 h test for pipes was introduced at the instance of the various utilities, as approval type test to be carried out once in order to establish the manufacturer's capability to produce the pipes as per this standard.

In view of the basic requirements and safety concerns involved with the product covered in this standard, it is considered essential for the pipe manufacturers not only to ensure proper identification of the polyethylene compound and documentation of its test results received from the resin suppliers but also to establish a satisfactory evaluation programme with respect to various tests for the determination of the short-term and long-term properties leading to the classification of the PE compound and determination of arrest or propagation of a crack initiated in thermoplastics pipes at a specified temperature and internal pressure before taking up bulk production.

In the revision of this standard considerable assistance has been derived from the following International Standards:

ISO 4437 (Part 1) : 2014 Plastic piping systems for the supply of gaseous fuels — Polyethylene (PE) – Part 1: General; and

ISO 4437 (Part 2) : 2014 Plastic piping systems for the supply of gaseous fuels — Polyethylene (PE) – Part 2: Pipes

(*Continued to third cover*)

Indian Standard

POLYETHYLENE PIPES FOR THE SUPPLY OF GASEOUS FUELS — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the requirements for buried polyethylene pipes from 16 mm to 630 mm in diameter with SDR 9, SDR 11, SDR 13.6 and SDR 17 and in material grades PE 80 and PE 100, intended to be used for the supply of gaseous fuels. In addition, it specifies general properties of the materials from which these pipes shall be made, including a classification scheme.

2 REFERENCES

The standards given below contain provisions, which through reference in this text, constitute the provisions of this standard. At the time of publication, the editions indicated are 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 standards indicated below:

IS No.	*Title*
2530 : 1963	Methods of test for polyethylene moulding materials and polyethylene compounds
4905:2015/ ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)
4984 : 2016	Polyethylene pipes for water supply — Specification (*fifth revision*)
7328 : 2020	Specification for polyethylene material for moulding and extrusion (*second revision*)

3 TERMINOLOGY

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

3.1 Nominal Size (DN) — Numerical designation of the size of a component, other than a component designated by a thread size, which is a convenient round number approximately equal to the manufacturing dimension in millimetres (mm).

3.2 Nominal Size (DN/OD) — Nominal size, related to the outside diameter.

3.3 Nominal Outside Diameter (d_n) — Specified outside diameter, in millimetres, assigned to a nominal size DN/OD.

3.4 Mean Outside Diameter (d_{em}) — Average value of the measurement of the outer circumference of the pipe or spigot end of a fitting in any cross-section divided by π (3.142), for the number of measurements taken, rounded to the next greater 0.1 mm.

3.5 Out-of-Roundness (Ovality) — Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross-section of the pipe, at 300 mm away from the cut end, for the pipe to be coiled.

3.6 Nominal Wall Thickness (e_n) — Numerical designation of the wall thickness of a pipe, which is a convenient round number approximately equal to the manufacturing dimension in millimetres.

3.7 Wall Thickness at any Point (e) — Wall thickness at any point of the body of the pipe, around its circumference.

3.7.1 *Minimum Wall Thickness at any Point* (e_{Min}) — Minimum value of the wall thickness at any point of the body of the pipe, around its circumference as specified.

3.7.2 *Maximum Wall Thickness at any Point* (e_{Max}) — Maximum value of the wall thickness at any point of the body of the pipe, around its circumference as specified.

3.8 Mean Wall Thickness (e_m) — The arithmetic mean of a number of measurements regularly spaced around the circumference of the pipe in the same cross-section of the pipe, including the measured minimum and the measured maximum values of the wall thickness.

3.9 Standard Dimensions Ratio (*SDR*) —The SDR value is the ratio of the nominal outside diameter, d_n, of a pipe to its nominal wall thickness.

$$\text{SDR} = \frac{d_n}{e_n}$$

3.10 Minimum Required Strength (*MRS*) — Minimum value in megapascals (MPa), for long term hydrostatic strength (LTHS) of the polyethylene resin which represents the 97.5 percent confidence limits of the predicted hydrostatic strength at 20 °C for 50 years. This is considered as the property of the material.

3.11 Melt Flow Rate (*MFR*) — Value relating to the viscosity of the molten thermoplastic material at a specified temperature and rate of shear.

3.12 Maximum Allowable Operating Pressure (*MAOP*) — The maximum effective pressure of the gas in the piping system, expressed in MPa, which is allowed in continuous use. It takes into account the physical and the mechanical characteristics of the components of a piping system. It is given by the equation,

$$MAOP \text{ (in MPa)} = \frac{2 \times MRS}{C \times (SDR - 1)}$$

3.13 Lower Confidence Limit at 20 ºC for 50 Years (LCL) — Quantity with the dimensions of stress in MPa (megapascals) which can be considered as a property of the material and represents the 97.5 percent lower confidence limit of the mean long-term strength at 20 °C for 50 years with internal pressure with water.

3.14 Overall Service (Design) Co-efficient (*C*) — An overall design co-efficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit. For the purpose of this standard, the minimum value of 'C' is 2.0.

3.15 Gaseous Fuel — Any fuel which is in the gaseous state at a temperature of +15 °C and a pressure of 0.1 MPa.

4 DESIGNATION AND GRADE OF MATERIAL

4.1 Designation

Pipes shall be designated according to the grade of material (*see* **4.2**), nominal diameter (*see* **4.3**), nominal wall thickness (*see* **3.6**) and standard dimension ratio (*SDR*) (*see* **3.9**) followed by the word 'GAS'. For example, PE 80 DN 200 × 11.9 SDR 17 GAS indicates that a pipe is made from the material grade PE 80 nominal outside diameter of 200 mm, minimum wall thickness of 11.9 mm and SDR 17 and for gaseous fuel application.

4.2 Grade of Material

4.2.1 Pipe shall be classified according to the grade of material as given in Table 1.

4.2.2 The maximum allowable hydrostatic design stress (σ) of a pipe is obtained by applying the minimum overall service (design) co-efficient, *C* of 2.0 at 20 ºC to the MRS value of the material.

NOTE — The above value of overall service (design) co-efficient, *C* of 2.0 is for natural gas. C value for liquefied petroleum gas (LPG) shall be taken as 2.2.

4.2.3 The raw material supplier shall give the material grading as given in **4.2.1**.

4.3 Nominal Diameter (d_n)

The nominal diameter of pipes covered in this standard are:

16, 20, 25, 32, 40, 50, 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450, 500, 560 and 630 mm.

4.4 Colour

The colour of the pipes shall be yellow when manufactured from PE 80 grade and orange when manufactured from PE 100 grade.

5 MATERIAL

5.1 Polyethylene Compound

The polyethylene compound used in the manufacture of pipes shall be a cadmium free pigmented compound. It shall be free from visible water. The compound in the form of granules used for the manufacture of pipes shall have characteristics conforming to the requirements given in Table 2. The compound in the form of pipe used for the manufacture of pipes shall have characteristics conforming to the requirements given in Table 3.

Table 1 Classification of the Material

(*Clauses* 4.2.1 *and* 5.7)

Sl No.	Material	Minimum Required Strength of Materials in MPa at 20 °C for 50 Years	Maximum Allowable Hydrostatic Design Stress (σ) in MPa at 20ºC
(1)	(2)	(3)	(4)
i)	PE 80	8.0	4.0
ii)	PE 100	10.0	5.0

Table 2 Characteristics of the PE Compound in Granules Form

(*Clauses* 5.1 *and* 5.7)

Sl No.	Characteristics	Unit	Requirements	Test Parameters	Test Method
(1)	(2)	(3)	(4)	(5)	(6)
i)	Conventional density (of base polymer)	kg/m^3	≥ 930	23 ºC	IS 7328
ii)	Melt flow rate (MFR)	g/10 min	0.20 ≤ MFR ≤ 1.40 The tested value of MFR shall be with in ± 20 percent of the nominated value declared by the compound manufacturer	190 ºC/5.0 kg	IS 2530
iii)	Thermal stability (oxidation induction time)	min	≥ 20	200 ºC	Annex B of IS 4984
iv)	Volatile content	mg/kg	≤ 350	Number of test pieces = 01	Annex C of IS 4984
v)	Water content[1)]	mg/kg	≤ 300 (equivalent to < 0.03 percent by mass)	Number of test pieces = 01	Annex D of IS 4984
vi)	Pigment dispersion	Grade	≤ 3		Annex A

[1)] This requirement is only applicable if the measured volatile content is not in conformity to the specified requirement. In case of dispute, the requirement for water content shall apply. The requirement applies to the compound producer at the stage of compound manufacturing and to the compound user at the stage of processing. (If the water content exceeds the limit specified, drying is required prior to use.)

Table 3 Characteristics of the PE Compound in Pipe Form

(*Clauses* 5.1 *and* 5.7)

Sl No.	Characteristics	Unit	Requirements	Test Parameters	Test Method
(1)	(2)	(3)	(4)	(5)	(6)
i)	Resistance to gas condensate	–	No failure during the test period of the test piece	*Test Temperature* = 80 ºC *Test Period* = 20 h, *Min*	**5.5**
ii)	Resistance to weathering	–	**5.6**	**5.6**	**5.6**
iii)	Tensile properties				
	a) Tensile yield strength, *Min*	MPa	15	23 ºC	**8.8**
	b) Elongation at break, *Min*	percent	350	23 ºC	**8.8**
iv)	Resistance to slow crack growth rate (hydraulic characteristics of notched test pieces for pipes of size more than 63 mm)		No failure during the test period of the test piece	*Test Temperature* = 80 ºC *Internal Test Pressure:* PE 80 = 0.8 MPa PE 100 = 0.92 MPa *Test Period* = 500 h, *Min* Test pieces to be prepared as per Annex J of IS 4984 from SDR 11/110 mm nominal dia pipes	Annex E of IS 4984

NOTE — PE compound supplier shall also provide test results for conformity to resistance to rapid crack propagation as per ISO 4437-1 : 2014 'Plastic piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 1: General' for each individual lot or batch of compound received by the pipe manufacturer. The pipe manufacturer shall obtain from the PE compound supplier, the test results for the above test carried out on the highest wall thickness of the pipes being manufactured by him.

5.2 The compound shall be made by adding to the polyethylene base polymer only those additives and pigments necessary for the manufacture of pipes conforming to this standard, and those necessary for their fusibility, storage and use.

5.3 Anti-Oxidant

When tested as per IS 2530, the percentage of anti-oxidant used in the compound shall not be more than 0.3 percent by mass of finished resin.

5.4 U.V. Stabilizer

The percentage of U.V. stabilizer used in the compound shall not be more than 0.5 percent by mass of finished resin. Raw material supplier shall provide a certificate in this regard.

5.5 Effects of Gas Condensate on the Hydrostatic Strength

5.5.1 A synthetic condensate shall be prepared from a mixture of n-decane (99 percent) and 1, 3, 5 trimethyl benzene (1 : 1).

5.5.2 Before testing, the pipe shall be conditioned by filling it with condensate and allowing it to stand in air for 1 500 h at 23 ± 2 °C. The test shall be carried out according to Annex E of IS 4984 but using the synthetic condensate inside pipe at a temperature of 80 ºC for at least 20 h at an induced stress of 2.0 MPa. The pipe under test shall not show any failure during the test period.

5.6 Resistance to Weathering

After exposure to sunlight in accordance with Annex B, pipes manufactured from the PE compound shall comply with the following requirements:

Sl No.	*Characteristic*	*Requirement*	*Test Parameters*	*Test Method*
i)	Elongation at break	350 percent, *Min*	23 ºC	**8.8**
ii)	Hydraulic characteristics	No failure of the test piece during the test period	As per Sl No. (iii) of Table 9 at 80 °C for 1 000 h	Annex E of IS 4984
iii)	Thermal stability (Oxidation induction time)	≥ 20 min	200 ºC	Annex B of IS 4984

5.7 PE Compound Quality Evaluation

The compound supplier shall provide the pipe manufacturer with certified test results for PE compound classification as per Table 1 and its characteristics as per Tables 2 and 3, resistance to rapid crack propagation (*see* Note under Table 3) along with results of tensile tests applicable to each individual lot or batch of compound received by the pipe manufacturer.

In order to establish the validity of classification for the material received by the manufacturer and to get qualified for the production of polyethylene pipes for supply of gaseous fuel, an additional type approval test for long-term hydrostatic strength at 20 °C for 10 000 h shall be carried out once.

6 DIMENSIONS OF PIPES

6.1 Outside Diameters and Out-of-Roundness (Ovality)

6.1.1 The nominal outside diameters of the pipe, d_n, and tolerances thereon shall be in accordance with Table 4.

Table 4 Outside Diameter

(*Clauses* 6.1 *and* 8.2.2)

All dimensions in millimetres

Sl No.	Nominal Outside diameter, d_n	Mean Outside diameter	
		$d_{em,\,Min}$	$d_{em,\,Max}$
(1)	(2)	(3)	(4)
i)	16	16.0	16.3
ii)	20	20.0	20.3
iii)	25	25.0	25.3
iv)	32	32.0	32.3
v)	40	40.0	40.4
vi)	50	50.0	50.4
vii)	63	63.0	63.4
viii)	75	75.0	75.5
ix)	90	90.0	90.6
x)	110	110.0	110.7
xi)	125	125.0	125.8
xii)	140	140.0	140.9
xiii)	160	160.0	161.0
xiv)	180	180.0	181.1
xv)	200	200.0	201.2
xvi)	225	225.0	226.4
xvii)	250	250.0	251.5
xviii)	280	280.0	281.7
xix)	315	315.0	316.9
xx)	355	355.0	357.2
xxi)	400	400.0	402.4
xxii)	450	450.0	452.7
xxiii)	500	500.0	503.0
xxiv)	560	560. 0	563.4
xxv)	630	630.0	633.8

6.1.2 The maximum out-of-roundness (ovality) of pipes shall be in accordance with Table 5.

Table 5 Maximum Ovality Based on Nominal Diameters of Pipes

(*Clause* 6.1.2)

Sl No.	Type	Nominal Outside Diameter (d_n)	Maximum Ovality
		mm	mm
(1)	(2)	(3)	(4)
i)	Straight pipe	≤ 75	1 + 0.008 *d*
		> 75 ≤ 250	0.02 *d*
		> 250	0.035 *d*
ii)	Coiled Pipe	≤ 180	0.06 *d* for SDR 9 and SDR 11
			0.15 *d* for SDR 13.6 and SDR 17

6.2 Wall Thickness (e_{min})

6.2.1 The minimum wall thickness shall be as given in Table 6.

Table 6 Wall Thickness

(*Clause* 6.2.1)

All dimensions in millimetres

Sl No.	Nominal Outside Diameter (d_n)	Minimum Wall Thickness (e_{min})			
		SDR 17	SDR 13.6	SDR 11	SDR 9
(1)	(2)	(3)	(4)	(5)	(6)
i)	16	–	2.3	3.0	3.0
ii)	20	–	2.3	3.0	3.0
iii)	25	–	2.3	3.0	3.0
iv)	32	2.3	2.3	3.0	3.6
v)	40	2.4	3.0	3.7	4.5
vi)	50	3.0	3.7	4.6	5.6
vii)	63	3.8	4.7	5.8	7.1
viii)	75	4.5	5.5	6.8	8.4
ix)	90	5.4	6.6	8.2	10.1
x)	110	6.6	8.1	10.0	12.3
xi)	125	7.4	9.2	11.4	14.0
xii)	140	8.3	10.3	12.7	15.7
xiii)	160	9.5	11.8	14.6	17.9
xiv)	180	10.7	13.3	16.4	20.1
xv)	200	11.9	14.7	18.2	22.4
xvi)	225	13.4	16.6	20.5	25.1
xvii)	250	14.8	18.4	22.7	27.9
xviii)	280	16.6	20.6	25.4	31.3
xix)	315	18.7	23.2	28.6	35.2
xx)	355	21.1	26.1	32.3	39.7
xxi)	400	23.7	29.4	36.4	44.7
xxii)	450	26.7	33.1	40.9	50.3
xxiii)	500	29.7	36.8	45.5	55.8
xxiv)	560	33.2	41.2	50.9	–
xxv)	630	37.4	46.3	57.3	–

a) $e_{min} = e_n$; and

b) Minimum wall thickness of 2.3 mm has been imposed for practical reasons.

6.2.1.1 The tolerance on nominal wall thickness (e_n) shall be as given in Table 7.

Table 7 Tolerances on Wall Thickness at Any Point

(*Clause* 6.2.1.1)

All dimensions in millimetres

Sl No.	Nominal Wall Thickness, e_n		Plus Tolerance
	>	≤	
(1)	(2)	(3)	(4)
i)	2.0	3.0	0.4
ii)	3.0	4.0	0.5
iii)	4.0	5.0	0.6
iv)	5.0	6.0	0.7
v)	6.0	7.0	0.8
vi)	7.0	8.0	0.9
vii)	8.0	9.0	1.0
viii)	9.0	10.0	1.1
ix)	10.0	11.0	1.2
x)	11.0	12.0	1.3
xi)	12.0	13.0	1.4
xii)	13.0	14.0	1.5
xiii)	14.0	15.0	1.6
xiv)	15.0	16.0	1.7
xv)	16.0	17.0	1.8
xvi)	17.0	18.0	1.9
xvii)	18.0	19.0	2.0
xviii)	19.0	20.0	2.1
xix)	20.0	21.0	2.2
xx)	21.0	22.0	2.3
xxi)	22.0	23.0	2.4
xxii)	23.0	24.0	2.5
xxiii)	24.0	25.0	2.6
xxiv)	25.0	26.0	2.7
xxv)	26.0	27.0	2.8
xxvi)	27.0	28.0	2.9
xxvii)	28.0	29.0	3.0
xxviii)	29.0	30.0	3.1

Table 7 (*Concluded*)

Sl No.	Nominal Wall Thickness, e_n		Plus Tolerance
	>	≤	
(1)	(2)	(3)	(4)
xxix)	30.0	31.0	3.2
xxx)	31.0	32.0	3.3
xxxi)	32.0	33.0	3.4
xxxii)	33.0	34.0	3.5
xxxiii)	34.0	35.0	3.6
xxxiv)	35.0	36.0	3.7
xxxv)	36.0	37.0	3.8
xxxvi)	37.0	38.0	3.9
xxxvii)	38.0	39.0	4.0
xxxviii)	39.0	40.0	4.1
xxxix)	40.0	41.0	4.2
xl)	41.0	42.0	4.3
xli)	42.0	43.0	4.4
xlii)	43.0	44.0	4.5
xliii)	44.0	45.0	4.6
xliv)	45.0	46.0	4.7
xlv)	46.0	47.0	4.8
xlvi)	47.0	48.0	4.9
xlvii)	48.0	49.0	5.0
xlviii)	49.0	50.0	5.1
xlix)	50.0	51.0	5.2
l)	51.0	52.0	5.3
li)	52.0	53.0	5.4
lii)	53.0	54.0	5.5
liii)	54.0	55.0	5.6
liv)	55.0	56.0	5.7
lv)	56.0	57.0	5.8
lvi)	57.0	58.0	5.9

6.3 Method of Measurement

6.3.1 The mean outside diameter of the pipe shall be the average of two measurements taken using a vernier at right angles for pipes up to 25 mm diameter. For higher sizes, the diameter shall be measured by using a flexible Pi tape or a circometer, having an accuracy of not less than 0.01 mm.

The wall thickness shall be measured by a ball ended micrometer. The resulting dimension shall be expressed to the nearest 0.05 mm. The continuous wall thickness measurement arrangement shall be installed for cross checking wall thickness during production.

NOTES

1 The outside diameter shall be measured at a distance equal to the diameter of the pipe or 300 mm from the end of the pipe, whichever is greater.

2 In the case of dispute, the dimension of pipes shall be measured after conditioning at room temperature (27 ± 2 °C) for 4 h.

6.3.2 Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter and it shall be measured during manufacturing after extrusion of the pipe but prior to coiling. Ovality shall be measured at 300 mm away from cut end, along a scale having suitable graduations. For coiled pipes, re-rounding shall be carried out prior to the measurement of ovality.

6.4 Length of Pipe

The length of straight pipes and coils shall be as agreed to between the manufacturer and the purchaser.

7 FINISH

The internal surface of the pipes shall generally be smooth, clean and free from grooving, rings and poke marks which may effect the pipe performance. The ends shall be cleanly cut and shall be square with axis and within the tolerance given in Table 8.

Table 8 Out of Square Tolerance of Ends

(*Clause* 7)

SI No.	Pipe Size Outside Diameter	Maximum Out of Square of Each Pipe End
	mm	mm
(1)	(2)	(3)
i)	16 to < 90	2
ii)	≥ 90 to < 140	3
iii)	≥ 140 to < 200	4
iv)	≥ 200 to < 315	5
v)	≥ 315	7

8 PERFORMANCE REQUIREMENTS

8.1 Hydraulic Characteristics

When subjected to internal pressure creep rupture test in accordance with procedure given in Annex E of IS 4984, the plain pipes under test shall show no signs of localized swelling, leakage or weeping, and shall not burst during the prescribed test duration. The temperature, duration for the test and induced stresses for the test shall conform to those specified in Table 9 for plain pipes.

Table 9 Test Requirements for Internal Pressure Creep Rupture Test for Plain Pipes

(*Clause* 8.1)

SI No.	Test Temperature	Test Duration	Induced Stress		Frequency
	ºC	h	MPa		
			PE 80	PE 100	
(1)	(2)	(3)	(4)	(5)	(6)
Type tests					
i)	20	100	9.0	12.0	Once in two years
ii)	80	1 000	4.0	5.0	Once in four years
Acceptance tests					
iii)	80	165	4.5	5.4	As per Table 14

8.2 Reversion Test

8.2.1 *Longitudinal Reversion*

When tested according to the procedure given in Annex F of IS 4984, the value of longitudinal reversion shall not be greater than 3 percent.

8.2.2 *Circumferential Reversion of Pipes with* $d_n \geq 250$ *mm*

The circumferential reversion of pipes with d_n equal to or greater than 250 mm shall be determined between 24 h and 48 h after manufacture and after conditioning in water at 80 °C. The minimum conditioning period for various wall thicknesses of pipes shall be as given in Table 10. The pipe test pieces shall be $3d_n$ in length. With the test piece at (27 ± 2) °C, circumferential measurements shall be taken to establish d_o at a distance of $0.1d_n$ and $1.0\ d_n$, respectively, from the end of the test piece and reported as $d_{o,\ 0.1\ d_n}$ and $d_{o,\ 1.0\ d_n}$. The difference between $d_{o,\ 0.1\ d_n}$ and $d_{o,\ 1.0\ d_n}$ shall not be greater than the tolerance range on mean outside diameter as specified in Table 4.

NOTE — Circumferential reversion or "tow-in" of the pipe end is created by the residual stress of the pipes during extrusion. This results in a small reduction of diameter at the cut end of the pipes.

Table 10 Conditioning Periods

(*Clause* 8.2.2)

Sl No.	Thickness, e_{min}	Minimum Conditioning Period
	mm	*h*
(1)	(2)	(3)
i)	$3 \leq e_{min} < 8$	3
ii)	$8 \leq e_{min} < 16$	6

NOTE — It is recognized that extended conditioning periods beyond those specified in Table 10 could influence the test results.

8.3 Density

When tested from a composite sample of minimum of 3 pipes as per IS 7328, the base density of the pipe shall be ≥ 930 kg/m^3 at 23 ºC.

8.4 Melt Flow Rate (MFR)

When tested from a composite sample of minimum three pipes as per IS 2530 at 190 ºC with normal load of 5 kgf, MFR of the pipe material shall not deviate from the MFR of the resin by more than 20 percent of the value specified by the compound manufacture.

8.5 Pigment Dispersion

When tested from a composite sample of minimum three pipes, in accordance with Annex A, the grading shall be ≤ 3.

8.6 Thermal Stability (Oxidation Induction Time)

The minimum oxidation induction time (OIT) of the pipe when tested in accordance with the method given in Annex B of IS 4984 shall be not less than 20 min.

8.7 Volatile Matter Content

When tested in accordance with Annex C of IS 4984, the value of volatile matter content shall be not more than 350 mg/kg.

8.8 Tensile Properties (Tensile Yield Strength and Elongation at Break)

When tested in accordance with Annex H of IS 4984 and with test parameters as per Table 6 of IS 4984, however, the conditioning temperature and temperature of testing being 23 ± 1 °C, the yield stress and elongation at break shall be as follows:

a) Yield stress = 15 MPa, *Min*; and

b) Elongation at break = 350 percent, *Min*.

8.9 Resistance to Weathering

After exposure to sunlight in accordance with Annex B, pipes shall comply with the requirements given in **5.6**.

8.10 Slow Crack Growth Rate Test

8.10.1 When subjected to test parameters as given below and tested in accordance with the procedure given in Annex E of IS 4984, the notched test specimens prepared from 110 mm SDR 11 pipe in accordance with Annex J of IS 4984 shall show no signs of localized swelling, leakage or weeping and shall not burst during the prescribed test period.

Sl No.	*Test Temperature*	*Test Duration*	*Internal Test Pressure, Min (or Induced Hoop Stress, Min)*	
	ºC	h	MPa	
			PE 80	PE 100
(1)	(2)	(3)	(4)	(5)
i)	80 ± 1	165	0.8 (4.0)	0.92 (4.6)
ii)	80 ± 1	500	0.8 (4.0)	0.92 (4.6)

8.10.1.1 If 110 mm SDR 11 pipes are not being manufactured, the test shall be carried out on the nearest higher size SDR 11 pipe being manufactured with test parameters as given in **8.10.1**.

NOTES

1 The test is applicable to pipes of wall thickness greater than 5 mm.

2 If pipe sizes only below 63 mm are manufactured, the test is not required. However, in such cases, the test certificate from the raw material (resin) supplier for establishing conformity to the above requirement for 110 mm and SDR 11 pipe will suffice.

3 In case SDR 11 pipes are not manufactured, the internal test pressure values shall be calculated using the formula given in **3.12** for an induced hoop stress of 4.0 MPa and 4.6 MPa for PE 80 and PE 100 pipes, respectively.

8.11 Squeeze-off

On all sizes of pipe up to and including 400 mm diameter, hydrostatic strength at 80 °C for 165 h after squeeze-off and subsequent re-rounding, shall be demonstrated by testing in accordance with Annex C. The pipe samples under test shall show no signs of localized swelling, leakage or weeping, and shall not burst during the prescribed test duration.

9 SAMPLING, FREQUENCY OF TEST AND CRITERIA FOR CONFORMITY

9.1 Type Test

9.1.1 Type tests are intended to prove the suitability and performance of a new composition, a new technique or new size of a pipe. Such tests, therefore, need to be applied only when a change is made in composition or method of manufacture, or when a new size of pipe is to be introduced. Even if no change is envisaged, type test shall be done at least once during the validity period as given for each of the type tests in **9.1.5**.

9.1.2 For each of the type test, three samples of pipes of same grade, same size, same SDR and same pressure rating shall be selected at random from the regular production lot and shall be tested for compliance with the requirements of the type test as given in Table 11.

9.1.3 If all the samples pass the requirements of the type test, the type of the pipe under consideration shall be considered eligible for type approval.

9.1.4 In case, any of the samples fails in the type test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number and subject them to the type test again. If in 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 tests, 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.

9.1.5 At the end of the validity period [normally four years for internal pressure creep rupture test at 80 °C for 1 000 h and two years for all other type tests (*see* Table 11) or earlier as may be necessary, the testing authority may call for fresh samples for type test for the purpose of type approval.

9.2 Acceptance Tests

9.2.1 Acceptance tests are carried out on samples selected from a lot for the purposes of acceptance of the lot.

9.2.2 *Lot*

All pipes of the same size, same SDR, same grade and same pressure rating and also manufactured essentially under similar conditions of manufacture shall constitute a lot. For ascertaining conformity of the lot to the requirements of this standard, samples shall be selected in accordance with Table 12 and tested for compliance as per Table 12.

9.2.3 *Conformity to Dimensional and Visual Requirements*

9.2.3.1 The number of test samples shall be in accordance with Table 13.

Table 11 Type Tests

(*Clause* 9.1.2)

SI. No.	Description of Test	Requirement Clause	Sample Size	Test Method
(1)	(2)	(3)	(4)	(5)
i)	Hydrostatic pressure resistance at 80 ºC for 1 000 h	**8.1**	3	Annex E of IS 4984
ii)	Hydrostatic pressure resistance at 20 ºC for 100 h	**8.1**	3	Annex E of IS 4984
iii)	Volatile matter content	**8.7**	3	Annex C of IS 4984
iv)	Resistance to weathering	**8.9**	3	Annex B
v)	Slow crack growth rate test	**8.10.2**	3	Annex J and Annex E of IS 4984
vi)	Squeeze-off test	**8.11**	3	Annex C

Table 12 Acceptance Tests

(*Clauses* 9.2.2 *and* 9 .2.4)

SI No.	Description of test	Requirement Clause	Sample Size
(1)	(2)	(3)	(4)
i)	Dimensional checks	**6**	Table 13
ii)	Visual appearance	**7** and **4.4**	Table 13
iii)	Marking information	**10**	Table 13
iv)	Hydrostatic pressure resistance at 80 ºC for 165 h for plain pipes	**8.1**	Table 14
v)	Longitudinal reversion	**8.2.1**	Table 14
vi)	Circumferential reversion of pipes	**8.2.2**	Table 14
vii)	Density	**8.3**	Table 14
viii)	MFR	**8.4**	Table 14
ix)	Pigment dispersion	**8.5**	Table 14
x)	Thermal stability (OIT)	**8.6**	Table 14
xi)	Tensile properties (tensile yield stress and elongation at break)	**8.8**	Table 14
xii)	Slow crack growth rate test	**8.10.1**	Table 14

Table 13 Scale of Sampling for Visual and Dimensional Requirements

(*Clauses* 9.2.3.1 *and* 9.2.3.3)

SI No.	No. of Pipes	Sample No.	Sample Size	Cumulative Sample Size	Acceptance No.	Rejection No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Up to 150	First	13	13	0	2
		Second	13	26	1	2
ii)	151 to 280	First	20	20	0	3
		Second	20	40	3	4
iii)	281 to 500	First	32	32	1	4
		Second	32	64	4	5
iv)	501 to 1 200	First	50	50	2	5
		Second	50	100	6	7
v)	1 201 to 3 200	First	80	80	3	7
		Second	80	160	8	9
vi)	3 201 to 10 000	First	125	125	5	9
		Second	125	250	12	13
vii)	Above 10 000	First	200	200	7	11
		Second	200	400	18	19

9.2.3.2 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. For the above purpose, each length of the coil of a given size, grade and SDR shall be considered as one pipe. In the absence of a random number table, the following procedure may be adopted.

Starting from any pipe in the lot, count them as 1, 2, 3, 4, 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* is the number of pipes in the samples. Every r^{th} pipe so counted shall be drawn so as to constitute the required sample size.

9.2.3.3 The number of pipes given for the first sample in col 4 of Table 13 shall be examined for visual and dimensional requirements given in **6, 7** and **4.4**. 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 are less than or equal to the corresponding acceptance number given in col 6 of Table 13. 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 numbers given in col 7 of Table 13. 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 of Table 13, the second sample of the size given in col 4 of Table 13 shall be taken and examined for these requirements. The lot shall be considered to have satisfied these requirements, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in col 6 of Table 13 otherwise not. In case, the sample size is equal or less than lot size, 100 percent inspection shall be done for these tests and all the samples from the lot which pass these tests shall be tested for other acceptance tests.

9.2.4 *Conformity to Acceptance Tests Other than Visual and Dimensional Requirements*

The lot having satisfied dimensional and visual requirements shall be tested for other acceptance tests as given in Table 12. The number of test samples selected from the lot for subjecting to these tests shall be in accordance with Table 14. The lot shall be considered to have met the requirements of these tests, if none of samples tested fails.

Table 14 Scale of Sampling for Acceptance Tests Other than Visual and Dimensional Requirements

(*Clause* 9.2.4)

SI No.	No. of Pipes	Sample Size
(1)	(2)	(3)
i)	Up to 800	3
ii)	801 to 1 600	4
iii)	1 601 to 2 400	5
iv)	2 401 to 3 200	6
v)	>3 200	7

10 MARKING

10.1 All pipes shall be permanently and legibly marked along their length with a legend, which shall be impressed to a depth of not more than 0.2 mm.

10.2 Marking details shall be formed on the pipe in such a way that the marking does not initiate cracks or other types of failure, and in such a way that with normal storage, weathering and processing and the permissible method of installation and use, legibility remains maintained for the life of the pipes.

10.3 The marking shall be made in a single strip in case of pipe nominal sizes up to 32 mm, and the same shall be done in two strips on opposite sides of the pipe in case of nominal sizes above 32 mm.

10.4 The embossing/inkjet printing for yellow/orange pipe shall have black base. The height of the character shall be uniform and at least of the dimension as given below:

a) 3 mm for pipes of nominal size up to 90 mm; and
b) 5 mm for pipes of nominal size more than 90 mm.

10.5 The legend shall be repeated at intervals of 1 m and shall consist of the following information:

a) Manufacturer’s identity name or trade name;
b) Material designation which shall include the following (*see* **4.1)**;
    i) Material grade;
    ii) Nominal outside diameter;
    iii) Nominal wall thickness;
    iv) Standard dimension ratio (SDR); and
    v) Word ‘GAS’.
c) Lot number/Batch number containing information of date of manufacture.

10.5.1 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

10.6 BIS Certification Marking

Polyethylene pipes for supply of gaseous fuel, 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 each pipe may be marked with the Standard Mark.

11 SUPPLY, PACKAGING, HANDLING AND TRANSPORTATION

The supply, packaging, handling and transportation of polyethylene pipes for gas transmission shall be done in accordance with Annex D.

ANNEX A

(*Table* 2 *and Clause* 8.5)

ASSESSMENT OF PIGMENT DISPERSION IN POLYOLEFIN PIPES AND FITTINGS BY MICROTOME METHOD

A-1 GENERAL

This Annex describes the method for the assessment of pigment dispersion in polyolefin pipes and fittings.

A-2 PRINCIPL E

A microtomed section of material is examined by transmitted light at a magnification of X 100 and compared against standard photomicrographs.

A-3 APPARATUS

A-3.1 A Microtome

A-3.2 A Microscope, of at least X 100 linear magnification and circular field of view of 0.7 ± 0.07 mm diameter set for transmitted light.

A-3.3 Microscope Slides and Cover Slips

A-4 TEST PIECE

Microtome section 10 μm to 20 μm thick shall be cut from a cross-section of the pipe or fitting. They shall have an area of approximately 7.0 mm^2.

Six test pieces shall be taken from different parts of the cross-section.

NOTE — It is often easier to take microtome sections if the pipe or fitting has been cooled to below room temperature.

A-5 PROCEDURE

Place the pieces on a microscope slide so that each one is equidistant from its neighbour(s) and from adjacent edge(s) of the slide and cover with Canada balsam before placing a coverslip over the test pieces. Examine the six test pieces in turn through the microscope at a linear magnification of X 100 ± 10. Scan the whole of each test piece and compare the worst field of view of each with the standard photomicrographs numbered 1 to 6 in Fig. 1.

Assign to each of the six test pieces a numerical rating corresponding to the number of the photomicrograph equivalent to the worst field of view of each test piece.

A-6 EXPRESSION OF RESULTS

Record the rating of each test piece as per Fig. 1.

A-7 TEST REPORT

The test report shall include the following:

a) Full identification of pipe or fitting from which the test pieces were taken;
b) The individual rating of each test piece; and
c) The date of testing.

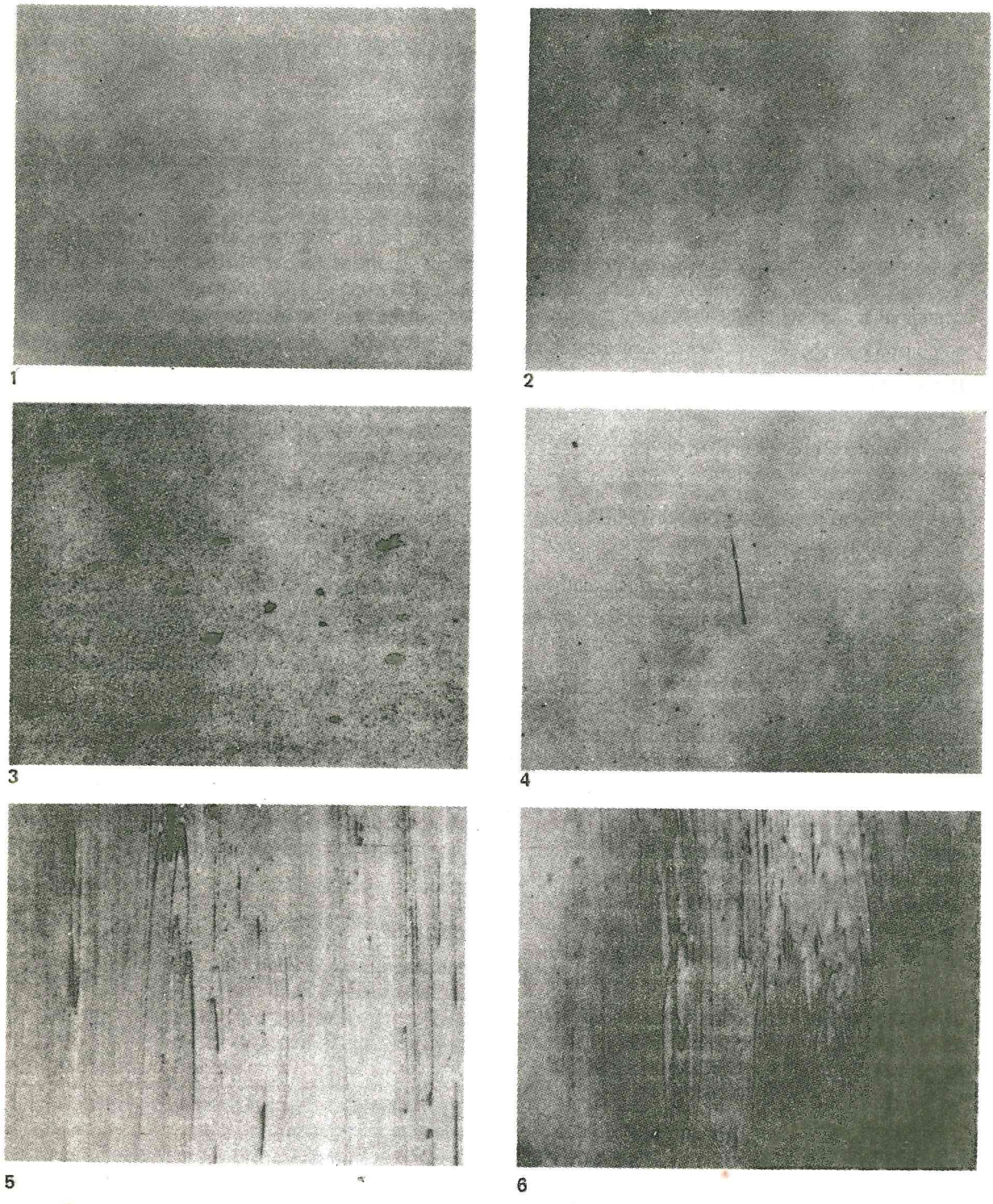

FIG. 1 PIGMENT DISPERSION PICTOMICROGRAPHS (GRADES 1 TO 6)

ANNEX B

(*Clauses* 5.6 *and* 8.9)

RESISTANCE TO WEATHERING

B-1 The equipment shall be capable of supporting specimen of pipe, such that the exposed surface of the specimen shall be at 45° to the horizontal with the upper end pointing to the north and the exposed surface to the south.

B-2 The size of the apparatus and the distance between the specimens shall be such that no shadow fall across the specimens for the period of at least 8 h during which the sun is normally the strongest.

B-3 The specimen shall be approximately 1 m long pipe and shall normally be selected from those having the thinnest wall for the size to be tested. The test pieces shall be taken from the outside surface of the pipe after removing the upper 0.2 mm layer.

B-4 The pipe sample shall be exposed for a period of two years.

B-5 After weathering exposure, the sample shall be tested as per **5.6**.

ANNEX C

(*Clause* 8.11)

TEST METHOD FOR THE RESISTANCE TO INTERNAL PRESSURE AFTER APPLICATION OF SQUEEZE-OFF

C-1 GENERAL

This standard specifies a method for determining the resistance to internal pressure of polyethylene (PE) pipes after being subjected to squeeze-off procedure.

C-2 PRINCIPLE

A polyethylene (PE) pipe, conditioned to 0 °C, is squeezed between two parallel circular-section bars located at right angles to the pipe centreline, at a position mid-way between the pipe ends. The squeeze is subsequently released after an appropriate time period. The pipe is then subjected to a hydrostatic strength test at 80 °C.

NOTE — The technique of squeeze-off is used to restrict the flow of fluid in PE piping systems whilst effecting maintenance and repair operations. The test described herein may be used to assess the effect of squeeze-off on the strength of pipes.

C-3 APPARATUS

C-3.1 Squeeze-off equipment, comprising compressive loading device with a combination of a fixed bar and a movable bar contained within a framework designed to withstand the forces generated by the squeeze-off action.

Each bar shall have a circular cross-section having sufficient rigidity to ensure a uniform separation between and along the bars in the course of squeeze-off. Each bar shall have the same diameter which shall be not less than the applicable minimum value given in Table 15.

The movable bar may be hydraulically or mechanically operated to achieve the applicable level of squeeze-off given in Table 15.

Table 15 Squeeze-off Levels

(*Clauses* C-3.1 *and* C-5.1)

Sl No.	Nominal Outside Diameter, d_n	Minimum Bar Diameter	Squeeze-off Level, *L*
	mm	mm	percent[1)]
(1)	(2)	(3)	(4)
i)	$d_n \leq 63$	25.0	80
ii)	$63 < d_n \leq 250$	38.0	80
iii)	$250 < d_n \leq 400$	50.0	90

[1)] The squeeze-off level, *L*, is the percentage ratio of the distance between the squeeze-off bars, in millimetres, and twice the specified minimum wall thickness of the pipe, e_{min}, in millimetres.

Means shall be provided for the measurement and maintenance of the bar displacement to within ± 0.2 mm of the required squeeze-off level, *L* during the squeeze-off phase.

C-3.2 Temperature conditioning apparatus, capable of establishing and maintaining the test piece temperature (before squeeze-off) at (0 ± 1.5) °C.

C-3.3 Pipe test equipment, as specified in Annex E of IS 4984.

C-4 TEST PIECE

C-4.1 Preparation

The test piece shall be a pipe of which the minimum free length, between the end caps of any type, shall be 250 mm or six times the nominal outside diameter, d_n, of the pipe, whichever is greater.

The diameter and SDR of the pipe shall be as specified in the standard.

For pressure testing (*see* **C-5.5**), the test piece shall be closed with end caps of Type A (*see* **C-3.3**).

C-4.2 Number

The number of test pieces shall be as specified in **9.1.2**.

C-5 PROCEDURE

C-5.1 Calculate the final distance, e_q, to be applied between the squeeze-off bars, in milimetres, using the following equations:

$$e_q = 0.02\ L \times e_{min}$$

where,

e_{min} = minimum wall thickness specified for the pipe; and

L = squeeze-off level conforming to Table 15.

C-5.2 Condition the pipe at 0 °C at least for the time period as given below for different pipe wall thicknesses.

Table 16 Conditioning Periods

(*Clause* C-5.2)

Sl No.	e_{min}	Period
	mm	min
(1)	(2)	(3)
i)	$e_{min} < 16$	60 ± 5
ii)	$16 \leq e_{min} < 32$	120 ± 10
iii)	$32 \leq e_{min}$	180 ± 15

Any conditioning fluids used shall not affect the properties of the test piece.

C-5.3 Position the test piece between squeeze bars set at right angles to the pipe centreline and midway between the pipe ends. Using a squeeze bars closure rate between 25 mm/min and 50 mm/min, squeeze-off at ambient temperature of not more than 25 °C to the distance, e_q, calculated in accordance with **C-5.1,** within the following time interval after its removal from the conditioning environment:

a) 90 s for $d_n \leq 110$;

b) 180 s for $110 < d_n \leq 250$; and

c) 300 s for $d_n > 250$.

C-5.4 Maintain the squeeze-off level for a hold time period of (60 ± 5) min. Immediately after that hold time has elapsed, release the squeeze progressively so that the squeeze applied by the bars is fully released within 1 min.

C-5.5 Prepare the test piece for determination of hydrostatic strength at 80 °C as specified in Annex E of IS 4984. Close the specimen with pressure-tight end load bearing end-caps or plugs, which shall be provided with connections for entry of the water and the release of air. Test the specimen at 80 °C for a duration of minimum 165 h at a stress of 4.5 MPa for PE 80 and 5.4 MPa for PE 100.

C-5.6 After testing, inspect the test piece and record the position and mode of any failure, as applicable (*see* **C-5.5**).

C-6 TEST REPORT

The test report shall include the following information:

a) a complete identification of the pipe, including manufacturer, type of material (example PE 80) and production date;

b) the nominal diameter, d_n, of the pipe;

c) the minimum wall thickness, e_{min}, of the pipe;

d) the squeeze-off bar diameter;

e) the final distance, e_q, between squeeze-off bars;

f) the test pressure;

g) the duration of testing at 80 °C;

j) details of the position and mode of any failure;

k) any factors which may have affected the results, such as any incidents or any operating details; and

m) the date of test.

ANNEX D

(*Clause* 11)

SUPPLY, PACKAGING, HANDLING AND TRANSPORTATION OF POLYETHYLENE PIPES FOR GAS TRANSMISSION

D-1 SUPPLY

The polyethylene pipes shall be supplied as straight length either independent or bundled together, self supporting coils or as agreed between supplier and purchaser.

Their ends shall be cleanly cut, square with the axis of pipe and protected against shocks and ingress of foreign bodies by appropriate end caps.

D-2 BUNDLES

The distance (X) between the supporting frames shall be equally spaced in order to allow stacking (*see* Fig. 2). The polyethylene straight pipe shall rest evenly over their whole length. The supporting frame shall not be nailed together and shall be constructed, such as to lead the pressure load directly through the supporting frame and not through the polyethylene pipe.

D-3 COILS

Polyethylene pipes may be coiled or packed on drums. Large diameter coils with $d_n \geq 90$ mm should be stored flat or vertically in purpose-built racks or cradles, if desired by purchaser. Consideration should be given for facilities, which avoid single point contact of the coils.

D-3.1 The minimum internal diameter of the pipe coils shall be as per Table 17. The maximum width of any coil shall be 1 m. The maximum coil diameter for all pipe sizes should be 4 m. The maximum external surface temperature at the time of coiling should be 35 °C.

D-3.2 Coiled pipes not greater than 32 mm diameter shall preferably be restrained using an outer covering of 'shrink wrap' or equivalent material to enable pipe to be drawn from the center of the coil.

D-3.3 All coiled pipes shall be constrained in a stable configuration by banding in at least six equispaced position during production. The banding should not be less than 50 mm wide and shall be sufficiently stable to prevent movement. It shall be possible to remove one layer of the coil without the remainder of the coil being unraveled and individual layers shall be clearly discriminated by the banding.

Two labels of suitable dimensions should be carefully attached to each coil, bundle indicating:

a) Supplier's name;
b) Purchaser's purchase order number.;
c) Manufacturing standard;
d) Material designation (*see* **4.1**) and pressure rating;
e) Weight of coil, in kg; and
f) Length of coil, in m.

The marking on labels shall be indelible.

D-4 HANDLING

D-4.1 General

Do not drag or throw the polyethylene pipes along the ground. If handling equipment is not used, choose techniques which are not likely to damage the pipe.

D-4.2 Straight Pipe

During the initial handling and storage of straight polyethylene pipes, they should be kept in packaged form, thus minimizing damage during this phase. When loading, unloading or handling, it is preferable to use mechanical equipment to move or stack the packs.

D-4.3 Coils

Individual coils shall not be rolled off the edge of the loading platforms or trailers. These coils should be slung individually when off-loading with a crane. Personnel should not be required to climb the framework of the lorry during slinging operations.

D-5 TRANSPORTATION

D-5.1 Straight Lengths

When transporting straight polyethylene pipes, use flat bed vehicles with a partition. The bed shall be free from nails and other protuberances. The polyethylene pipes shall rest uniformly in the vehicle over their whole length.

The vehicles shall have side supports appropriately spaced 2 m apart, and the polyethylene pipes shall be secured effectively during transportation. All posts shall be flat with no sharp edges.

During transportation, the polyethylene pipes should be continuously supported such as to minimize movement between the pipes and their supports. Also being relatively soft, poor handling techniques may result in gauges, scratches, cuts or puncture.

D-5.2 Coiled Pipe

Coiled pipes with $d_n < 63$ mm may be supplied on pallets. The coils should be firmly strapped to the pallets, which should in turn be firmly secured to the vehicle. Coiled pipe with $d_n \geq 63$ mm should be supplied individually.

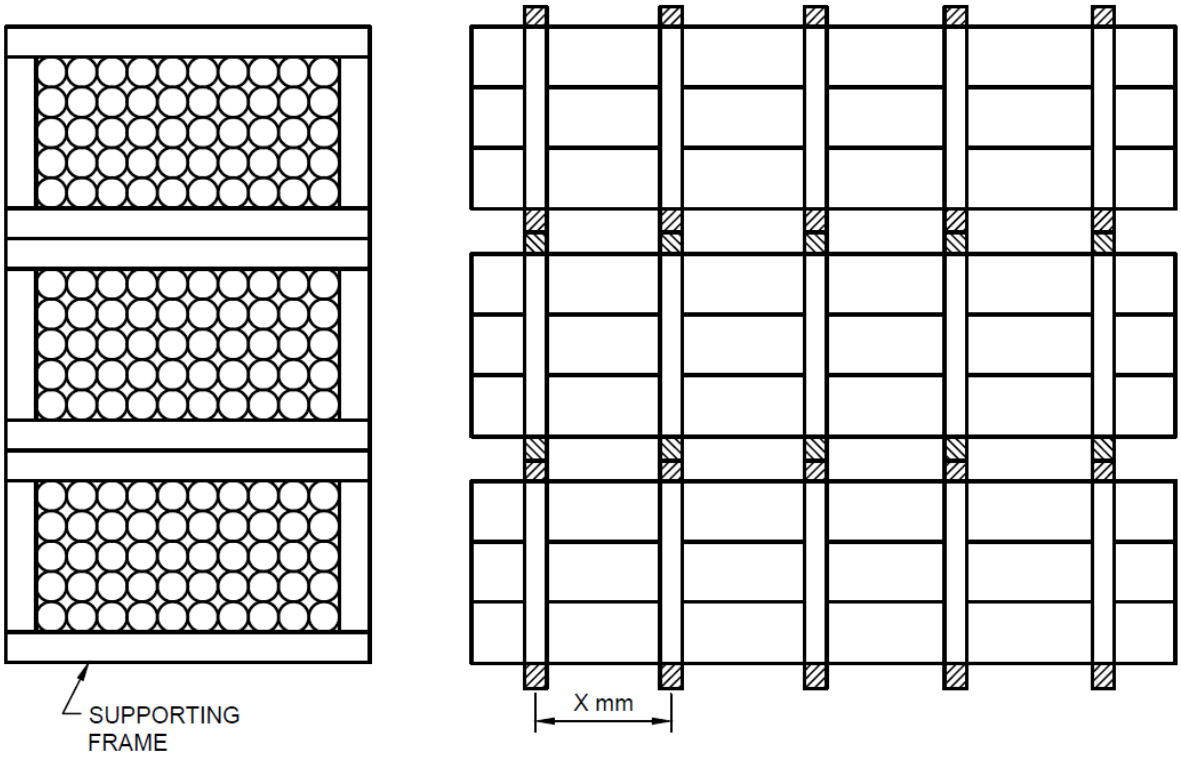

FIG. 2 STACKING ARRANGEMENT OF STRAIGHT LENGTH PIPES

Table 17 Minimum Internal Coil Dimension

(*Clause* D-3.1)

SI No.	Nominal Outside Diameter (d_n)	Minimum Internal Coil Diameter (M_i)	
	mm	m	
		SDR 11 and SDR 9	SDR 17 and SDR 13.6
(1)	(2)	(3)	(4)
i)	20	0.6	–
ii)	25	0.6	–
iii)	32	0.7	–
iv)	63	1.3	–
v)	90	1.8	–
vi)	110	2.0	–
vii)	125	2.5	–

There should be facilities to restrain each coil securely throughout the transit and the loading process.

To save on transport cost, nesting of coils/straight length can be considered, if agreed between the purchaser and the supplier.

D-6 STORING

Pipes shall be stored in the manner to prevent damage from elevated temperature, contact with chemicals, and prolonged exposure to direct sunlight. Stored pipes shall be covered to prevent exposure to direct sunlight over long periods as degradation of the material may occur. If the polyethylene pipes are to be stored outside, the recommendations on maximum storage time limits and maximum temperature exposure shall be consulted from the manufacturers and accordingly practised. Non-ventilated covering of the polyethylene pipe to protect it against UV exposure may sometimes create excessive heat, which may also be detrimental to the pipe performance.

In case of outside storage, the cumulative exposure period should be determined with reference to the pipe production code, which includes the date of extrusion. By using this date, allowance is also made for exposure received during storage by the manufacturer.

It is recommended that polyethylene pipes shall not be stored outside for more than 2 years. Where individual pipe lengths and coils are stacked in pyramidal fashion, deformation may occur in the lower layers, particularly in warm weather. Therefore, such stacks should not exceed a height of 1 000 mm.

The polyethylene pipes shall be stacked on a reasonably flat surface, free from sharp objects, stones or projections likely to deform or damage them.

D-7 FIRST IN-FIRST OUT

In general, most manufacturers store the polyethylene pipes outside prior to shipment. Issuing from store on a ‘first in-first out’ can minimize the exposure time rotation with the extrusion date used as control. The polyethylene pipe with the earliest extrusion date should be issued for first installation.

ANNEX E

(*Foreword*)

COMMITTEE COMPOSITION

Plastic Piping System Sectional Committee, CED 50

Organization	*Representative(s)*
Central Institute of Plastic Engineering and Technology, Chennai	Dr S. K. Nayak (***Chairman***)
Borouge India Pvt Ltd, Mumbai	Shri Prashant D. Nikhade
Brihan Mumbai Licensed Plumbers Association, Mumbai	Shri Kishor V. Merchant Shri Bijal M. Shah (*Alternate*)
Central Institute of Plastic Engineering and Technology, Chennai	Dr S. N. Yadav Shri D. Anjaneya Sharma (*Alternate*)
Central Public Health Environmental Engineering Organization, New Delhi	Adviser (PHE) Assistant Adviser (PHE) (*Alternate*)
Central Public Works Department, New Delhi	Shri M. K. Sharma Shri Amar Singh (*Alternate*)
Chennai Metropolitan Water Supply & Sewerage Board, Chennai	Engineering Director Superintending Engineer (P & D) (*Alternate*)
CSIR-Central Building Research Institute, Roorkee	Dr B. Singh Shri Rajiv Kumar (*Alternate*)
CSIR-National Environmental Engineering Research Institute, Nagpur	Dr (Shrimati) Abha Sargonkar Dr Ritesh Vijay (*Alternate*)
Delhi Development Authority, New Delhi	Superintending Engineer (D) Executive Engineer (R & D) (*Alternate*)
Delhi Jal Board, New Delhi	Shri Y. K. Sharma Shri S. L. Meena (*Alternate*)
Department of Chemical & Petrochemicals Govt of India, New Delhi	Joint Industrial Advisor
Finolex Industries Limited, Pune	Shri Arun Sonawane Shri D. J. Salunke (*Alternate*)
GAIL India Limited, New Delhi	Shri Manish Khandelwal Shri Kuldeep Negi (*Alternate*)
Government e-Marketplace, New Delhi	Representative
Haldia Petrochemicals Ltd, Kolkata	Shri Raj K. Datta Shri Amartya Maity (*Alternate*)
Indian Oil Corporation Ltd, Panipat	Shri Dhananjay Sahoo Shri Raja Poddar (*Alternate*)
Jain Irrigation System Limited, Jalgaon	Shri S. Narayanaswami Shri P. H. Chaudhari (*Alternate*)
Kolkata Municipal Corporation, Kolkata	Shri D. K. Sanyal Shri A. K. Biswas (*Alternate*)
Mahindra EPC Irrigation Ltd, Nashik	Shri Sankar Kumar Maiti Shri C. V. Joshi (*Alternate*)

Organization	*Representative(s)*
Military Engineer Services, Engineer-in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi	Shri A. K. Dubey Shri R. K. Chauhan (*Alternate*)
Ministry of Drinking Water and Sanitation, New Delhi	Shri Dinesh Chand Shri Sumit Priyadarshi (*Alternate*)
NSF Safety and Certification India PvtLtd, Gurugram	Shri B. B. Singh Shri Nasrin Kashefi (*Alternate*)
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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, Jaipur	Superintending Engineer Executive Engineer (*Alternate*)
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RITES Limited, New Delhi	Shri Pankaj Aggarwal Shri Mukesh Sinha (*Alternate*)
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Supreme Industries Limited, Jalgaon	Shri G. K. Saxena
Tamil Nadu Water Supply & Drainage Board, Chennai	Engineering Director Joint Chief Engineer (COM) (*Alternate*)
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Scientist 'D' (Civil Engineering), BIS

Polyolefins and GRP Piping System Subcommittee, CED 50 : 1

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Working Group for Revision of IS 14885 and IS 15927

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Kimplas Piping Systems Ltd, Nashik	Shri Kiran Sarode
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Reliance Industries Limited, Mumbai	Shri S. V. Raju
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(Continued from second cover)

The minimum value of overall service (design) coefficient at 20 °C, *C* has been taken as 2.0 for natural gas supply. The above 'C' value for liquefied petroleum gas (LPG) shall be taken as 2.2 and gaseous pipes for LPG applications may also be designed as per this standard by applying suitable derating.

Considering that no test facility is available for resistance to rapid crack propagation test; and this test is required to ascertain long-term performance of pipes in sub-zero temperature applications, and such conditions are very less likely to be experienced in the country; also because the gaseous supply pipes in India are used underground, the Committee responsible for the preparation of this standard decided that conformity to the concerned requirements may only be provided by the PE compound supplier.

In this revision, following major modifications have been incorporated in the standard:

a) Existing terms and definitions have been modified and various new terms and definitions have been added considering current internationally accepted definitions.

b) SDR 17 pipes have been included and SDR 17.6 pipes have been removed considering the current manufacturing practice.

c) Information regarding overall service (design) coefficient of 2.2 for LPG has been added so that gaseous pipes for LPG applications may also be designed as per this standard by applying suitable derating.

d) Requirement of volatile matter content and water content for PE compound in granules form have been added.

e) Resistance to rapid crack propagation test as per the ISO Standard has been added, the conformity to which is to be provided by the raw material (PE compound) supplier.

f) Resistance to weathering test, tensile properties (tensile yield strength and elongation at break) and resistance to slow crack growth rate test has now been specified for the raw material as well, which is to be provided by the PE compound supplier. The weathering period has been increased from 6 months to 2 years and the test duration has been increased from 165 h to 1 000 h.

g) Circumferential reversion test for the pipe has been added.

h) Slow crack growth rate test for notched pipes for 500 h has been included as per the corresponding International Standard.

j) Testing procedure for squeeze-off test has been modified in line with the current practice by the industry.

k) Marking by inkjet printing has been permitted and details to be included in lot number/batch number has been specified.

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

The composition of the technical committee responsible for formulation of this standard is given in Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the results of a test or analysis, shall be rounded off in accordance with IS 2: 1960 ' Rules for rounding off 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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This Indian Standard has been developed from Doc No.: CED 50 (13670).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi