IS 14885 (2001): Polyethylene Pipes for the Supply of Gaseous Fuels - [CED 50: Plastic Piping System]

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भारतीय मानक

गैसीय ईंधन की पूर्ति के लिए पालिईथाइलिन पाइपों की विशिष्टि

Indian Standard

POLYETHYLENE PIPES FOR THE SUPPLY OF GASEOUS FUELS — SPECIFICATION

ICS 75.200,83.140.30

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Price Group 9

FOREWORD

This Indian Standard 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.

Polyethylenes have been used to produce pipes for carrying natural gas for a number of years. Polyethylene's networks were installed in Europe more than 25 years ago without any major problems. Due to extensive research evaluation programme in the developed countries gas distribution technology has made appreciable progress and with the introduction of a 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 in recent years 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 net works 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 butt fusion and electro fusion techniques enables repairs or modification intervention under faster and more economical conditions than for steel.

The piped gas supply to our major cities for domestic and commercial purposes is likely to be operative in a large scale in the near future. In view of present scenario and future projections, a number of manufacturing plants has taken up manufacture of polyethylene pipes for the supply of gaseous fuels. However in the absence of a uniform Indian Standard Specification, a lot of difficulty is being experienced by our industry in this field. Accordingly, this Indian Standard has been prepared on International lines in the national interests.

In view of basic requirement and safety concern involved 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 before taking up bulk production. The minimum value of overall service (design) coefficient at 20°C has been taken as 2.0.

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.

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

ISO 497-1973 (E) Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers.

ISO 4607-1978 Plastics — Methods of exposure to natural weathering.

ISO 4437-1997-E Buried polyethylene (PE) pipes for supply of gaseous fuels specifications.

ISO/TR-9080-1992 (E) Thermoplastics pipes for transport of fluids, methods of extrapolation of hydrostatic stress rupture data to determine LTHS of thermoplastics pipe material.

ISO/DIS-6259-1-1994 Thermoplastic pipes — Tensile properties — Determination and basic specifications — Part 1: General test method.

ISO/DIS-6259-3-1994 Thermoplastic pipes — Determination of tensile properties — Part 3: Polyolefin pipe.

ISO/DIS-11922-1997 Thermoplastic pipes for transportation of fluids — Dimensions and tolerances.

(*Continued on third cover*)

Indian Standard

POLYEHYLENE PIPES FOR THE SUPPLY OF GASEOUS FUELS — SPECIFICATION

1 SCOPE

This standard covers the requirements for buried polyethylene pipe from 16 mm to 630 mm in diameter with SDR 9, SDR 11, SDR 14 and SDR 17.6 and in material grade PE-80 and PE-100, intended to be used for the supply of gaseous fuel. In addition, it specifies some general properties of the material from which these pipes are made, including a classification scheme.

2 NORMATIVE REFERENCES

The following Indian Standards contain provisions which through reference in this text, constitute the provisions of the standard. At the time of this publication the additions indicated were valid. All standards are subject to revision and parties to agreement based on the standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

IS No.	*Title*
2530 : 1963	Method of test for polyethylene moulding materials and polyethylene compound
4905 : 1992	Methods for random sampling
7328 : 1992	High density polyethylene materials for moulding and extrusion—Specification (*first revision*)

3 TERMINOLOGY

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

3.1 Nominal Outside Diameter (d_n) — 'd_n' is the specified nominal outside diameter of the pipe.

3.2 Mean Outside Diameter (d_o) — Average value corresponding to the circumference of any pipe divided by (π = 3.141 6) for the number of measurements rounded upto the next greater 0.1 mm.

3.3 Out of Roundness (Ovality) — The absolute out of roundness is the difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-section of pipe.

3.4 Nominal Wall Thickness (e_n) — 'e_n' is the numerical designation of the wall thickness of the pipe which is convenient round number approximately equal to the manufacturing dimension in mm.

3.5 Minimum Wall Thickness (e_{min}) —'e_{min}' is the minimum value of the mean wall thickness as specified for a given nominal wall thickness.

3.5.1 *Wall Thickness at any Point (e_i)* — It is the result of measurement of the wall thickness of the pipe at any point, rounded off to the next higher 0.05 mm.

3.6 Mean Wall Thickness (e_m) — 'e_m' is 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 absolute measured minimum and the measured maximum values of the wall thickness.

3.7 Standard Dimensions Ratio (SDR) — SDR is the quotient of the nominal outside diameter and the nominal wall thickness (expressed rounded to one decimal).

$$SDR = d_n/e_n$$

3.8 Minimum Required Strength (MRS) — Minimum value in Mpa, for long-term hydrostatic strength (LTHS) of the material.

3.9 Melt Flow Rate (MFR) — MFR is a value relating to the viscosity of the molten material at a specified temperature and rate of shear.

3.10 Maximum Allowable Operating Pressure (MAOP) — The highest effective pressure of the gas in the piping system expressed in bar, 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:

$$MAOP = \frac{20 \times MRS}{C \times (SDR - 1)}$$

3.11 Lower Confidence Limit at 20°C 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.

3.12 Overall Service (Design) Co-efficient (*C*)— '*C*' is an overall co-efficient with a value greater than 1 which takes into consideration service condition as well as properties of the components of a piping system other then those represented in the lower confidence limit. For this specification the minimum of '*C*' is 2.0.

3.13 Gaseous Fuel— Any fuel which is in the gaseous state at a temperature of +15°C and a pressure of 1 bar.

4 DESIGNATION

4.1 Pipes shall be designated according to the grade of material (*see* **4.2**), nominal diameter (*see* **4.3**) nominal wall thickness (*see* **3.4**) and standard dimension ratio (SDR) (*see* **3.7**) followed by word 'GAS'. For example, PE-80 DN 200 × 11.4 SDR 17.6 GAS indicates that a pipe is made from the material grade PE-80 nominal outside diameter of 200 mm, minimum wall thickness, 11.4 mm having SDR 17.6 and it is 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.

Table 1 Classification of the Material

(*Clauses* 4.2.1 *and* 5.6)

Material	Minimum Required Strength of Material in MPa at 20°C for 50 years	Maximum Allowable Hydrostatic Design Stress (σ) MPa at 20°C
PE-80	8.0	4.0
PE-100	10.0	5.0

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

4.2.3 The raw material supplier shall give the material grading.

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, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450, 500, 560, 630 mm.

4.4 Colour

The colour of the pipes shall be yellow when manufactured from PE-80 grade and orange 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 and shall comply with the requirements as specified in Table 2.

5.2 Anti-Oxidant

The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin as per IS 2530.

5.3 U.V. Stabilizer

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

Table 2 Characteristics of the PE Compound

(*Clause* 5.1)

Characteristics	Units	Requirements	Test Parameters	Test Method
Conventionl density	kg/m³	≥ 928.4 (base polymer) ≥930 (base polymer)	23°C 27°C	IS 7328 : 1992[1)]
Melt flow rate	g/10 min	± 20 percent of value nominated by compound producer	190°C/ 5.0 kg	IS 2530 : 1963
Thermal stability	min	≥20	200°C	Annex D
Resistance to gas constituents	h	≥20	80°C	Clause 5.5
Pigment dispersion	Grade	≤3		Annex E

[1)] *See* Explanatory Notes at Annex L.

NOTE — Indian testing methods mentioned in IS 7328 and IS 2530 for the determination of conventional density and mass flow rate have been found co-related with ISO/British Standard Testing methods, such as ISO 1183-1983(E), ISO 1133-1991(E), ISO 6964 and BS 2782 Part 8, method 823-A, 823-B, 1978 respectively. The compound shall confirm to the weathering requirements for thermal stability as above, hydrostatic strength HS (165 h-80°C) at induced stress 4.6 MPa and 5.5 MPa for PE-80 and PE-100 material respectively and elongation at break 350 percent minimum after exposure of the test as per Annex F.

5.4 Pigment Dispersion

When tested as per Annex E, the grading should be ≤ 3 .

5.5 Effects of Gas Constituents 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 **8.1** but using the synthetic condensate inside pipe at a temperature of 80°C for at least 20 h at an induced stress of 2 MPa.

5.6 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 Table 2 along with results of tensile tests applicable to each individual lot of 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 @ 20° C for 10 000 h shall be carried out once.

6 DIMENSION OF PIPES

6.1 The nominal outside diameter and out of roundness (ovality)shall be in accordance with Table 3.

Table 3 Outside Diameter of Pipes and Ovality Pipe

(*Clause* 6.1)

Type	Nominal Outside Diameter (d_n) mm	Maximum Ovality mm
Straight pipe	≤ 75	1+0.008 *d*
	> 75 to ≤ 250	0.02 *d*
	> 250	0.035 *d*
Coiled pipe	≤ 180	0.06 *d* for SDR 11 0.15 *d* for SDR 17.6

6.2 Wall Thickness (e_{min})

6.2.1 The minimum wall thickness shall be as given in Table 4.

Table 4 Wall Thickness

(*Clause* 6.2.1)

Nominal Outside Diameter, mm	Minimum Wall Thickness (e_{min}), mm			
d_n	SDR 17.6	SDR 13.6	SDR 11.0	SDR 9
16	2.3	2.3	3.0	3.0
20	2.3	2.3	3.0	3.0
25	2.3	2.3	3.0	3.0
32	2.3	2.3	3.0	3.6
40	2.3	3.0	3.7	4.5
50	2.9	3.7	4.6	5.6
63	3.6	4.7	5.8	7.1
75	4.3	5.5	6.8	8.4
90	5.2	6.6	8.2	10.1
110	6.3	8.1	10.0	12.3
125	7.1	9.2	11.4	14.0
140	8.0	10.3	12.7	15.7
160	9.1	11.8	14.6	17.9
180	10.3	13.3	16.4	20.1
200	11.4	14.7	18.2	22.4
225	12.8	16.6	20.5	25.1
250	14.2	18.4	22.7	27.9
280	16.0	20.6	25.4	31.3
315	17.9	23.2	28.6	35.2
355	20.2	26.1	32.3	39.7
400	22.8	29.4	36.4	44.7
450	25.6	33.1	41.0	50.3
500	28.5	36.8	45.5	55.8
560	31.9	41.2	51.0	—
630	35.8	46.3	57.3	—

6.2.1.1 The tolerance on nominal wall thickness (e_n) shall be as given in Table 5.

6.3 Method of Measurement

6.3.1 The outside diameter of the pipe shall be the average of two measurements taken using a vernier at right angles for pipes upto 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 0.1 mm.

The wall thickness shall be measured by a dial vernier or ball ended micrometer. The resulting dimension shall be expressed to the nearest 0.1 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 1 × (diameter of 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 for 4 h.

6.3.2 Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured during manufacturing after extrusion but prior to coiling. For coiled pipes rerounding shall be carried out prior to the measurements 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 6.

Table 5 Tolerances on Wall Thickness at Any Point

(*Clause* 6.2.1.1)

All dimensions in millimetres.

Nominal Wall Thickness (e_n)		Plus Tolerance	Nominal Wall Thickness (e_n)		Plus Tolerance
>	≤		>	≤	
2.0	3.0	0.4	30.0	31.0	3.2
3.0	4.0	0.5	31.0	32.0	3.3
4.0	5.0	0.6	32.0	33.0	3.4
5.0	6.0	0.7	33.0	34.0	3.5
6.0	7.0	0.8	34.0	35.0	3.6
7.0	8.0	0.9	35.0	36.0	3.7
8.0	9.0	1.0	36.0	37.0	3.8
9.0	10.0	1.1	37.0	38.0	3.9
10.0	11.0	1.2	38.0	39.0	4.0
11.0	12.0	1.3	39.0	40.0	4.1
12.0	13.0	1.4	40.0	41.0	4.2
13.0	14.0	1.5	41.0	42.0	4.3
14.0	15.0	1.6	42.0	43.0	4.4
15.0	16.0	1.7	43.0	44.0	4.5
16.0	17.0	1.8	44.0	45.0	4.6
17.0	18.0	1.9	45.0	46.0	4.7
18.0	19.0	2.0	46.0	47.0	4.8
19.0	20.0	2.1	47.0	48.0	4.9
20.0	21.0	2.2	48.0	49.0	5.0
21.0	22.0	2.3	49.0	50.0	5.1
22.0	23.0	2.4	50.0	51.0	5.2
23.0	24.0	2.5	51.0	52.0	5.3
24.0	25.0	2.6	52.0	53.0	5.4
25.0	26.0	2.7	53.0	54.0	5.5
26.0	27.0	2.8	54.0	55.0	5.6
27.0	28.0	2.9	55.0	56.0	5.7
28.0	29.0	3.0	56.0	57.0	5.8
29.0	30.0	3.1	57.0	58.0	5.9

Table 6 Out of Square Tolerance of Ends

(*Clause* 7)

Pipe Size Outside Diameter mm	Maximum Out of Square of Each Pipe End mm
16 to < 90	2
≥ 90 to < 140	3
≥ 140 to < 200	4
≥ 200 to < 315	5
≥ 315	7

8 PERFORMANCE REQUIREMENTS

8.1 Hydraulic Characteristics

When subjected to internal pressure creep rupture test in accordance with procedure given in Annex A, the 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 for plain pipes and notched pipes (63 mm dia and above test pieces as per Annex B shall conform to those specified in Table 7).

8.2 Reversion Test

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

8.3 Density

When tested as per Annex A of IS 7328 it shall meet the requirement as given in Table 1.

8.4 Melt Flow Rate (MFR)

MFR of the compound material shall be ± 20 percent of the values specified by the compound manufacture when tested as per IS 2530, at 190°C with normal load of 5 kgf and when tested from a composite sample of minimum three pipes shall not differ more than 30 percent from the values specified by the compound manufacturer.

The change of MFR by processing that is the difference between the measured value for material from the pipe and the measured value for the compound shall not be more than 25 percent.

8.5 Thermal Stability to Oxidation

The minimum oxidation induction time (OIT) of the material from the product shall be ≥ 20 min when tested as per Annex D.

8.6 Volatile Matter Content

When tested in accordance with Annex H, the value of volatile matter content shall be ≤ 350 mg/kg.

8.7 Tensile Test

8.7.1 When tested in accordance with Annex J at 23 ± 1°C at a speed of 100 mm/min ±10 percent for specimen thickness below 5 mm and at a speed of 25 mm/ min for thickness above 5 mm, the values obtained shall be as follows:

Tensile yield strength	15 MPa, *Min*
Elongation at break	350 percent, *Min*

8.8 Resistance to Weathering

After exposure to sunlight in accordance with Annex F, pipes shall comply with the following requirements:

a) Elongation as per **8.7.1**,

b) Hydraulic characteristics as per **8.1**, and

c) Thermal stability to oxidation as per **8.5**.

Table 7 Test Requirements for Internal Pressure Creep Rupture Test for Plain and Notched Pipes

(*Clauses* 8.1 *and* 9.1.2)

Test	Test Temperature °C	Test Duration h	Induced Stress MPa PE-80	Induced Stress MPa PE-100	Frequency
Plain pipes	20	≥100	9.0	12.5	Once in two years
	80	1 000	4.0	5.0	Once in four years
Acceptance Test					
Notched pipes	80	165	4.0	4.6	As per Table 9
Plain pipes	80	165	4.6	5.5	As per Table 9

8.9 Squeeze-Off

On all sizes of pipe up to and including 400 mm diameter, strength after squeeze-off and subsequent rerounding, must be demonstrated by testing in accordance with Annex G.

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 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 in two years on each pressure rating for each grade/class of material with highest size of pipe manufactured.

9.1.2 However, hydrostatic pressure resistance test at 80°C for 1 000 h shall be done at least once in 4 years and at 20°C for 100 h once in two years as shown in Table 7 (*see* **8.1**).

Three samples of the same pressure class and same size should be selected at random for each type test and shall be tested for compliance with the requirements as indicated against each test as shown in Table 8.

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.

Table 8 Type Test (Scale of Sampling — 3 Samples for Each Test)

(*Clause* 9.1.2)

Sl No.	Description of Test	Requirement, Ref to Clause/Table	Test Method
i)	Hydrostatic pressure resistance at 80°C for 1 000 h	8.1 Table 7	Annex A
ii)	Hydrostatic pressure resistance at 20°C for ≥100 h.	8.1 Table 7	Annex A
iii)	Resistance to weathering	8.8	Annex F
iv)	Squeeze-off test	8.9	Annex G
v)	Volatile matter content	8.6	Annex H

9.2.2 *Lot*

All pipes of the same size, same pressure rating and also manufactured essentially under similar conditions of manufacture shall constitute a lot. For ascertaining conformity of the lot the requirements of this standard, samples shall be selected in accordance with the provisions as mentioned in Table 9 and tested for compliance.

9.2.3 Dimensional and Visual Requirements

9.2.3.1 The number of test samples shall be in accordance with Table 10.

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 tables given in IS 4905 may be referred.

Table 9 Acceptance Tests

(*Clauses* 9.2.2, 9.2.4.1 *and* 9.2.4.2)

Sl No.	Description of Test	Requirement Clause	Sample Size
i)	Dimensional checks	6.1, 6.2 and 9.2.3	Table 10
ii)	Visual appearance	7, 9.2.3	Table 10
iii)	Marking information	10	Table 10
iv)	Hydrostatic pressure resistance at 80°C for 165 h for plain pipes	8.1	Table 11
v)	Reversion test	8.2	Table 11
vi)	Density	8.3	Table 11
vii)	MFR	8.4	Table 11
viii)	Pigment dispersion	5.4	Table 11
ix)	Thermal stability (OIT)	8.5	Table 11
x)	Tensile test	5.4	Table 11
xi)	Hydrostatic pressure resistance at 80°C for 165 h (Notched pipes for 63 mm and above)	8.1	Annex A and B

Table 10 Scale of Sampling for Visual and Dimensional Requirements

(*Clauses* 9.2.3.1 *and* 9.2.3.3)

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

Table 11 Scale of Sampling for Tests for Hydraulic Characteristics (Including Notched Pipes) Reversion Density, MFR, Thermal Stability and Tensile

(*Clause* 9.2.2)

No. of Pipes	Sample Size
Up to 800	3
801 to 1 600	4
1 601 to 2 400	5
2 401 to 3 200	6
> 3200	7

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 withdrawn so as to constitute the required sample size.

9.2.3.3 The number of pipes given for the 'First' sample in col 3 of Table 10 shall be examined for dimensional and visual requirements as given in **6.1**, **6.2**, **7** and **10**. 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 defective found in the 'First' sample are less than or equal to the corresponding acceptance number given in col 5 of Table 10. The lot shall be deemed not to have met these requirements if the number of defective found in the 'First' sample is greater than or equal to the corresponding rejection given in col 6 of Table 10.

If however, the number of defective found in the 'First' sample lies between the corresponding acceptance and rejection numbers given in col 5 and 6 of Table 10, the 'Second' sample of the size given in col 3 of Table 10 shall be taken and examined for these requirements, if the number of defective found in the cumulative samples is less than or equal to the corresponding acceptance number given in col 5 of Table 10 otherwise not.

9.2.4 *Test for Hydraulic Characteristics, Reversion and Other Requirements*

9.2.4.1 The lot having satisfied dimensional and visual requirements shall be tested for hydraulic characteristics, reversion and other requirements as shown in Table 9.

9.2.4.2 A sample size for each of these tests, shall be taken as stipulated in Table 9 and selected at random from the sample already examined for dimensional and visual inspection. All the pipes in each of the sample size shall be tested for compliance of the requirements for Hydraulic characteristics (**8.1**), Reversion (**8.2**), Density (**8.3**), Melt flow rate (**8.4**), Pigment dispersion (**5.4**),Thermal stability (**8.5**), Tensile test (**8.7**). The lot shall be considered to have met the requirement of these tests, if none of the samples tested fail.

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 type of failure and in such a way that with normal storage weathering and processing and the permissible method of installation use, legibility shall be maintained for the life of the pipes.

10.3 Pipes not greater than 32 mm nominal size shall be marked with a single strip and all other pipes sizes shall be marked along two strips on opposite side of the pipe.

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

a) 3 mm for pipe not greater than 90 mm nominal size, and
b) 5 mm for pipe greater than 90 mm nominal size.

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) Designation, and
c) Batch or lot number.

10.6 BIS Certification Marking

10.6.1 Each pipe may also be marked with the Standard Mark

10.6.2 The use of Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereafter. Details of conditions under which a license for the use of the Standard Mark may be granted to the manufacturers or the producers may be obtained from the Bureau of Indian Standards.

11 SUPPLY, PACKAGING, HANDLING AND TRANSPORTATION OF POLYETHYLENE PIPES FOR GAS TRANSMISSION (*see* **Annex K**)

ANNEX A

(*Clause* 8.1)

INTERNAL PRESSURE CREEP RUPTURE TEST

A-1 GENERAL

A-1.1 The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

A-2 TEST SPECIMENS

A-2.1 A sample of pipe having free length between the end fitting equal to ten times the outside diameter but neither less than 250 mm nor greater than 750 mm shall be taken for testing from each pipe to be tested.

A-3 APPARATUS

A-3.1 Equipment which permits the application of a controlled internal hydraulic pressure to the specimen which are immersed in a thermostatically controlled water bath.

A-4 PROCEDURE

A-4.1 The pipe shall be fitted with the locking plugs at both ends in such a way that the axial forces coming from the internal pressure are transmitted to the pipe. The pipe shall remain free to move in longitudinal direction.

A-4.2 Through a closable opening in one of the locking plugs, the pipe shall be filled with water at ambient temperature. It shall be then put in a water bath at the test temperature (permissible deviation ±1°C) and kept in the bath for minimum 1 h to adjust the temperature.

A-4.3 The pressure in the pipe shall then be increased to the test pressure (p) gradually and without shock preferably within 10 to 30 seconds in bath whose temperature has been adjusted in accordance with **A-4.2.** The pressure with a permissible deviation of ± 2.5 percent shall be maintained for the period laid down in Table 5. The test pressure (p) shall be calculated from the minimum dimensions as measured according to **6.3.1** and induced stress values given in Table 7.

A-4.3.1

$$p = \frac{2\sigma_I \times e_{min}}{d_n - e_{min}}$$

where

p – Test pressure in Mpa,
e_{min} – Minimum wall thickness in mm,
σ_I – Induced stress in Mpa, and
d_n – Nominal outside diameter of pipe in mm.

A-5 ASSESSMENT OF RESULTS

The sample shall not show any signs of localized swelling or leakage and shall not burst during the prescribed test duration. The test showing failure within a distance equivalent to the length of end cap from the end shall be disregarded and the test repeated.

ANNEX B

(*Clause* 8.1)

METHOD OF PREPARATION OF LONGITUDINALLY NOTCHED TEST PIECES

B-1 APPARATUS

The apparatus shall consist of a milling machine having a horizontal mandrel rigidly fixed to the bed to enable a pipe to be securely clamped to give a straight specimen. The mandrel shall support the pipe bore beneath and along the full length of the notch to be machined.

The milling cutter, mounted on a horizontal arbor, shall be a 60° included angle '*v*' cutter 12.5 mm wide having a cutting rate of 0.010 ± 0.002 mm/rev/tooth, for example a cutter with 20 teeth rotating at 700 rev/min traversed along at a speed of 150 mm/min has a cutting rate of:

$$150 / (20 \times 700) = 0.011 \text{ mm/rev/tooth}$$

The milling cutter shall be carefully protected against damage. It shall not be used for any other material or purpose and shall be replaced after 100 m of notching.

B-2 TEST PIECE

A sample of pipe having free length between the end fittings equal to 10 times the outside diameter but neither less than 250 mm nor greater than 750 mm shall be taken for testing from each pipe to be tested.

B-3 PROCEDURE

B-3.1 The minimum pipe wall thickness shall be located and marked for machining an initial notch. The positions shall be marked for machining three additional notches equally spaced around the pipe circumference at the same position along the specimen as the initial notch.

B-3.2 The average minimum wall thickness shall be determined from measurements taken at either end of the specimen in line with a position of the initial notch.

B-3.3 For pipes having a wall thickness greater than 50 mm, the notch shall initially be machined with a slot drill of 15 mm to 20 mm diameter to leave approximately 10 mm to be removed by the '*v*' cutter when machining in accordance with **B-3.4** or **B-3.5**.

B-3.4 The initial notch (*see* **B-3.1**) shall be machined by climb milling to depth so as to produce a pipe wall ligament of thickness between 0.78 and 0.82 times the minimum specified wall thickness of the pipe (*see* Fig. 1).

NOTE — To achieve a remaining ligament within the required tolerance range, it is advisable to aim for a remaining ligament at the top of the tolerance range. This is because the pipe wall can move due to release of residual stresses, resulting in a deeper than anticipated notch.

The length of the notch, at full depth, shall be equal to the pipe outside diameter ±1 mm .

B-3.5 An additional notch shall be machined at each of the three positions marked in accordance with **B-3.1** so that each notch has an identical ligament thickness to that of the initial notch and the ends of each notch are aligned circumferentially with those of the initial notch as shown in Fig. 1 and 2.

B-4 MEASUREMENT OF NOTCH DEPTH

On completion of the pressure test, the test piece shall be removed from the water tank and allowed to cool to 23°C. A section of pipe shall be cut out from around the position of each notch.

The notch shall be opened up to give clear access to one of the machined surfaces of the notch. The width L (mm) of the machined surface of the notch shall be measured to an accuracy of ± 0.1 mm with a microscope or other suitable means as shown in Fig. 3.

The notch depth N (mm) shall be calculated from the equation.

$$N = 0.5 \{dm - (dm^2 — L^2)1/2\} + 0.866 L$$

where

dm = measured mean pipe outside diameter, in mm; and

L = width of machined surface of notch, in mm.

The ligament thickness shall be calculated from the notch depth. For acceptance, each notch shall be in accordance with **B-3.4**.

B-5 TEST REPORT

The test report shall include the following:

a) The identification of the test piece,
b) A reference to this method of preparation,
c) The minimum wall thickness found for the ends of the test piece,
d) The depth of the notch,
e) The wall thickness of the pipe sections through the notch after use,
f) Any deviations from the cutting speed and feed ranges (*see* **B-1**), and
g) The date of test piece preparation.

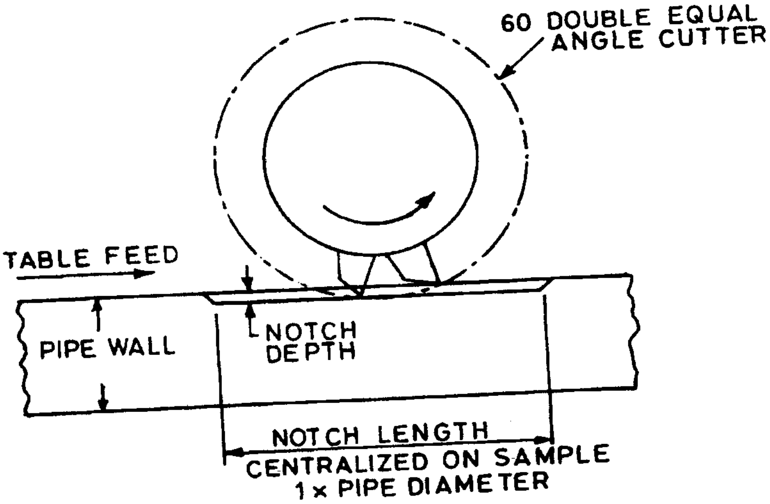


FIG. 1 NOTCH METHOD

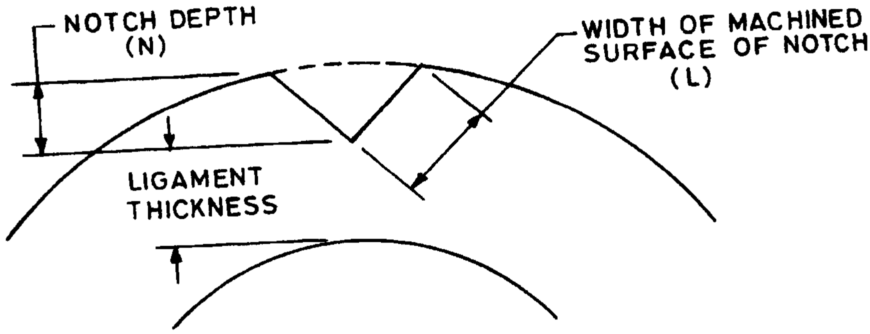


FIG. 2 MEASUREMENT TO CALCULATE NOTCH DEPTH

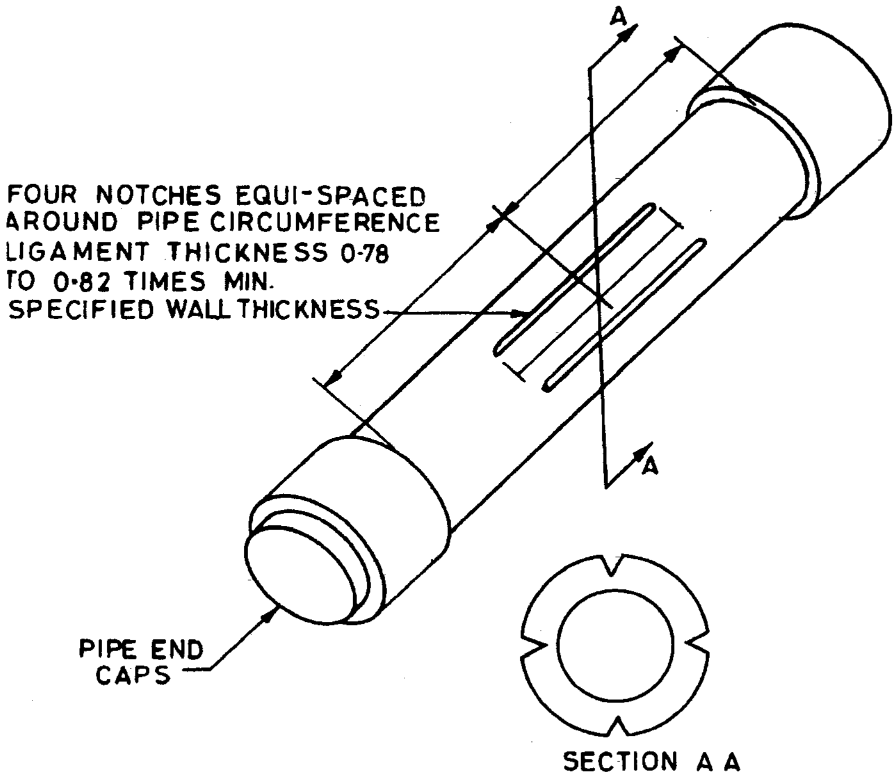


FIG. 3 PIPE TEST PIECE

ANNEX C

(*Clause* 8.2)

LONGITUDINAL REVERSION TEST

C-1 APPARATUS

C-1.1 Air oven, thermostatically controlled at 110 ± 2°C and is capable of re-establishing this temperature within 15 min after the introduction of test specimen in the oven.

C-1.2 Thermometer, graduated to 0.5°C.

C-1.3 Test specimens, either 3 complete sections of pipe, approximately 200 mm long, shall be taken as test pieces, or where the pipe diameter is greater than 200 mm, pieces of pipe of about 200 mm axial length and with an approximately 200 mm long section of pipe shall be divided into pieces measuring approximately 200 mm square. The direction of the pipe axis shall be marked on the pieces. All pieces are required to be tested. A mark shall be scribed on the external surface approximately 50 mm from each end of the test pieces in the axial direction of pipe (in the case of complete section of pipe, the mark shall be scribed around the whole circumference). The distance between the two marks, L_0 (reference length), shall be approximately 100 mm and shall be measured to the nearest 0.25 mm at ambient temperature.

C-2 PROCEDURE

C-2.1 Place the test pieces concave side up on a glass plate previously dusted with talcum, to ensure that changes in length take place unimpeded. The pieces shall not touch each other.

C-2.2 Set the oven temperature at 110 ± 2°C. The glass plate with the test pieces shall then be placed in the oven heated to test temperature and capable of maintaining continuous forced air circulation. The test pieces shall be kept in the oven at the temperature and for the periods specified below:

Wall Thickness, e mm	*Test Temperature* (±2)° C	*Period of Heating, t* min
Up to 8	110	60 ± 1
Over 8 up to and including 16	110	120 ± 2
Over 16	110	240 ± 5

C-2.3 Remove the test pieces from the oven and allow to cool in air, without being moved, at the ambient temperature. Measure the minimum distance between the two marks.

C-3 EXPRESSION FOR RESULTS

C-3.1 For each test pieces, calculate the longitudinal reversion, T, as a percentage, as follows:

$$T = L_0 - L_1 / L_0 \times 100$$

where L_0 and L_1, are the distance in mm before and after the test.

C-3.2 The average value (arithmetic mean) of all the test pieces shall be obtained and reported.

C-3.3 Test Report

The test report shall include the following particulars:

Full identification of the pipe

The test temperature with degree of accuracy

The length variation of each test piece (L_0–L_1) together with its sign (+ or –)

Any change in the appearance of the test pieces during the test or immediately afterwards.

The value of the longitudinal reversion of the pipe as given in **C-3.1.**

All operating details not specified in this standard as well as incidents likely to have influenced the results.

ANNEX D

(*Clause* 8.5 and *Table* 2)

METHOD FOR DETERMINATION OF OXIDATION INDUCTION TIME

D-1 APPARATUS

D-1.1 A differential thermal analyser (DTA), calibrated using pure indium and pure tin to give values which lie within 156.6 ± 0.5°C and 231.9 ± 0.5°C respectively.

The test cell shall allow the cell to be purged within 1 min by use of successive gases at the specified flow rate (*see* **D-3**).

D-1.2 Aluminium pans, large enough to accommodate a test piece in solid or molten form.

D-2 TEST PIECES

A sample shall be taken by use of a core drill directed radically through the pipe wall. The diameter of the core shall be just less than the inner diameter of the sample pan of the thermal analyser, and care should be taken not to overheat the sample during the coring operation. Using a scalpel, cut test pieces that weigh 15 ± 0.5 mg in the form of discs from the core sample, selecting the inner surface, outer surface and mid-wall as the minimum sample points which are to be tested individually.

D-3 PROCEDURE

Except where this method differs, follow the operating instructions of the instrument manufacturer as applicable.

Establish a nitrogen flow of 50 ml/ min ±10 per cent through the DTA cell. Check that when a switch over to oxygen is made, the gas flow will continue at the rate of 50 ml/min ±10 per cent and then revert to a nitrogen flow of 50 ml/min, introduce a test piece in an open aluminium pan and an empty aluminium reference pan into the cell. Set the instrument to raise the temperature at a rate of 20°C/min, and then to run isothermally at 200 ± 0.1°C and allow the temperature to stabilize. Make any minor corrections to the heater voltage to bring the specimen temperature to 200 ± 0.1°C. Start to record the thermogram (that is a plot of the temperature differential against time).

When steady conditions exist under nitrogen after 5 min, switch over to oxygen and mark this point on the thermogram.

Continue to run the thermogram until the oxidation exotherm has occurred and has reached its maximum.

D-4 INTERPRETATION OF RESULTS

The oxidation induction time for the test piece is the time taken, in minutes from the introduction of oxygen to the intercept of the extended baseline and the extended tangent drawn to the exotherm at the point of maximum slope as shown in Fig. 4.

The thermal stability of the sample is the arithmetic mean of at least five oxidation induction time measurements at 200°C or 210°C.

D-5 TEST REPORT

The test report shall include the following:

a) The identification of the test pieces,

b) A reference to this test method,

c) The individual results, in minutes, and

d) The date of the test.

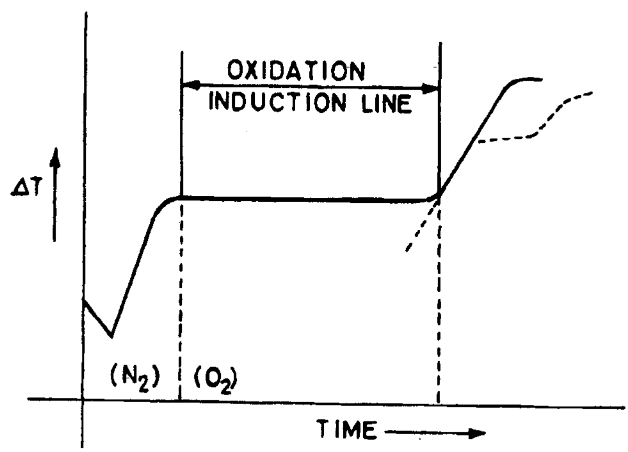


FIG. 4 OXIDATION INDUCTION TIME

ANNEX E

(*Table* 2)

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

E-1 SCOPE

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

E-2 PRINCIPLE

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

E-3 APPARATUS

E-3.1 A Microtome

E-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.

E-3.3 Microscope Slides and Cover Slips

E-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.

E-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 stan ard photomicrographs numbered 1 to 6 in Fig. 5.

Give 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.

E-6 EXPRESSION OF RESULTS

Record the rating of each test piece as per Fig. 5.

E-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.

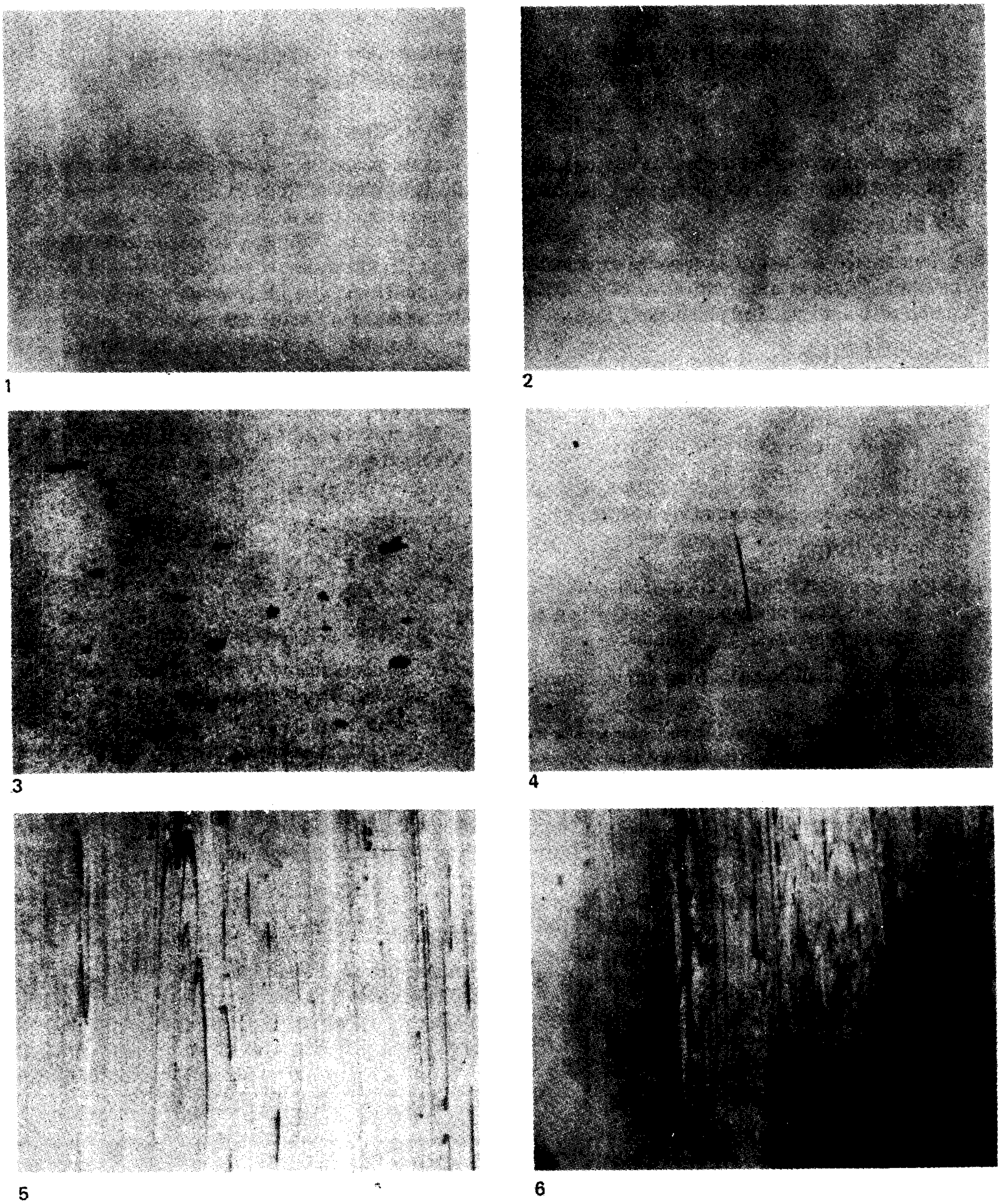


FIG. 5 PIGMENT DISPERSION PHOTOMICROGRAPHS 1 TO 6

ANNEX F

(*Clause* 8.8)

RESISTANCE TO WEATHERING

F-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.

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

F-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.

F-4 The pipe sample shall be exposed for a period of six months.

F-5 After weathering exposure the sample shall be tested in accordance with the provision of **8.8** as follows:

a) Hydrostatic strength at 80°C for at least 165 h as per **8.1**,

b) Elongation at break 350 percent, *Min* as per **8.7**, and

c) The OIT measurement after weathering at 200°C as per **8.5**.

(This test should be done on test pieces taken from the out side surface of the pipe after removing the upper 0.2 mm layer.)

ANNEX G

(*Clause* 8.9)

SQUEEZE-OFF TEST

G-1 In certain countries the technique of squeeze-off is used to restrict the flow of gas in PE pipelines whilst effecting maintenance and repair operations. If the user desires to employ the technique, the pipe manufacturer may provide evidence to the user that after squeeze-off in accordance with the method recommended by the manufacturer or the possible use of a reinforcement sleeve, the long-term strength of the pipe is not harmfully affected by this technique.

G-2 The evidence may be given by the following procedure.

G-2.1 The apparatus shall be squeeze-off equipment as recommended by the pipe manufacturer and the code of practice.

G-2.2 The specimen shall be a pipe of which the minimum free length shall be eight times the outside diameter of the pipe (between fittings of any type) with a minimum of 250 mm.

The specimen shall be closed 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.

G-2.3 The pipe shall be conditioned at a temperature of 0°C(+0,–5°C) for a minimum period of 10 h. Within 10 min of this conditioning, the center of the pipe shall be squeezed-off to the level specified by the pipe manufacture or the code of practice, whichever specifies the smaller separation. This squeeze-off shall be maintained for a minimum period of 60 min. The specimen shall be tested at 80° C at a stress of 4.6 MPa for PE-80 and 5.5 MPa for PE-100, and shall withstand that stress for a minimum of 165 h.

a) Size of mandrel shall be as per ASTM F 1041-92.

b) Include the requirements of squeeze-off as 30 percent minimum.

ANNEX H

(*Clause* 8.6 and *Table* 2)

VOLATILE CONTENT

H-1 PRINCIPLE OF THE METHOD

The volatile content is determined as the loss of mass of a sample, which has been put in a drying oven.

H-2 EQUIPMENT

- Non-ventilated drying oven with thermostat.
- Weighing cup with a diameter of 35 mm.
- Desiccator.
- Analytical balance accurate to ± 0.1 mg.

H-3 PROCEDURE

Tare the weighing cup and its lid which have been in a desiccator for at least half an hour. Fill the cup with about 25 g sample weighed to the nearest 0.1 mg. Put the weighing cup in the non-ventilated drying oven which is kept at 105°C ± 2°C. Take the weighing cup out of the drying oven after 1 h and put it in a desiccator for 1 h. Cover the cup and weigh it to the nearest 0.1 mg.

H-4 CALCULATION OF THE RESULTS

Calculate the volatile matter content using the following equation:

$$V = \{P_1 - P_2 / P_1 - P_0\} \times 10^6$$

where

V is the volatile matter content in mg/kg at 105°C,

P_0 is the weight in g of the empty weighing cup,

P_1 is the weight in g of the weighing cup plus sample, and

P_2 is the weight in g of the weighing cup plus sample after 1 h at 105°C.

ANNEX J

(*Clause* 8.7.1)

POLYETHYLENE (PE) PIPES DETERMINATION OF TENSILE PROPERTIES

J-1 SCOPE

This Annex specifies the method for the determination of the tensile properties of polyethylene (PE) pipes.

J-2 PRINCIPLE

Preparation of test pieces of given shape and size from a polyethylene (PE) pipe by cutting. Measurement of the tensile properties on a suitable testing machine under standardized condition.

J-3 APPARATUS

J-3.1 Testing machine of the type with constant separating speed, basically incorporating the following parts:

J-3.1.1 A fixed part, or a virtually fixed part, with a grip to hold the test piece.

J-3.1.2 A movable part, incorporating a second grip.

These grips holding each end of the test piece should do so as far as possible without slipping, but nevertheless without crushing (grips which tighten automatically are suitable).The fixed and moving parts and their associated grips must enable the test piece to be lined up as soon as the least load is applied to it so that the axis of the test piece is the same as that of the force.

J-3.1.3 A drive mechanism which transfers constant speed motion to the moving part.

J-3.1.4 A load indicator (dynamometer), showing the load borne by the test piece which is held in the grips. The mechanism must be virtually free from inertia lag at the specified rate of testing and must show the load with an accuracy of at least 1 percent of the measured value.

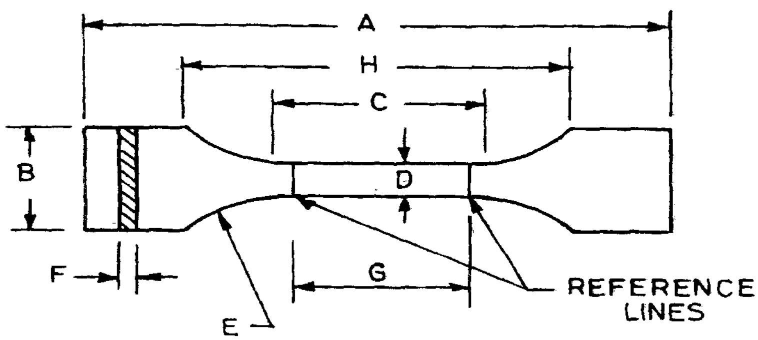
J-3.1.5 An extension indicator, free from inertia lag, enabling the distance separating two given points on the test piece to be determined at any moment during the test with an accuracy of 2 percent.

J-3.2 Measuring instrument, such as a micrometer, accurate to within 0.01 mm, enabling the width and thickness of the test piece to be measured.

J-4 TEST PIECES

Test Piece Type 1/2

The shape and dimension of this test piece are given in Fig. 6 This is more particularly intended for determining the tensile properties of smaller diameter pipes.



A	— Minimum total length	75		*E*	— Minimum radius	30
B	— Width of the ends	10 ± 0.5		*F*	— Thickness	*see* Table12
C	— Length of the calibrated part	30 ± 0.5		*G*	— Distance between the reference line	25 ± 0.5
D	— Width of the calibrated part	5 ± 0.5		*H*	— Initial distance between clamps	60 ± 5

FIG. 6 TEST PIECE TYPE 1/2

J-4.1 Number of Test Pieces

The number of test pieces to be used for determining the tensile properties of a pipe depends on the wall thickness of the pipe (*see* Table 12) and is never less than three.

J-4.2 Taking of Test Pieces

Taking the test pieces from the pipe in such a way that is not flattened, that is without heating, so that the test piece axes are parallel to the axis of the pipe and in such a number that they are regularly distributed around the circumference of the pipe.

J-4.2.1 To achieve this, use a sufficiently long piece of pipe, and divide its circumference into a certain number of sectors with an arc length of approximately 150 mm. From these divisions, mark out strips with a length equal to that of the test piece of pipe (*see* Fig. 9). For example, a pipe with an external diameter of 200 mm and a circumference of approximately 630 mm will be divided into four strips.

J-4.2.2 In the middle of each of these strips, take a test piece, by means of punch with sharp cutting edges free from burrs, and with a profile complying with one of the Fig. 6, 7 or 8 (*see* Table 12). Cut out the test piece by applying the punch to the inner surface of the strip and by exerting uniform pressure.

J-4.2.3 Draw two reference lines, equidistant from the ends of the wasted part of the test piece as shown in Fig. 6, 7 and 8. Mark these lines with a wax crayon or with ink, which does not affect the properties of polyethylene. The reference marks must not under any circumstances from scratches, nor shall they be stamped or printed on the test piece.

J-4.2.4 As a function of the pipe wall thickness (*e*), the test shall be carried out with the test pieces as given in Table 12.

Table 12 Selection of the Pieces

(*Clauses* J-4.1, J-4.2.2 *and* J-4.2.4)

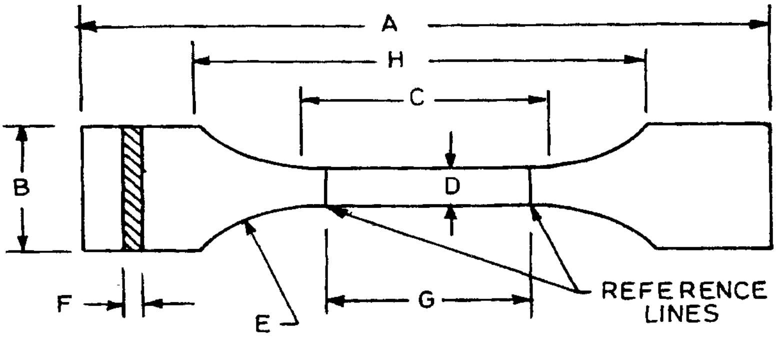
Wall Thickness (*e*) of the Pipe mm	Test Piece Type mm	Thickness Test Piece (*F*)	Remarks
$e < 5$	1/2 or 2	*e*	Non-machined[1]
$5 < e < 10$	1	*e*	Non-machined[1]
$e > 10$	1	10	machined[2]

[1] Non-machined test piece (thickness of test piece equal to the thickness of the pipe).

[2] Machined test piece: Two series of test pieces are prepared. The thickness of test pieces is brought down to 10 mm by suitable machining, which does not cause any heating of the machined surface, and which enables a smooth surface to be obtained. For the first series, the inside surface of the pipe is machined. Only the series, which has given the lowest results, is taken into consideration for the test result.

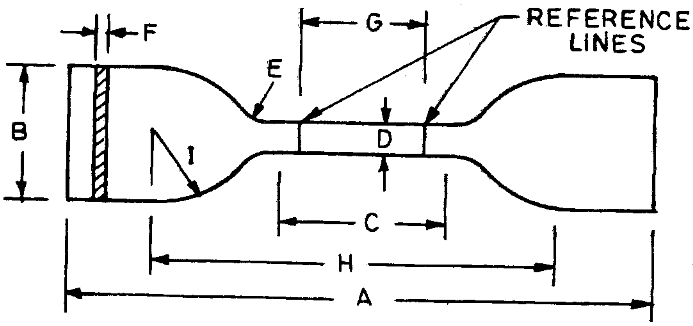
J-4.3 Procedure

The test pieces shall be conditioned for two hours in air or one hour in water so that it is at a temperature of 27 ±2°C immediately before test. The test shall be carried out as given in **6** of IS 2530.



A —	Minimum total length	150	*E* —	Minimum radius	30
B —	Width of the ends	20 ± 0.5	*F* —	Thickness	*see* Table 12
C —	Length of the calibrated part	60 ± 0.5	*G* —	Distance between the reference line	25 ± 0.5
D —	Width of the calibrated part	10 ± 0.5	*H* —	Initial distance between clamps	60 ± 5

FIG. 7 TEST PIECE TYPE 1



A —	Minimum total length	115	*F* —	Thickness	*see* Table 12
B —	Width of the ends	25 ± 0.5	*G* —	Distance between the reference line	25 ± 1.0
C —	Length of the calibrated part	33 ± 1.0	*H* —	Initial distance between clamp	80 ± 5
D —	Width of the calibrated part	6 ± 0.4	*I* —	Large radius	25 ±1
E —	Small radius	14			

FIG. 8 TEST PIECE TYPE 2

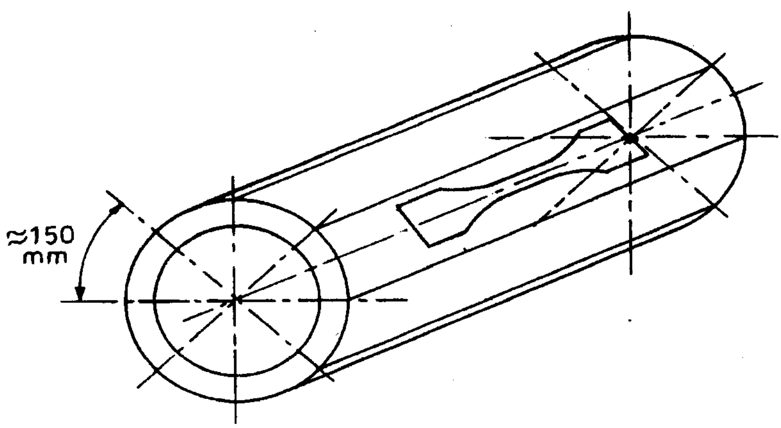


FIG. 9 TAKING OF TEST PIECES

ANNEX K

(*Clause* 11)

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

K-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.

K-2 BUNDLES

The distance (X) between the supporting frames shall be equally spaced in order to allow stacking (Fig. 10). The polyethylene straight pipe shall rest evenly over their whole length. The supporting frame must not be nailed together and must be constructed such as to lead the pressure load directly through the supporting frame and not through the polyethylene pipe.

K-3 COILS

Polyethylene pipes may be coiled or packed on drums. Large diameter coils with $d \geq 90$ 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.

K-3.1 The dimensions of the pipe coils shall be as per Table 13. The maximum width of any coil shall be 0.55 m.

Table 13 Coil Dimension and Winding Temperature

(*Clause* K-3.1)

Nominal Outside Diameter (d) mm	Minimum Internal Coil Diameter (M) m	
	SDR 11	SDR 17.6
20	0.6	–
25	0.6	–
32	0.7	–
63	1.3	–
90	1.8	–
110	2.2	–
125	2.5	–
All sizes	Maximum external coil diameter M	
	3.2	3.2
Maximum external surface temperature at time of coiling	35° C	

K-3.2 Coiled pipe 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.

K-3.3 All coiled pipe shall be constrained in a stable configuration by banding in at least six equi-spaced position during production. The banding should not be less than 50 mm wide and shall be sufficiently

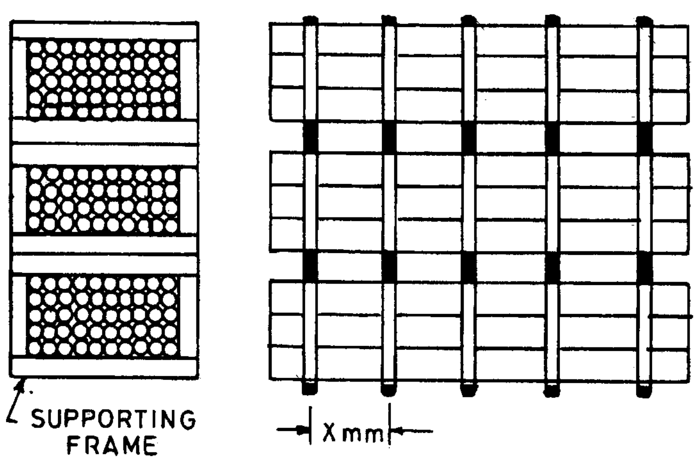


FIG. 10 STACKING ARRANGEMENT

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:

Suppliers name
Purchaser's purchase order No.
Manufacturing standard
Pipe size (mm) × pressure rating (kg/cm²)
Weight of coil in kg
Length of coil in m
Marking on labels to be indelible

K-4 HANDLING

K-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.

K-4.2 Straight Pipe

Initial handling and storage of straight polyethylene pipes should be made with the polyethylene pipe 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.

K-4.3 Coils

Individual coils must 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.

K-5 TRANSPORTATION

K-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.

K-5.2 Coiled Pipe

Coiled pipe with $d < 63$ 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 $d \geq 63$ mm should be supplied individually.

There should be facilities to restrain each coil securely throughout 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.

K-6 STORING

Pipe shall be stored in the manner to prevent damage from elevated temperature, contact with chemicals, 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 must be consulted for recommendations from the manufacturers. 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.

K-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 L

(*Table* 2)

EXPLANATORY NOTES

L-1 MATERIAL

L-1.1 Indian testing methods mentioned in IS 7328 and IS 2530 for the determination of conventional density, mass flow rate have been found co-related with ISO/BIS testing method such as ISO 1183-1987 (E), ISO 1133-1991(E), ISO 6964 and BS-2782 Part-8 method 823-A, 823-B, 1978, respectively.

L-2 TOLERANCE ON OUTSIDE DIAMETER AND MAXIMUM OVALITY (Table 2)

L-2.1 The values specified for tolerance on outside diameter have been calculated as 0.009 d_n, rounded off to the next higher 0.1 mm, subject to minimum of 0.3 mm. No negative tolerance are allowed.

L-2.2 The ovality specified correspondence to Grade N and K of ISO/DIS 11922-1 'Thermoplastic pipes for transport of fluids, dimensions and tolerance'. The basis for the values specified is:

a) For nominal outside diameter $\leq$ 75, the tolerance equals (0.08 d_n + 1.0) mm, rounded to the next higher 0.1 mm, with a minimum value of 1.2 mm.

b) For nominal outside diameter > 75 and $\leq$ 250. the tolerance equals 0.02 d_n rounded to the next higher 0.1 mm.

c) For nominal outside diameter > 250, the tolerance equals 0.035 d_n rounded to the next higher 0.1 mm.

ANNEX M

(*Foreword*)

COMMITTEE COMPOSITION

Plastic Piping System Sectional Committee, CED 50

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(*Continued on page* 22)

(*Continued from page* 21)

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(*Continued on page* 23)

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Polyolefins Piping System Subcommittee, CED 50 : 2

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(*Continued on page* 24)

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(*Continued from second cover*)

ISO 1133-1991 (E) Plastics — Determination of the melt mass flow rate (MFR) and the melt volume flow rate (MVR) of thermoplastics.

ISO 1183-1987 (E) Plastics—Methods for determining density of non-cellular plastics.

ISO/TR-10837-1991 (E) Determination of the thermal stability of polyethylene (PE) for use in gas pipes and fittings.

BS 7281-1990 Specification of polyethylene pipe for the supply of gaseous fuels.

BS 2782 Part II 1983 Method 1106-A—Assessment of pigment dispersion in polyethylene (PE) pipes and fittings, microtome method.

British Gas Standard Technical Specifications for GBE/PL2: Part 1 Polyethylene (PE) pipes and fittings for natural gas and manufactured gas Part 1 : Pipes.

ASTM D-2513-1995-B Standard specification for thermoplastic gas pressure pipe, tubing and fittings.

ASTM D-4019-1994 Standard test method for moisture in plastics.

DIN 8074-1987 High density polyethylene (HDPE) pipes dimensions.

DIN 8075-1987 High density polyethylene (HDPE) pipes general quality requirements — Testing.

Draft European Standard Plastic piping system for

EN 1555-7-1995 Gaseous fuels supply polyethylene (PE).

CAN B-137-4-M86 Polyethylene piping system for gas services.

The composition of the committee responsible for formulating this standard is siven in Annex M.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding 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.

This Indian Standard has been developed from Doc : No. CED 50 (5764).

Amendments Issued Since Publication

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AMENDMENT NO. 1 MAY 2003
TO
IS 14885 : 2001 POLYETHYLENE PIPES FOR THE SUPPLY OF GASEOUS FUELS — SPECIFICATION

(*Page* 9, *clause* **B-4**, *para* 3, *equation*) — Substitute the following equation for the existing:

'$N = 0.5 \{ d\mathrm{m} - (d\mathrm{m}^2 - L^2)^{\frac{1}{2}} \} + 0.86 L$'

(CED 50)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 APRIL 2007
TO
IS 14885 : 2001 POLYETHYLENE PIPES FOR THE SUPPLY OF GASEOUS FUELS — SPECIFICATION

[*Page* 15, *clause* **G-2.3**(a)] — Substitute the following for the existing:

'Size of mandrel shall be as given in Table 11A.

Table 11A Mandrel Size

Sl No.	**Nominal Outside Diameter of Pipe,** mm	**Minimum Radius of Mandrel,** mm
(1)	(2)	(3)
i)	16-20	12
ii)	25-50	16
iii)	63-110	19
iv)	125-200	25
v)	225-315	25
vi)	355-400	32

(CED 50)

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