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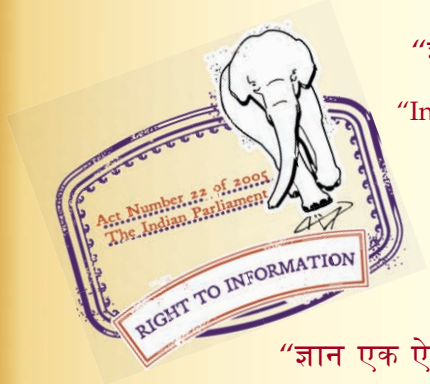
IS 9271 (2004): Unplasticized Polyvinyl Chloride (UPVC) Single Wall Corrugated Pipes for Drainage - [CED 50: Plastic Piping System]



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IS 9271 : 2004
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(पहला पुनरीक्षण)

Indian Standard

UNPLASTICIZED POLYVINYL CHLORIDE (UPVC) SINGLE WALL CORRUGATED PIPES FOR DRAINAGE — SPECIFICATION

(First Revision)

ICS 23.040.20; 65.060.35

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2004

Price Group 5

AMENDMENT NO. 1 NOVEMBER 2005
TO
IS 9271 : 2004 UNPLASTICIZED POLYVINYL CHLORIDE (UPVC) SINGLE WALL CORRUGATED PIPES FOR DRAINAGE — SPECIFICATION

(First Revision)

(*Page* 2, *clause* **5.1.3**, *line* 2) — Add '64' after 'K-value of'

(*Page* 6, *clause* **B-2**) — Substitute '1 h at 0 ± 1°C' *for* '24 h at 10°C'

(*Page* 6, *clause* **B-4.1**, *first line*) — Substitute '1 h' *for* '24 h'

(CED 50)

Reprography Unit, BIS, New Delhi, India

FOREWORD

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

Different types of plastic pipes have been in use in this country for potable water supplies, electrical and telephone conduits, rainwater gutter and agriculture purposes. For potable water supplies following standards have already been published

IS No.	*Title*
3076 : 1985	Specification for low density polyethylene pipes for water supplies (*second revision*)
4984 : 1995	Specification for high density polyethylene pipes for water supplies (*fourth revision*)
4985 : 2000	Unplasticized PVC pipes for potable water supplies — Specification (*third revision*)

Plastic pipes have been found to have useful application in the following drainage systems

a) Underground irrigation pipes,

b) Sprinkler irrigation system,

c) Lift irrigation,

d) Drip or trickle irrigation, and

e) Sub-surface farm drainage

The simple system of sub-surface drainage consists of corrugated perforated and non-perforated drain pipelines placed at suitable spacing and depth below ground on a slope towards the outlet or collector. The water enters the pipelines through the perforations and flows towards the outlet and is carried away under gravitational flow.

HDPE pipes, smooth wall PVC pipes and PVC corrugated pipes due to their different material characteristic and functional properties have different applicability.

PVC smooth wall corrugated pipes have main application for transmission of water with pressure and cable ducting, HDPE pipes for conveyance of water, fluid, etc, under pressure and cable ducting PVC single wall corrugated pipes have been found suitable for drainage and for removal of excess water from surface, sub-surface, in agricultural fields, farms, sports field, highways and road, canals, etc, under gravitational flow

In the preparation of this standard, assistance has been derived from the following International Standards with suitable modification wherever felt necessary keeping in view the climatic, soil and working condition prevailing in the country:

BS 4962 : 1989	Plastic pipes and fittings for use as sub-soil field drains
AS 2439 (Part 1) : 1981	Perforated plastics drainage and effluent pipe and fittings Part 1 Perforated drainage pipe and associated fittings

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

Indian Standard

UNPLASTICIZED POLYVINYL CHLORIDE (UPVC) SINGLE WALL CORRUGATED PIPES FOR DRAINAGE — SPECIFICATION

(First Revision)

1 SCOPE

This standard specifies the requirements and methods of tests of unplasticized PVC corrugated perforated/non-perforated pipes designed for use in under-drainage of surface and sub-surface land/ farms, canal, highways, roads, sports fields, building foundation, construction sites, interceptor drainage, in fields/farms, intercepting canal seepage and under-drainage of lined canals etc

2 REFERENCES

The standard listed below contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid All standards are subject to revisions 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*
4558 1995	Specification for under drainage of lined canals
4669 1968	Methods of test for polyvinyl chloride resin
4905 : 1968	Methods for random sampling
4985 2000	Specification for un-plasticized PVC pipes for potable water supplies
10151 . 1982	Specification for polyvinyl chloride (PVC) and its copolymer for its safe use in contact with foodstuff pharmaceuticals and drinking water
13360 (Part 3 / Sec 1) . 1995	Methods of testing for plastics: Part 3 Physical and dimensional properties, Section 1 Determination of density and relative density of non-cellular plastic

3 TERMINOLOGY

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

3.1 Nominal Outside Diameter (d_n), is the specified nominal outside diameter, in millimetres assigned to a nominal size

3.2 Perforations, are the slots/ openings made in the pipe for letting the water into the pipe.

3.3 Corrugation, is the design of the profile of the pipe.

3.4 Pipe Stiffness (*PS*) — The value obtained by *dividing the force per unit length of specimen by the* resulting deflection in the same units at the prescribed percentage deflection.

3.5 Water Inlet Area — The perforated portion of the pipe needed to let the water in

3.6 Sub-surface Drainage — Sub-surface is drainage work done below the surface .

3.7 Pipe Deflection — The ratio of the deflection in pipe inside diameter to the initial inside diameter expressed as the percentage of the initial inside diameter

3.8 ΔY — Measured change of the inside diameter in the direction of load application expressed, in mm.

3.9 Pipe Significant Events

3.9.1 *Liner Cracking or Crazing — The occurrence* of a break or network of fine breaks in the liner visible to the unaided eye.

3.9.2 *Wall Cracking* — The occurrence of a break in the pipe wall visible to the unaided eye

3.9.3 *Rupture* — A crack of break extending entirely or partly through the pipe wall

4 NOTATIONS

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

d_n = nominal outside diameter
PS = pipe stiffness
E = elongation of the pipe
F = load
d_i = inside diameter

5 MATERIAL

5.1 The pipes shall be produced from material consisting substantially of polyvinyl chloride conforming to IS 10151 to which may be added only those additives as are needed to facilitate manufacturer of sound pipe with surface finish, mechanical strength in order to condition of use. None of these additives shall be used separately or together in quantity sufficient to constitute toxic hazard or materially to impair the fabrication, chemical and physical properties of the pipe.

5.1.1 Up to 10 percent addition of the manufacturers own rework material produced during the manufacture and testing of pipes, complying with the standard is permissible

5.1.2 The material used shall be resistant to the chemicals normally present in the sub-soil and ground water Due to strong ultra-violet rays present in the intense sunlight under Indian conditions, the compound used for manufacturing drainage pipe should contain ultra-violet stabilizer.

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

6 TYPES

For the purpose of this standard, the single wall corrugated pipes shall be of perforated or non-perforated types.

7 DIMENSIONS AND TOLERANCE

The nominal outside diameter and tolerances of the corrugated pipes shall be as per Table 1.

Table 1 Dimensions of Corrugated Single Wall Pipe
(Clause 7)

Sl No.	Nominal Outside Diameter of Pipes, d_n	Tolerances mm	Inside Diameter of Pipes, d_i
(1)	(2)	(3)	(4)
i)	80	± 0 5	72
ii)	100	± 0 5	88
iii)	125	+ 0 5	112
iv)	160	+ 0 5 − 1 0	144
v)	200	+ 0 5 − 1 0	178
vi)	294	+ 0 5 − 1 0	258
vii)	355	± 1 0	315
viii)	455	± 1 0	401

7.1.1 *Measurement of Dimensions*

The dimensions shown in Fig 1 shall be measured using instruments as given below:

Nominal outside diameter (d_n)	=	By pie tape
Inside diameter	=	By bore gauge
Perforation length	=	By vernier callipers
Perforation width	=	By filler gauge

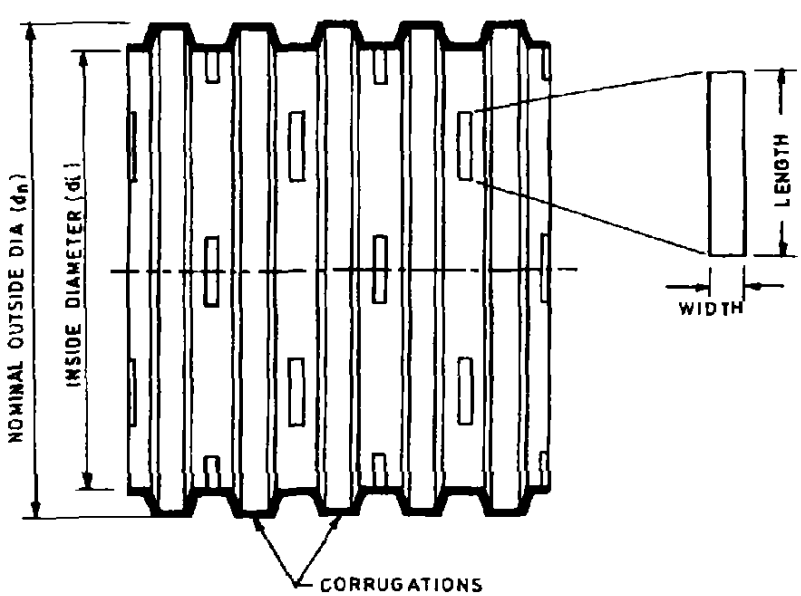

FIG. 1 MEASUREMENTS OF DIMENSIONS

7.2 Wall Thickness

The wall thickness of pipes shall be such that pipes shall meet the physical requirement given in 8.

7.3 Length

Unless otherwise specified corrugated pipes up to 160 mm nominal outside diameter shall be supplied in coils of length 30, 50, 75 or 100 as agreed to between the manufacturer and the buyer. These coils of length may be achieved by joining maximum of three pieces by means of couplers. The length shall not be less than 99 percent of the stated quantity. Nominal outside diameter above 160 mm may be supplied in straight lengths of 6 m or as agreed to between the manufacturer and the buyer.

7.4 Perforation Requirement

7.4.1 The perforation shall be in the valley of the corrugations. The longer dimensions of the perforations shall be along the circumstance of the pipe There shall be maximum 8 rows of perforations. Each row shall contain enough perforations to comply with the requirement of Table 2 for each size Perforation size and water inlet area shall be as per Table 2. Perforations should not be made by punching method.

Table 2 Size of Perforations and Water Inlet Area
(*Clause* 7.4.1)

Sl No.	Nominal Outside Diameter, d_n mm	Water Inlet Area cm^2/m	Perforation Size Width mm	Perforation Size Length mm
(1)	(2)	(3)	(4)	(5)
i)	80	≥ 18	≤ 2	≤ 15
ii)	100	≥ 21	≤ 2	≤ 15
iii)	Above 100	≥ 21	≤ 3	≤ 32

7.4.2 The maximum in flow area shall be 80 cm^2/m length of pipe of all diameters.

7.4.3 The height of corrugation should be between 8 to 13 percent of nominal outside diameter (d_n).

8 PHYSICAL REQUIREMENTS

8.1 Visual Appearance, Workmanship and Finish

8.1.1 The colour of the pipes shall be light grey. Slight variation in the appearance of the colour are permitted.

8.1.2 The pipe shall be homogeneous throughout, essentially uniform in colour, density and other properties. The inside and outside surface shall be smooth and free of sticky material. The pipe wall shall be free of cracks, holes, blisters, voids, foreign inclusion or other defects that are visible to the naked eye and that may affect the wall integrity

8.2 Density

When tested in accordance with IS 13360 (Part 3/ Sec 1), the density of the pipe shall be between 1.40 and 1.46 gm/cm^3.

8.3 Pipe Stiffness

The stiffness of the pipe, when tested in accordance with method given in Annex A, shall be as given in Table 3.

Table 3 Requirement for Minimum Stiffness
(*Clause* 8.3)

Sl No.	Nominal Outside Diameter	Minimum Stiffness Required at	
		5% Deflection kPa	10% Deflection kPa
(1)	(2)	(3)	(4)
i)	80	210	175
ii)	100	210	175
iii)	125	210	175
iv)	160	250	210
v)	200	250	210
vi)	294	250	210
vii)	355	250	210
viii)	455	250	210

NOTE — For highways/roads, drainage applications, the minimum suffness should be 1.6 times the above

8.4 Impact Strength at 0°C

When tested in accordance with the method given in Annex B the pipe shall not show the sign of fracture, cracking, rupture, or splitting.

8.5 Elongation Test

When tested in accordance with the method given in Annex C, pipes shall not elongate more than 7 5 percent

8.6 Bending Test

When tested in accordance with the method given in Annex D there shall be no evidence of splitting or cracking.

8.7 Joints

The type and size of joints shall be as per the agreement between the buyers and the sellers. The strength of joints shall be tested in accordance with Annex E.

9 SCALE OF SAMPLING

9.1 Lot

9.1.1 In a single consignment, all the drainage pipes of the same type, same size, same length and manufactured under similar conditions of manufacture shall constitute of a lot.

9.1.2 For ascertaining the conformity of the lot to the requirements of the specifications, samples shall be tested from each lot separately

9.1.3 The number of pipes to be selected from the lot shall depend on the size of the lot and shall be in accordance with Table 4.

Table 4 Scale of Sampling for Visual and Dimensions
(*Clauses* 9.1.3 *and* 9.2.1)

Sl No.	Length of Pipes in the Lot	Sample No.	Sample Size	Cumulative Sample Size	Acceptance No.	Rejection No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	1 500	First	5	5	0	2
		Second	5	10	1	2
ii)	1 501 to 5 000	First	8	8	0	2
		Second	8	16	1	2
iii)	5 001	First	13	13	0	2
		Second	13	26	1	2

9.1.3.1 These pipes shall be selected at random In order to ensure the randomness of selection IS 4905 may be referred

9.2 Number of Test and Criteria for Conformity

9.2.1 The number of pipes given for the first sample in col 3 of Table 4 shall be taken from the lot and examined for visual and dimensional requirements given in 7 and **8.1**.

Pipes failing to satisfy these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements, if the number of the defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 5 of Table 4. The lot shall be deemed not to have met these requirements, if the number of rejections found in the first sample is greater than or equal to the corresponding rejection number given in col 6 of the Table 4.

If however the number of defectives found in the first sample lies between the corresponding acceptance and rejection number as given in col 5 and 6 of Table 4, the second sample of the size given in col 3 of the Table 4 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 5 of Table 4, otherwise not.

9.2.2 The lot having been found satisfactory in visual and dimensional requirements according to **9.2.1**, shall be further tested for physical requirements given in **8**. For this purpose, the number of tests for the physical requirements shall be according to Table 5.

Table 5 Scale of Sampling for Pipe Stiffness, Impact, Elongation, and Bending Test
(*Clause* 9 2.2)

Sl No.	Length of Pipes in the Lot m	Sample Size
(1)	(2)	(3)
i)	1 500	3
ii)	1 501 to 5 000	5
iii)	5 001 and above	8

9.2.2.1 The required number of pipes for carrying out these tests should be selected at random from the lot. The lot shall be considered to have met these requirements, if no failure occurs, otherwise not.

9.2.3 The lot shall be declared as confirming to the requirements of the standard, if **9.2.1** and **9.2.2** are satisfied.

10 MARKING

10.1 Each coil/pipe shall be tagged / indelibly marked with the following:

a) Identification and source of manufacture;
b) Nominal outside diameter of the pipe, in mm;
c) Perforated/Non-perforated;
d) Length, in m; and
e) Batch number or lot number.

10.2 BIS Certification Marking

Each coil/pipe may also be marked/tagged with the Standard Mark.

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

ANNEX A

(*Clause* 8.3)

METHOD FOR TEST FOR PIPE STIFFNESS

A-1 TEST SPECIMEN

Specimen length shall be equal to nominal outside diameter (d_n) but not less than 305 ± 3 mm.

A-2 CONDITIONING

Specimen shall be conditioned at least for 1h at 23 ± 2 °C. The test shall be conducted in conditioned atmosphere

A-3 TESTING APPARATUS

A-3.1 Testing Machine

A-3.1.1 A properly calibrated compression-testing machine of the constant-rate of-cross-head movement type shall be used to make the tests The rate of head approach shall be 12.5 ± 0.5 mm/min

A-3.2 Loading Plate

The load shall be applied to the specimen through two parallel steel bearing plates The plates shall be flat smooth and clean The thickness of the plates shall be sufficient so that no bending or deformation occurs during test, but it shall not be less than 6 mm. The plate length shall equal or exceed the specimen length and the plate width shall not be less than the pipe contact width at maximum pipe deflection plus 150 mm.

A-3.3 Deformation (Deflection Indicator)

The change in inside diameter (d_i) or deformation parallel to the direction of loading shall be measured with a suitable instrument accurate to the nearest 0.25 mm. The instrument shall not support the pipe test specimen or the plate or affect any way the load deflection measurement. Changes in the diameter may be measured during loading by continuously recording plate travel or by periodically computing it.

A-4 PROCEDURE

A-4.1 Measure the length of each specimen to the nearest 1 mm by averaging at least four equally spaced measurements around perimeter.

A-4.2 For pipes controlled by nominal outside diameter, calculate the average inside diameter (of nominal outside diameter) by subtracting two times the average wall thickness from the average nominal outside diameter. Use this average inside diameter as the basis for measuring the percentage of deflection for all specimens in that lot of pipe.

A-4.3 Locate the pipe specimen with its longitudinal axis parallel to the bearing plates and centre it laterally in the stiffness-testing machine. Minimum wall thickness line is at the top

A-4.4 With the deflection indicator in place, bring the upper plate in to contact with the specimen with no more loads than is necessary to hold it in place. This establishes the beginning point for subsequent deflection measurement.

A-4.5 Compress the sample and note down the readings of plate movement at 1 mm interval for pipes up to 100 mm and 2 mm interval for pipes above 100 mm nominal outside diameter and corresponding reading of proving ring dial gauge. Minimum 10 readings are taken for plotting the graph

A-4.6 Compress the specimen at a constant rate of 12.5 ± 0 5 mm/min. Record load-deflection measurement continuously.

A-4.7 Same procedure is repeated for two samples, which are rotated at 35° and 70° from minimum wall thickness line.

A-4.8 Plot the graph deflection *versus* load Draw vertical lines form the point of 5 percent and 10 percent deflection. Draw horizontal lines form the points where vertical line intersects load deflection curve. Note down loads corresponding to 5 percent and 10 percent deflection

A-4.9 Calculate the pipe stiffness (PS) for any given deflection as follows:

$$PS = F/\Delta Y$$

where

PS = pipe stiffness, in kN/m^2,

F = load at 5 percent and 10 percent deflection, and

ΔY = at 5 percent and 10 percent deflection.

A-4.10 Observe and note the load and deflection at the first evidence of following significant events when and if they occur :

a) Line cracking or crazing,
b) Wall thickness,
c) Wall de-lamination, and
d) Rupture.

ANNEX B

(*Clause* 8.4)

IMPACT STRENGTH AT 0°C

B-1 TEST SPECIMEN

Each specimen of 300^{+3}_{-0} mm long shall be a complete section of pipe. The ends of each specimen shall be cut, clean and square to the axis of the pipe and free of burrs and jagged edges.

B-2 CONDITIONING OF TEST SPECIMEN

Specimen shall be conditioned for 24 h at 10°C prior to test.

B-3 APPARATUS

B-3.1 Falling weight test machine consisting of:

a) *Main Frame* — With guide rail or tube, which can be fixed in the true vertical position, to accommodate a striker and release mechanism to release the striker to fall vertically and freely (*see* Fig. 2).

b) *Striker* — Striker shall be with a shape Tub B type (*see* Fig. 3), 50.8 mm sphere radius, 2.5 kg, mass, 550^{+10}_{-0} mm height of fall A flat plate specimen holder shall be used.

B-4 PROCEDURE

B-4.1 After 24 h, samples are taken one by one from freezer and put on the anvil of the impact-testing machine. A weight of 2.5 kg from 0.55 m height is dropped on each sample The point of impact for all specimens shall be at the top of the vertical diameter Position the pipe specimen at random angular orientations. Impact each specimen only once

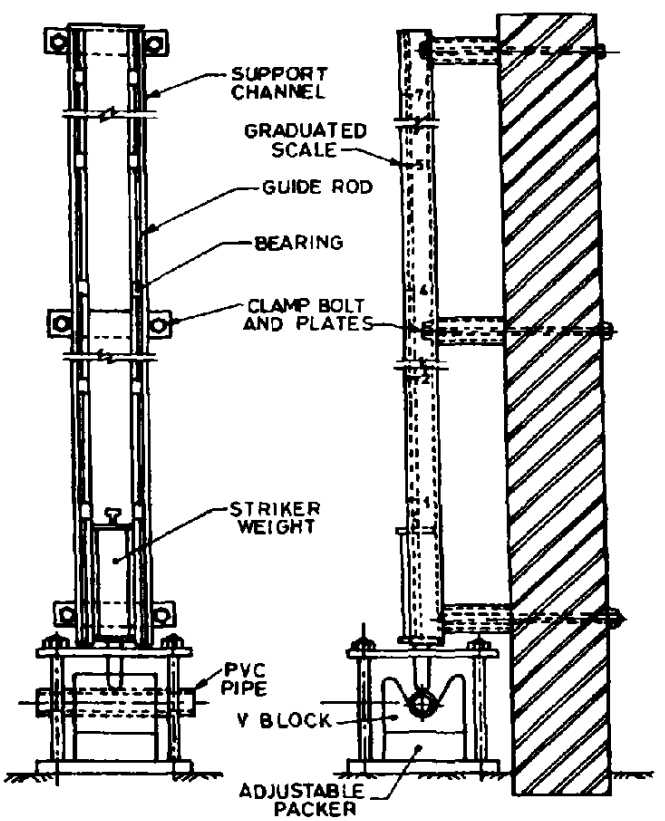

FIG. 2 IMPACT TESTING MACHINE

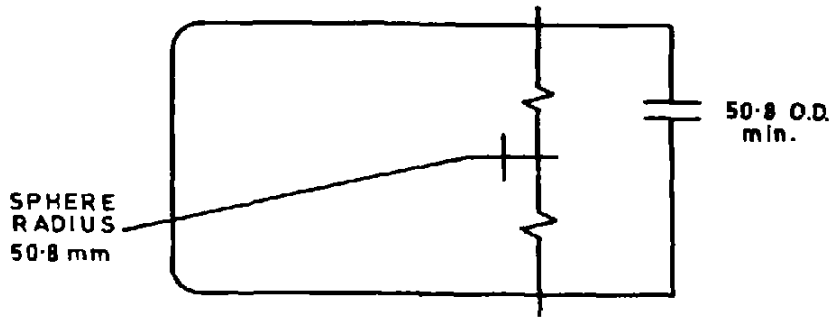

FIG. 3 DIMENSION OF STRIKER TUB 'B' TYPE

B-4.2 Individual specimens shall be tested within 60 s of removal from the conditioner. For round the clock testing, where the test might not be completed within 60 s, the specimen shall be reconditioned for a further period of at least 10 min.

B-5 ASSESSMENT OF RESULT

Out of 10 specimen, 9 shall not show any sign of fracture, cracking, rupture or splitting.

ANNEX C

(*Clause* 8.5)

ELONGATION TEST

C-1 TEST SPECIMEN

A minimum of 3 specimens 1 270 m in length shall be taken

C-2 CONDITIONING OF TEST SPECIMEN

Specimens shall be conditioned for 24 h at 23^{+2}_{-0}°C.

C-3 APPARATUS

A means of rigidly holding a test, piece in a vertical position and applying a tensile force of 7.73 kg to 42.23 kg

C-4 PROCEDURE

C-4.1 Each specimen shall be tested with the axis vertical. Apply the load by hanging mass at bottom end of the specimen. Tare load and test load shall be applied for each size as per Table 6 Apply tare load to straighten the specimen and mark gauge length in mm. The gauge length shall be middle 762 mm of the specimen. Apply the test weight gently and after 3 minute re-measure the gauge length to the nearest 3 mm (*see* Fig. 4).

C-4.1.1 Calculate the elongation, in percent, as follow :

Elongation (E) = mm of stretch × 100/762 mm

C-4.2 Tare Weight and Test Weight for Elongation Test

Required tare and test weight for elongation test are given in Table 6.

Table 6 Required Weights for Elongation Test
(*Clauses* C-4.1 *and* C-4.2)

Sl No.	Nominal Outside Diameter mm	Tare Weight kg	Test Weight kg	Total Weight kg
(1)	(2)	(3)	(4)	(5)
i)	80	1 30	6 43	7 73
ii)	100	1 55	7 71	9 26
iii)	125	2.27	11 35	13 62
iv)	160	2 53	12 62	15 15
v)	200	3 12	15 60	18 70
vi)	294	4 52	22 60	27 12
vii)	355	5 52	27 60	33 12
viii)	455	7 03	35 20	42.23

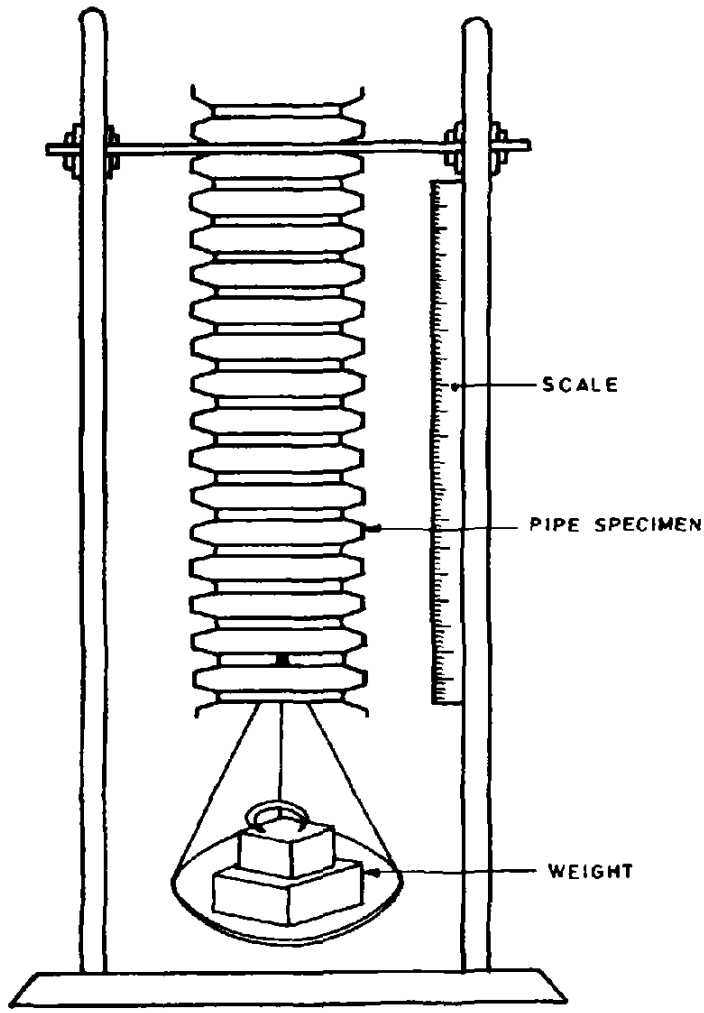

FIG 4 APPRATUS TO TEST ELONGATION

ANNEX D

(Clause 8.6)

BENDING TEST

D-1 TEST SPECIMEN

Length of the specimen shall be sufficient to make a bend half revolution around a cylindrical mandrel with a radius of 3 times the nominal outside diameter of the pipe

D-2 CONDITIONING OF TEST SPECIMEN

Specimens shall be conditioned at 0 ± 1°C for 24 h

D-3 APPARATUS

D-3.1 Cylindrical mandrels with a radius of 3 times the nominal outside diameter for each size with *clamping arrangement to clamp the both ends of the* specimen at the time of test.

D-3.2 Long deep-freezer to accommodate specimens of length 3 m and maximum nominal outside diameter

of 500 mm. Temperature shall be maintainable to 0 ±1 °C.

D-4 PROCEDURE

D-4.1 Remove the specimen from deep-freezer and within 30 s. Bend the specimen over the mandrel and clamp at both the ends.

D-4.2 Do not exert longitudinal pressure on specimen while bending.

D-4.3 Keep the specimen for 10 min in this position and then immediately inspect visually the specimen in the bent position for split and cracks.

ANNEX E

(Clause 8.7)

STRENGTH OF JOINT TEST

E-1 This test is designed to assess the strength of a joint when subjected to a tensile force for 10 min.

E-2 TEST SPECIMEN

The test piece for assessing the strength of the joint shall consist of a two equal length of pipe, such that the length of test specimen with the joint to be tested shall be 1.270 m long

E-3 CONDITION OF TEST SPECIMEN

E-3.1 The assembly shall be conditioned at 23 ± 2°C for at least 1 h before carrying out the test at that temperature.

E-4 APPARATUS

Same as given in **C-3.**

E-5 PROCEDURE

Attach one end of the test specimen rigidly to the apparatus and then hang pan at the bottom end of the specimen. Apply weights as per Table 6. This shall be total weight (Tare + Test weight). Avoid a snatch weight. Test weight shall be applied for 10 min.

E-6 RESULT

After test, the results shall be assessed. If the joint breaks or separates, the joint shall be reported as unsatisfactory

Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically, a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc . No. **CED 50 (7076).**

Amendments Issued Since Publication

Amend No	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones 2323 0131, 2323 33 75, 2323 9402

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices		Telephone
Central	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	2323 7617 2323 3841
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