IS 14402 (1996): GRP pipes joints and fittings for use sewerage, industrial waste and water (other than potable) [CED 50: Plastic Piping System]

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भारतीय मानक

मलक जल व्यवस्था, औद्योगिक अपशिष्ट व जल (पेयजल के अलावा) के लिये प्रयुक्त कांच रेशे के प्रबलित प्लास्टिक पाईप, जोड़ और फिटिंग — विशिष्टि

Indian Standard

GLASS FIBRE REINFORCED PLASTICS (GRP) PIPES, JOINTS AND FITTINGS FOR USE FOR SEWERAGE, INDUSTRIAL WASTE AND WATER (OTHER THAN POTABLE) — SPECIFICATION

ICS 23.040.20 ; 13.060.30

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

December 1996

Price Group 8

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastic Pipes and Fittings Sectional Committee had been approved by the Civil Engineering Division Council.

Fibre glasss reinforced plastic (GRP) pipes is a matrix of composite of glass fibre, thermosetting polyester resin and may contain fillers. The pipes so manufactured are light in weight and have smooth interior surface.

This standard has been prepared with a view to provide guidance for the manufacturing, selection and purchase of glass fibre reinforced thermosetting resin pipes for use for the conveyance of sewage, industrial waste and water (other than potable) for both above and under ground installations.

In the preparation of this standard, assistance has been derived from the following:

ISO 7370-1983	'Glass fibre reinforced thermosetting plastics (GRP) pipes and fittings — Nominal diameters, specified diameters and standard lengths', published by International Organisation for Standardization.
ASTM D 2992-1991	'Standard practice for obtaining hydrostatic or pressure design basis for Fiberglass (glass fiber-reinforced thermosetting resin) pipe and fittings,' published by American Society for Testing and Materials
ASTM D 3681-1989	'Standard test method for chemical resistance of fiber glass (glass fiber thermosetting resin) pipe in a deflected condition, published by American Society for Testing and Materials
ASTM D 3754-1988	'Standard specification for fiber glass (glass fiber reinforced thermosetting resin) sewer and industrial pressure pipe,' published by American Society for Testing and Materials
ASTM D 2563-1970	'Standard practice for classifying visual defects in glass reinforced plastic laminate parts', published by American Society for Testing and Materials
BS 5480 : 1990	Specification for glass fibre reinforecd plastic (GRP) pipes, joints and fittings for use for water supply and sewerage, issued by British Standards Institution.

The composition of technical committee responsible for the preparation of this standard is given in Annex H.

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.

AMENDMENT NO. 1 JUNE 2011
TO
IS 14402 : 1996 GLASS FIBRE REINFORCED PLASTICS (GRP) PIPES, JOINTS AND FITTINGS FOR USE FOR SEWERAGE, INDUSTRIAL WASTE AND WATER (OTHER THAN POTABLE) — SPECIFICATION

(*Page* 2, *Table* 1) — Insert the following at appropriate places in ascending order in the table:

Nominal Diameter, DN	Inside Diameter Range, ID		Tolerances on Declared ID
	Min	*Max*	
1 300	1 295	1 320	±5
1 500	1 495	1 520	±5

(*Page* 3, *Table* 2) — Insert the following at appropriate places in ascending order in the table:

Nominal Diameter, DN	Outside Diameter Range, OD	Tolerances on Declared OD
1 300	1 330	±5
1 500	1 534	±5

(*Page* 7, *Table* 6) — Insert the following at appropriate places in ascending order in the table:

Nominal Diameter	Beam Load	Minimum Longitudinal Tensile Strength in kN/m of Circumference, for Pressure Class				
DN	P	PN 3	PN 6	PN 9	PN 12	PN 15
1 300	—	152	226	345	393	468
1 500	—	175	265	397	454	540

(*Page* 7, *Table* 7) — Insert the following at appropriate places in ascending order in the table:

Nominal Diameter	Minimum Hoop Tensile Strength of Pipe Wall in kN/m Width of Circumference for Pressure Class				
mm	PN 3	PN 6	PN 9	PN 12	PN 15
1 300	790	1 580	2 369	3 159	3 949
1 500	911	1 823	2 734	3 645	4 556

(*Page* 13, *clause* **E-5.3**) — Substitute the following for the existing:

'Load the test piece by separating the mounts at a rate not exceeding 2.5 mm/min and record the maximum force resisted by the test piece.'

(CED 50)

Reprography Unit, BIS, New Delhi, India

Indian Standard

GLASS FIBRE REINFORCED PLASTICS (GRP) PIPES, JOINTS AND FITTINGS FOR USE FOR SEWERAGE, INDUSTRIAL WASTE AND WATER (OTHER THAN POTABLE) — SPECIFICATION

1 SCOPE

1.1 This specification covers requirements for materials, dimensions, classification, testing and sampling of machine made pipes with glass fibre reinforced thermosetting resin with or without aggregate filler having nominal diameter from 200 mm to 3 000 mm for use at pressure up to 1 500 kPa for conveyance of sewage, industrial waste and water (other than potable) such as river water, well water, sea water and storm water.

1.2 Joints and fittings covered in this standard are for guidance only.

1.3 GRP pipes for conveyance of potable water are covered in IS 12709 : 1994.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
5382 : 1985	Rubber sealing rings for gas mains, watermains and sewers (*first revision*)
6746 : 1993	Unsaturated polyester resin systems for low pressure fibre reinforced plastic
11273 : 1992	Woven roving fabrics of 'E' class fibre (*first revision*)
11320 : 1985	Glass fibre rovings for the reinforcement of polyester and epoxide resin systems
11551 : 1986	Glass fibre chopped strand mat for the reinforcement of polyester resin system
12709 : 1994	Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply — Specification

3 TERMINOLOGY

3.1 Glass Fibre Pipe

A tubular product containing glass fibre reinforcements embedded in or surrounded by cured thermosetting resin. The composite structure may contain aggregate (silicious), fillers, thixotropic agents, pigments or dyes. Thermoplastic or thermosetting liner and/or surface layer may be included.

3.2 Surface Layer

A resin layer, with or without filler, or reinforcement, or both, applied to the exterior surface of the pipe structural wall.

3.3 Liner

A resin layer, with or without filler, or reinforcement, or both, forming the interior surface of the pipe.

3.4 End Point

The passage of the fluid through the pipe wall unless otherwise stated. The failure mode may be catastrophic, characterised by a sudden fracture through the pipe wall in the area of greatest strain, parallel to the axis of the pipe, with the fibre reinforcement cleanly broken at the edge of the fracture, visual evidence of surface etching or pitting may or may not be present.

3.5 Strain Corrosion

The failure of the pipe wall caused by the exposure of the inside surface, while in a strained condition to a corrosive environment for a period of time.

3.6 Tests

3.6.1 *Type Test*

Tests carried out whenever a significant change is made in the design, composition or process of manufacturing and/or at a specified frequency in order to establish the suitability and performance capability of the pipes.

3.6.2 *Acceptance Test*

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

4 CLASSIFICATION

4.1 The pipes have been classified on the basis of pressure rating and stiffness class as given in **4.1.1** and **4.1.2**.

4.1.1 *Pressure Classes (PN)*

Five pressure classes of pipes namely, PN3, PN6, PN9, PN12, and PN15 correspond to the working pressure ratings of 300, 600, 900, 1 200 and 1 500 kPa respectively.

NOTES

1 The working pressure ratings mentioned above may have to be changed for use at fluid temperature greater than 43.5°C in accordance with the manufacturer's recommendations.

2 The above pressure classes correspond to the long term hydrostatic design pressure categories (*see* **15**).

4.1.2 *Stiffness Classes (SN)*

Four stiffness classes of pipes namely A, B, C and D corresponding to minimum pipe stiffness values of 62, 124, 248 and 496 kPa respectively at 5 percent deflection.

5 SIZE DESIGNATION AND NOMINAL DIAMETER

Size designation of the pipe is based on the nominal diameter, *D*. Nominal diameter shall be chosen from those given below:

200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1 000, 1 100, 1 200, 1 400, 1 600, 1 800, 2 000, 2 200, 2 400, 2 600, 2 800, 3 000 mm.

6 MATERIALS

6.1 Resins

Appropriate type of unsaturated polyester resin systems conforming to IS 6746 : 1993 shall be used.

6.2 Glass Fibre Reinforcement

Glass fibre reinforcement shall be of commercial grade E type and shall conform to IS 11273 : 1992, IS 11320 : 1985 or IS 11551 : 1986, as appropriate.

6.3 Other Materials

6.3.1 *Aggregates*

Siliceous sand of a size range between 0.05 mm and 0.8 mm may be incorporated in the composite structure.

6.3.2 *Filler*

Inert fillers (with particle size below 0.05 mm) may be incorporated either on their own or with aggregates.

6.3.3 *Additives*

Additives may be incorporated for modifying the properties of the resin.

7 DIMENSIONS

7.1 Specified Diameter of Pipes

7.1.1 Inside diameters of pipes for each of the size designation shall be as specified in the manufacturer's data sheet current at the time of purchase. The inside diameter so specified shall be within the range given in Table 1 and shall meet the tolerances, as specified.

7.1.1.1 The inside diameter shall be measured in accordance with **A-1.1**.

7.1.2 Alternatively, the outside diameter of pipes for each of the size designation shall be as given in Table 2 subject to the tolerances, as specified.

Table 1 Specified Inside Diameters and Tolerances

(*Clauses* 7.1.1 *and* 7.4)

All dimensions in millimetres.

Nominal Diameter, DN	Inside Diameter Range, ID		Tolerances on Declared ID
	Min	*Max*	
200	196	204	±1.5
250	246	255	±1.5
300	296	306	±1.8
350	346	356	±2.0
400	396	408	±2.4
450	446	459	±2.7
500	496	510	±3.0
600	596	612	±3.6
700	695	714	±4.2
800	795	816	
900	895	918	
1 000	995	1 020	±5.0
1 100	1 095	1 120	
1 200	1 195	1 220	
1 400	1 395	1 420	
1 600	1 595	1 620	
1 800	1 795	1 820	
2 000	1 995	2 020	
2 200	2 195	2 220	±6.0
2 400	2 395	2 420	
2 600	2 595	2 620	
2 800	2 795	2 820	
3 000	2 995	3 020	

Table 2 Specified Outside Diameters and Tolerances

(*Clauses* 7.1.2 *and* 7.4)

All dimesions in millimetres.

Nominal Diameter, DN	Outside Diameter, OD	Tolerance	
200	208	+2.0	
250	259	+2.1	
300	310	+2.3	
350	361	+2.4	
400	412	+2.5	
450	463	+2.7	
500	514	+2.8	
600	614	+3.0	
700	718	+3.3	
800	820	+3.5	
900	922	+3.8	
1 000	1 024	+4.0	− 2.0
1 100	1 126	+4.3	
1 200	1 228	+4.5	
1 400	1 432	+5.0	
1 600	1 636	+5.5	
1 800	1 840	+6.0	
2 000	2 044	+6.5	
2 200	2 248	+7.0	
2 400	2 452	+7.5	
2 600	2 656	+8.0	
2 800	2 860	+8.5	
3 000	3 064	+9.0	

7.1.2.1 The outside diamater shall be measured in accordance with **A-1.2**.

7.2 Lengths

Pipes shall be supplied in effective lengths of 6 m, 9 m and 12 m, A maximum of 10 percent of the pipe section may be supplied in random lenghts. The lengths of the pipe shall be measured in accordance with **A-2.1**.

NOTE — Lengths other than those specified above may be supplied as agreed between the purchaser and the manufacturer.

7.2.1 The tolerance on effective lengths shall be within ±15 mm.

7.3 Out of Squareness of Pipe

All points around each end of a pipe unit shall fall within ± 6.5 mm or ± 0.5 percent of the nominal diameter of the pipe whichever is greater, to a plane perpendicular to the longitudinal axis of the pipe when measured in accordance with **A-3.1**.

7.4 Wall Thickness

The minimum wall thickness at any point shall not be less than the wall thickness specified in the manufacturer's data sheets current at the time of purchase. The manufacturers shall ensure that the wall thickness specified in his data sheet shall be such as to satisfy the inside or outside diameters specified in Table 1 or Table 2 as the case may be and the tests specified in this standard.

7.4.1 Wall thickness shall be measured to an accuracy of 0.1 mm in accordance with **A-4.1**.

8 JOINTS

The pipe shall have a joining system that shall provide for fluid tightness for the intended service condition.

8.1 Unrestrained

Pipe joints capable of withstanding internal pressure but not longitudinal forces.

8.1.1 *Coupling or Socket and Spigot Gasket Joints*

Provided with groove(s) either on the spigot or in the socket to retain an elastomeric gasket(s) that shall be the sole element of the joint to provide watertightness. For typical joint detail (*see* Fig. 1).

8.1.2 *Mechanical Couplings*

8.2 Restrained

Pipe joints capable of withstanding internal pressure and longitudinal forces.

8.2.1 Joints similar to those in **8.1.1** with supplemental restraining elements.

8.2.2 *Butt Joint, with Laminated Overlay*

8.2.3 *Socket-and-Spigot, with Laminated Overlay*

8.2.4 *Socket-and-Spigot, Adhesive Bonded*

8.2.5 *Flanged*

8.2.6 *Mechanical*

8.3 Gaskets

Elastomeric gaskets when used with this pipe shall conform to the requirements of IS 5382 : 1985.

9 WORKMANSHIP

9.1 Workmanship shall be in accordance with good practices as listed in Table 3 and shall meet the acceptance criteria specified.

Table 3 Allowable Defects
(*Clause* 9.1)

Name	Definition	Visual Acceptance Levels
Chip	A small piece broken off an edge or surface	Maximum dimension of break, 6.5 mm
Crack	An actual separation of the laminate, visible on opposite surfaces, and extending through the thickness	None
Crack, surface	Crack existing only on the surface of the laminate	Maximum length, 6.5 mm
Crazing	Fine cracks at or under the surface of a laminate	Maximum dimension of crazing, 25 mm
Delamination, edge	Separation of the layers of material at the edge of a laminate	Maximum dimension, 6.5 mm
Delamination, internal	Separation of the layers of material in a laminate	None
Dry-spot	Area of incomplete surface film where the reinforcement has not been wetted with resin	Maximum diameter, 14 mm
Foreign inclusion (metallic)	Metallic particles included in a laminate which are foreign to its composition	Maximum dimension, 1.5 mm
Foreign inclusion (non-metallic)	Non-metallic particles of substance included in a laminate which seem foreign to its composition	Maximum dimension, 1.5 mm
Fracture	Rupture of laminate surface without complete penetration	Maximum dimension , 29 mm
Air bubble (void)	Air entrapment within and between the plies of reinforcement, usually spherical in shape	Maximum diameter, 3.0 mm
Blister	Rounded elevation of the surface of a laminate, with boundaries that may be more or less sharply defined, somewhat resembling in shape a blister on the human skin	Maximum diameter, 6.5 mm; height from surface not to be outside drawing tolerance
Burned	Showing evidence of thermal decomposition through some discolouration, distortion, or destruction of the surface of the laminate	None
Fish-eye	Small globular mass which has not blended completely into the surrounding material and is particularly evident in a transparent or translucent material	Maximum diameter, 13 mm
Lack of fillout	An area, occurring usually at the edge of a laminated plastic, where the reinforcement has not been wetted with resin	Maximum diameter, 9.5 mm
Orange-peel	Uneven surface somewhat resembling an orange peel	Maximum diameter, 29 mm
Pimple	Small, sharp, or conical elevation of the surface of a laminate	Maximum diameter, 3.0 mm
Pit (pinhole)	Small crater in the surface of a laminate, with its width approximately of the same order of magnitude as its depth	Maximum diameter, 0.8mm; depth less than 20 percent of wall thickness
Porosity (pinhole)	Presence of numerous visible pits (pinholes)	Maximum of 50 pits (pinholes)
Pre-gel	An unintentional extra layer of cured resin on part of the surface of the laminate (The condition does not include gel coats.)	Maximum dimensions, 13 mm; height above surface not to be outside drawing tolerance
Resin-pocket	An apparent accumulation of excess resin in a small localized area within the laminate	Maximum diameter, 6.5 mm

Table 3 — *Concluded*

Name	Definition	Visual Acceptance Levels
Resin-rich edge	Insufficient reinforcing material at the edge of moulded laminate	Maximum 0.8 mm from the edge
Shrink-mark (sink)	Depression in the surface of a moulded laminate where it has retracted from the mould	Maximum diameter 14 mm; depth not greater than 25 percent of wall thickness
Wash	Area where the reinforcement of moulded plastic has moved inadvertently during closure of the mould resulting in resin-rich areas	Maximum dimension, 29 mm
Wormhole	Elongated air entrapment which is either in or near the surface of a laminate and may be covered by a thin film of cured resin	Maximum diameter, 6.5 mm
Wrinkles	In a laminate, an imperfecting that has the appearance of a wave moulded into one or more plies of fabric or other reinforcement material	Maximum length surface side, 25 mm maximum length opposite side, 25 mm depth less than 15 percent of wall thickness
Scratch	Shallow mark, groove, furrow, or channel caused by improper handling or storage	Maximum length, 25 mm; maximum depth, 0.255 mm
Short	In a laminate, an incompletely filled out condition	None

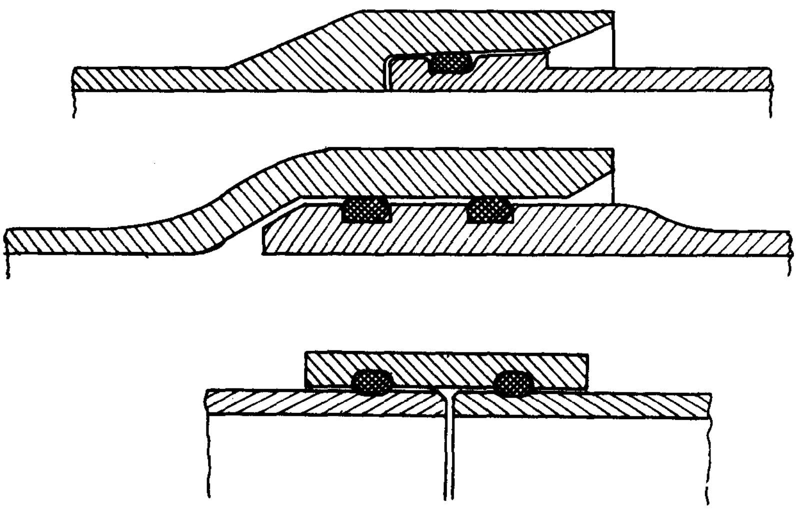

FIG. 1 TYPICAL JOINTS

Table 4 Pipe Stiffness at 5 Percent Deflection
(*Clause* 10.1)

Stiffness Class (SN)	Minimum Stiffness of Pipe of DN, at 5 Percent Deflection, kPa		
	200 mm	250 mm	300 mm and above
A	—	—	62
B	—	124	124
C	248	248	248
D	496	496	496

10 PIPE STIFFNESS

10.1 Each length of pipe shall have sufficient strength to exhibit the minimum pipe stiffness (F/Δ_y) specified in Table 4 when tested in accordance with Annex B

$$\text{Pipe stiffness} = \frac{F}{\Delta_y}$$

where

F = Load per unit length in kN per metre length; and

Δ_y = vertical pipe deflection, in metres.

10.1.1 Pipes shall be capable of being deflected to level 'X' with no visible damage in the test specimen evidenced by surface cracks and to level 'Y' with no indication of structural damage as evidenced by interlaminar separation, separation of the liner or surface layer (if incorporated) from the structural wall, tensile failure of the glass fibre reinforcement and fracture or buckling of the pipe wall, when tested in accordance with Annex B.

Deflection Level	*Ring Deflection Without Damage or Structural Failure, in Percent for Pipe of Stiffness Class*			
	A	B	C	D
Level X	18	15	12	9
Level Y	30	25	20	15

NOTE — This is a visual observation (made with the unaided eye) for quality cantrol purposes only and should not be considered a simulated service test. In actual use this product is not recommended for deflections above 5 percent. Since the pipe stiffness values (F/Δ_X) shown in Table 4 vary, the percent deflection of the pipe under given set of installation conditions will not be constant for all pipes. To avoid possible misapplication, take care to analyze all conditions which might affect performance of the installed pipe.

11 FITTINGS

11.1 General

All GRP fittings, such as bends, tees, junctions and reducers, shall be equal or superior in performance to pipe of the same classification and shall be smoothly finished internally.

GRP fittings are not subject to tests for strength and it is essential that external restraint be considered for installation.

11.2 Fittings Made From Straight Pipe

The fitting shall be fabricated from complete pipes or portions of straight pipe complying with this standard as applicable for the pipe classification. The fitting shall comply with the declared design requirements and be suitably mitred. The mitre shall be overwrapped externally and, if practicable, internally with woven roving and/or chopped strand mat to ensure the longitudinal and circumferential tensile strength is at least equal by design to that of the pipe with which the fitting is to be used.

11.3 Fittings Made by Moulding

Moulded GRP fittings shall be made by hand lay-up, contact moulding, hot or cold press moulding or tape winding.

11.4 Tolerances for GRP Fittings

11.4.1 Except for flanged pipework, which may require closer tolerances, the permissible deviations from the stated value of the angle of change of direction of a fitting such as a bend, tee or junction shall not exceed ±1°.

11.4.2 Except for flanged pipework, which may require closer tolerances, the permissible deviations on the manufacturer's declared length of a fitting, exclusive of the socket where applicable, shall be ±25 mm taken from the point of intersection to the end of the fitting.

12 HYDRAULIC TEST

12.1 General

12.1.1 Working pressure P_w in the system shall not exceed the pressure class of the pipe, that is $P_w \leq PN$.

12.1.2 When surge pressure is considered the maximum pressure in the system due to woking pressure plus surge pressure, the same shall not exceed 1.4 times the pressure class of pipe:

$$P_w + P_s \ngtr 1.4\,PN$$

NOTE — Special design considerations shall be given to sustained surge pressure.

12.2 Soundness

Each length of pipe of nominal diameter upto 1 400 mm shall withstand without leakage or cracking the internal hydrostatic test pressures as specified in Table 5 for the applicable class when tested in accordance with Annex C. For pipes of nominal diameter above 1 400 mm, the frequency of hydrostatic leak tests shall be as agreed between the manufacturer and the purchaser.

Table 5 Hydrostatic Test Pressures

Pressure Class PN	Hydrostatic Test Pressure kPa
3	600
6	1 200
9	1 600
12	2 400
15	3 000

13 LONGITUDINAL STRENGTH

For sizes up to DN 600 the pipe shall withstand, without failure, the beam loads specified in Table 6, when tested in accordance with **D-1**. For pipe sizes larger than DN 600 and alternatively for smaller sizes adequate beam strength shall be demonstrated by tensile tests conducted in accordance with **D-2** for pipe wall specimens oriented in the longitudinal direction. The minimum tensile strength specified in Table 6 shall be complied with.

NOTE — The values listed in Table 6 are the minimum criteria for pipes made to this standard. The values may not be indicative of the axial strength or of the axial strength required by some installation conditions and joint configurations.

Table 6 Beam Strength Test Loads and Longitudinal Tensile Strength of Pipe Wall

Nominal Diameter	Beam Load *P*	Minimum Longitudinal Tensile Strength in kN/m of Circumference, for Pressure Class of				
DN	kN	PN3	PN6	PN9	PN12	PN15
200	3.6	102	102	102	102	102
250	5.3	102	102	102	102	110
300	7.1	102	102	102	112	136
350	9.8	102	102	115	131	154
400	13.3	102	102	130	149	177
450	17.8	102	102	138	159	185
500	19.6	102	102	154	176	205
600	28.5	102	123	184	211	246
700	—	102	140	215	246	280
800	—	102	154	231	265	304
900	—	105	174	260	298	341
1 000	—	122	193	290	331	379
1 100	—	127	212	318	363	417
1 200	—	140	212	318	363	431
1 400	—	164	247	371	423	504
1 600	—	185	283	423	484	574
1 800	—	206	318	476	545	646
2 000	—	231	329	492	563	678
2 200	—	254	361	541	619	745
2 400	—	280	394	591	676	813
2 600	—	301	427	640	732	880
2 800	—	326	459	690	789	949
3 000	—	347	492	739	844	1 016

14 HOOP TENSILE STRENGTH

All pipes manufactured as per this specification shall meet or exceed the hoop tensile strength shown for each size and classs in Table 7, when tested in accordance with Annex E.

Table 7 Minimum Hoop Tensile Strength of Pipe Wall

Nominal Diameter (mm)	Minimum Hoop Tensile Strength in kN/m Width of Circumference for Pressure Class				
	PN 3	PN 6	PN 9	PN 12	P15
200	122	244	366	488	610
250	152	304	456	608	760
300	182	364	546	728	910
350	213	426	639	852	1 065
400	243	486	729	972	1 215
450	273	546	819	1 092	1 365
500	304	608	912	1 216	1 520
600	365	730	1 095	1 460	1 825
700	425	850	1 275	1 700	2 125
800	486	972	1 458	1 944	2 430
900	547	1 094	1 641	2 188	2 735
1 000	608	1 216	1 824	2 432	3 040
1 100	668	1 336	2 004	2 672	3 340
1 200	729	1 458	2 187	2 916	3 645
1 400	851	1 702	2 553	3 404	4 255
1 600	972	1 944	2 916	3 888	4 860
1 800	1 094	2 188	3 282	4 376	5 470
2 000	1 215	2 430	3 645	4 860	6 075
2 200	1 337	2 674	4 011	5 348	6 685
2 400	1 458	2 916	4 374	5 832	7 290
2 600	1 580	3 160	4 740	6 320	7 900
2 800	1 701	3 402	5 103	6 804	8 505
3 000	1 823	3 646	5 469	7 292	9 115

15 LONG TERM HYDROSTATIC DESIGN PRESSURE TEST

The pressure classes given in **4.1.1** shall be based on long term hydrostatic design pressure data obtained in accordance with Annex F of IS 12709 : 1994, and categorized in accordance with Table 8. Pressure classes are based on extrapolated strength at 50 years.

16 CHEMICAL REQUIREMENTS/TESTS

16.1 Chemical Requirements

Pipe specimens, when tested in accordance with **16.2.1**

Table 8 Long Term Hydrostatic Design Pressure Categories

(*Clause* 15)

Pressure Class PN	Minimum Calculated Values of Long term Hydrostatic Design Pressure kPa
3	540
6	1 080
9	1 620
12	2 160
15	2 700

shall be capable of being deflected, without failure, at the 50 year strain level given in Table 9 when exposed to 1.0 N sulfuric acid.

16.1.2 *Control Requirements*

Test pipe specimens periodically in accordance with **16.2.1.3** following the procedure of **16.2.1.4** or alternatively, the procedure of **16.2.1.5**.

16.1.3 When the procedure of **16.2.1.4** is used, the following criteria shall be met:

a) The average failure time at each strain level shall fall at or above the lower 95 percent confidence limit of the originally determined regression line;

b) No specimen-failure times may be sooner than the lower 95 percent prediction limit of the originally determined regression line; and

c) One-third or more of the specimen failure times shall be on or above the originally determined regression line.

NOTES

1 Determine the lower 95 percent confidence limit (LCL) and lower 95 percent prediction limit (LPL) according to the following:

$$h_{LCL} = (a + bf_o) - t_s\sqrt{\frac{(f_o - F)^2}{U} + \frac{1}{N}}$$

$$h_{LPL} = (a + bf_o) - t_s\sqrt{\frac{(f_o - F)^2}{U} + \frac{1}{N} + 1}$$

where

f_o = log of stress (strain) level of interest,

F = arithmetic average of all f values (kPa),

h = logarithm of cycles-to-failure (Procedure A),or hours-to-failure (Procedure B),

H = arithmetic average of all h values, and

N = number of failure points included in the analysis.

2 Of the expected failures at stress (strain) f_o 97.5 percent will occur after h_{LPL}. The average failure time at stress (strain) f_o will occur later than h_{LCL} 97.5 percent of the time.

16.1.4 When the alternative method of **16.2.1.5** is used, failure shall not occur in any specimen.

16.2 Chemical Tests

16.2.1 *Test Method*

Test the pipe in accordance with Annex F.

16.2.1.1 *Long term*

To find if the pipe meets the requirements of **16.1**, determine at least 18 failure points.

16.2.1.2 *Alternative qualification procedure*

Test four specimens each at the 10 and 10 000 h minimum strains given in Table 9 and test five specimens each at the 100 and 1 000 h minimum strains given in Table 9. Consider the product qualified if all 18 specimens are tested without failure for at least the prescribed times given in Table 9 (that is 10, 100, 1 000 or 10 000 h respectively).

16.2.1.3 *Control requirement*

Test at least six specimens in accordance with one of the following procedures and record the results.

16.2.1.4 Test at least 3 specimens at each of the strain levels corresponding to 100 and 1 000 h failure times from the product's regression line established in **16.2.1**.

16.2.1.5 When the alternative method described in **16.2.1.2** is used to qualify the product, test at least three specimens each at the 100 and 1 000 h minimum strains given in Table 9 and for at least 100 and 1 000 h respectively.

16.2.1.6 The control test procedures of **16.2.1.5** may be used as an alternative procedure to the reconfirmation procedure described in Annex F for those products evaluated by the alternative qualification procedure described in **16.2.1.2**.

17 SAMPLING, FREQUENCY AND CRITERIA FOR CONFORMITY

The sampling procedure to be adopted and the criteria for conformity shall be as given in Annex G.

18 MARKING

18.1 Both ends of pipe shall be marked with bold letters not less than 12 mm in height and in a colour and type that remains legible under normal handling and installation procedures. The markings shall include the following:

a) The manufacturer's name or trade-mark,

b) The nominal pipe diameter,

c) Class of pipe (pressure and stiffness), and

d) Batch No. or date of manufacture.

18.2 BIS Certification Marking

Pipes may also be marked with the Standard Mark.

18.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986, and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Table 9 Minimum Chemical Requirements
(*Clause* 16.2.1.2)

Pipe Stiffness	Minimum Strain EScv, at					
kPa	6 min	10 h	100 h	1 000 h	10 000 h	50 years
62	0.97 (t/d)	0.84 (t/d)	0.78 (t/d)	0.73 (t/d)	0.68 (t/d)	0.60 (t/d)
124	0.85 (t/d)	0.72 (t/d)	0.66 (t/d)	0.61 (t/d)	0.56 (t/d)	0.49 (t/d)
248	0.71 (t/d)	0.60 (t/d)	0.55 (t/d)	0.51 (t/d)	0.47 (t/d)	0.41 (t/d)
496	0.56 (t/d)	0.48 (t/d)	0.44 (t/d)	0.41 (t/d)	0.38 (t/d)	0.34 (t/d)

NOTE — *t* and *d* are the nominal total wall thickness and the mean diameter (inside diameter plus *t*) as determined in accordance with A-1.

ANNEX A
(*Clauses* 7.1.1.1, 7.1.2.1, 7.2, 7.3 *and* 7.4.1)

MEASUREMENT OF DIMENSIONS

A-1 MEASURMENT OF DIAMETERS

A-1.1 Inside Diameter

Inside diameter shall be measured at 150 mm away from the each end of the pipe section using a steel tape or an inside micrometer with graduation of 1 mm or less. Make two 90° opposing measurements at each point of measurement and average the readings.

A-1.2 Outside Diameter

A-1.2.1 Outside diameter shall be measured at 150 mm away from the joint seating surface at the outer edge of the pipe.

A-1.2.2 *Principle*
The circumference of the pipe is measured and by dividing by 3.142 (π) diameter is obtained.

A-1.2.3 Measurement shall be done by ordinary flexible tape or flexible tape suitably calibrated to read diameters directly. This tape shall comply with the following requirements:

a) It shall be made of stainless steel or some other suitable material.

b) It shall permit the reading to the nearest 1 mm.

c) It shall be graduated in such a way that neither its own thickness or the graduation has any influence on the result of the measurement, and

d) It shall have sufficient flexibility to conform exactly to the circumference of the pipe.

A-1.2.4 *Procedure*

Apply the tape on the whole of the circumference perpendicular to the axis of the pipe.

A-2 LENGTH

A-2.1 Length shall be measured with a steel tape having graduations of 1 mm or less. Lay the tape inside the pipe and measure the effective length of the pipe

A-3 SQUARENESS OF PIPE END

A-3.1 Rotate the pipe on a mandrel or trunnions and measure the runout of the ends with a dial indicator. The total indicated reading is equal to twice the distance from a plane perpendicular to the logitudinal axis of the pipe. Alternatively when squareness of pipe ends is rigidly fixed by tooling, the tooling may be verified and reinspected at frequent intervals to ensure that the squareness of the pipe ends is maintained within the specified tolerances.

A-4 WALL THICKNESS

A-4.1 Measure with a micrometer caliper or other suitable thickness measuring device or instrument with graduation of 0.1 mm or less and take a series of four measurements equally spaced around the circumference of the pipe after removing the liner where provided. These measurements should be taken before end joint surface machining is done and some distance away from the pipe end. The average of all measurements shall meet or exceed the minimum value specified in manufacturer's data sheet.

ANNEX B

(*Clauses* 10.1 *and* 10.1.1)

TEST FOR PIPE STIFFNESS

B-1 PROCEDURE

B-1.1 Determine the pipe stiffness (F/Δ_y) at 5 percent vertical deflection for the specimen using the apparatus and procedure described in **B-1.2**, **B-1.3** and **B-1.4**.

B-1.2 The apparatus shall consist of two parallel steel plates between which the test specimen is placed, and a means of uniform loading the pipe with a vertical load. (*see* Fig. 2)

B-1.3 Load the specimen to 5 percent deflection within 2 min. Record the load.

B-1.4 Calculate the pipe stiffness using the formula given in **10.1**.

B-1.5 Load the specimen further to deflection level 'X' as per **10.1.1** and examine the specimen for visible damage evidenced by surface cracks. Then load the specimen to deflection level 'Y' as per **10.1.1** and examine for evidence of structural damage, as evidenced by interlaminar separation, separation of the liner or surface layer (if incorporated) from the structural wall, tensile failure of the glass fibre reinforcement and structure or bukling of the pipe wall.

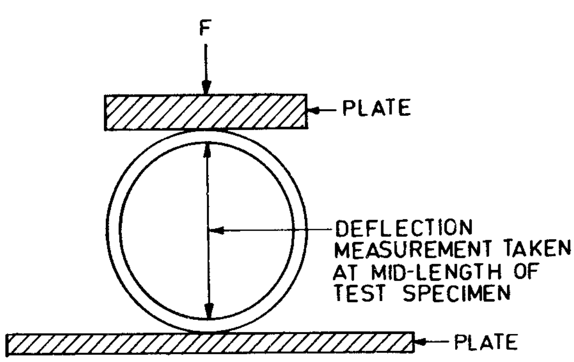

FIG. 2 SCHEMATIC DIAGRAM OF APPARATUS FOR DETERMINATION OF PIPE STIFFNESS

ANNEX C
(*Clause* 12.2)

SOUNDNESS OF PIPE

C-1 PROCEDURE

Soundness shall be determined by a hydrostatic proof test. Place the pipe in a hydrostatic pressure testing machine that seals the ends and exerts no end loads. Fill the pipe with water expelling all air and apply internal water pressure at a uniform rate not to exceed 300 kPa/s until the hydrostatic test pressure specified in accordance with **12.2** *and* Table 5 is reached. Maintain this pressure for 1 min. The pipe shall show no visual signs of weeping, leakage or fracture of the structural wall.

ANNEX D
(*Clause* 13)

LONGITUDINAL STRENGTH

D-1 BEAM STRENGTH

Place a 6 m effective length of pipe on saddles at end. Hold the ends of the pipe round during the test. Apply beam load for the diameter of pipe shown in Table 6 simultaneously to the pipe through two saddles located at the third points of the pipe (*see* Fig. 3). The loads shall be maintained for not less than 10 min with no evidence of failure. The testing apparatus shall be designed to minimize stress concentrations at the loading points.

D-2 LONGITUDINAL TENSILE STRENGTH

D-2.1 General

This method describes the test procedure to determine the longitudinal tensile strength of a reinforced plastics pipe by means of a tensile strength test carried out on strip cut from the pipe.

D-2.2 Apparatus

D-2.2.1 A tensile machine capable of indicating the force applied to the test piece with an accuracy of ±1 percent of the indicated value.

D-2.2.2 A means of measuring the width and thickness of the test piece to an accuracy of 0.1 mm.

D-2.3 Test Pieces

D-2.3.1 The test piece shall be strips cut from a pipe in the longitudinal direction and profiled to the dimensions shown in Fig. 4.

A minimum of three test pieces are required.

NOTE — If profile cutting is impractical, parallel-sided test pieces of width between $2e$ and $3e$ (*see* Fig. 4) shall be used, where e is the thickness of the test piece.

D-2.4 Test Conditions

Conduct the test at ambient temperature.

D-2.5 PROCEDURE

D-2.5.1 Measure the width w and thickness of the piece at the centre of the guage length and at points within 5 mm of each end of the guage length. Record the average width as w and the average thickness as e.

D-2.5.2 Grip the test piece in the testing machine with the test piece centreline along the loading axis of the machine.

D-2.5.3 Load the test piece by separating the grips at a rate to ensure failure occurs between 1 min and. 3 min. Record the maximum force as F.

D-2.5.4 Repeat **D-2.5.1** to **D-2.5.3** until three results have been obtained. Discard any test piece that breaks other than across the neck and test additional test pieces until three results are obtained.

D-2.6 Calculation

For each test piece, calculate the longitudinal tensile strength of the pipe per unit circumference T (in kN/m) using the following equation:

$$T = \frac{F}{w}$$

where

F = failure force in N, and

w = width of test piece in mm.

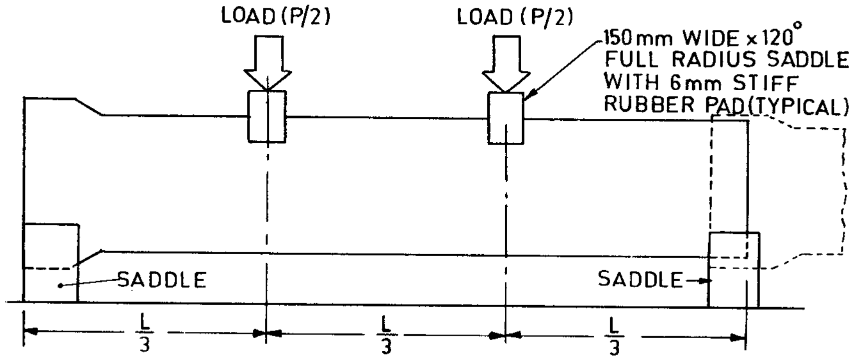

FIG. 3 BEAM STRENGTH — TEST SETUP

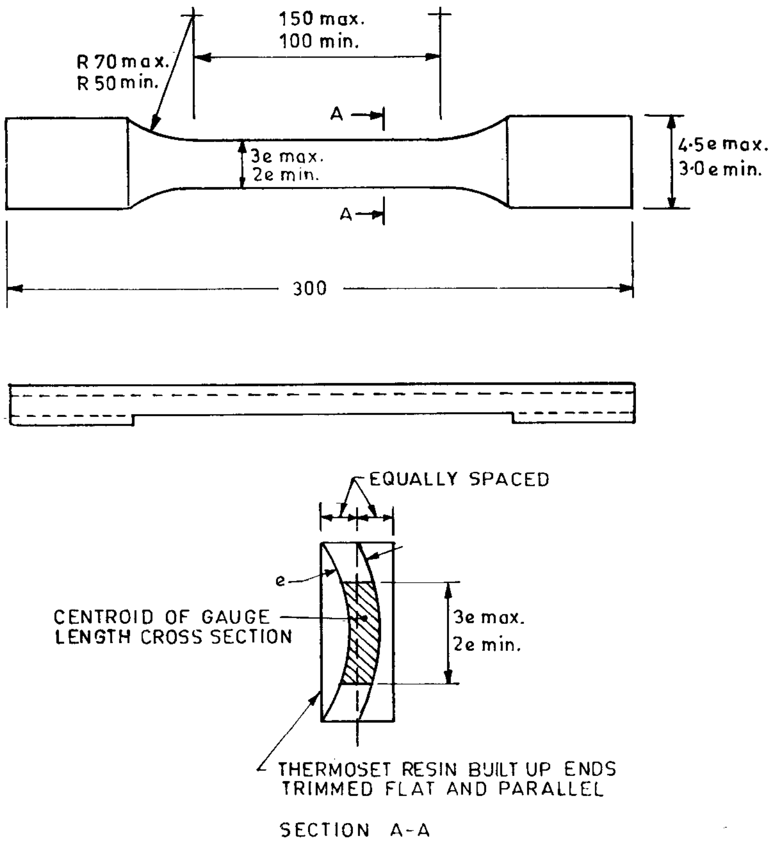

FIG. 4 STRIP TEST PIECES FOR DETERMINATION OF LONGITUDINAL TENSILE STRENGTH

ANNEX E
(*Clause* 14)

HOOP TENSILE STRENGTH

E-1 GENERAL

E-1.1 This method describes the test procedure to determine the hoop tensile strength of a reinforced plastics pipe by means of a split disc test.

E-2 APPARATUS

E-2.1 A testing machine capable of producing a progressive rate of separation of the split discs to produce failure of the test piece within 1 min to 3 min of initial loading.

E-2.2 Rigid split discs similar to those shown in Fig. 5 that make even contact with the internal diameter of the test piece and that immediately prior to the test piece being loaded are not separated by more than 1 percent of the pipe diameter.

E-2.3 A force indicator capable of measuring the force applied with an accuracy of ±3 percent.

E-2.4 A suitable means of measuring the width and thickness of the test piece with an accuracy of ±0.1 mm.

E-3 TEST PIECES

E-3.1 The test piece (*see* Fig. 6) shall be a ring cut from a pipe. The minimum width of the test piece shall be 8 mm; the maximum width is dependent on the method of manufacture and the testing equipment available. The width of the test piece shall not exceed the width of the split disc. A minimum of three test pieces shall be taken to obtain a reliable average result.

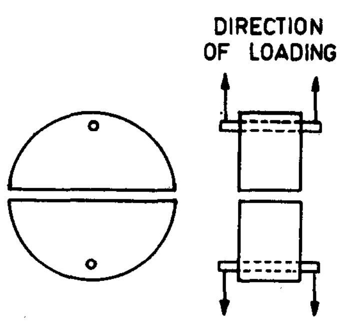

FIG. 5 SPLIT DISC

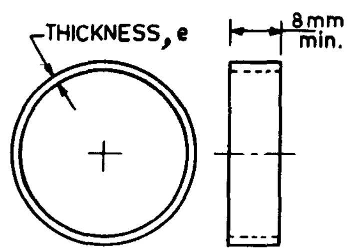

FIG. 6 SPLIT RING TEST PIECE

E-4 TEST CONDITIONS

Conduct the test at ambient temparature.

E-5 PROCEDURE

E-5.1 Measure the width and thickness of the test piece at diametrically opposed points.

E-5.2 Mount the test piece on the outside periphery of the split disc test fixture with the points of measurement at the split.

E-5.3 Load the test piece by separating the mounts at a rate not exceeding 2.5 mm/min ensuring failure to occur between 1 min and 3 min and record the maximum force F resisted by the test piece and the time to failure.

E-6 CALCULATION

E-6.1 For each test piece, calculate the apparent hoop tensile strength at failure σ_{gi} (in kN/m) from the following equation:

$$\sigma_{gi} = \frac{F}{2w \operatorname{Sin}^2 \theta}$$

where

F = failure load (in N);

w = width of the test piece (in mm); and

θ = plane angle between hoop oriented reinforcement and longitudinal axis of the pipe (helix angle).

ANNEX F

(*Clause* 16.2.1)

TEST METHOD FOR CHEMICAL RESISTANCE OF PIPE

F-1 GENERAL

F-1.1 The test method describes the procedure for determining the chemical-resistance properties of fibreglass pipe in a deflected condition. For those products where no long term strain corrosion testing has been performed, the full type testing as described in Method A (*see* **F-7**) shall be performed.

F-1.2 When strain corrosion basis has already been established for a nominally similar pipe using the same manufacturing process, the manufacturer need only conduct the requalification test as described under Method B (*see* **F-8**).

F-2 SIGNIFICANCE AND USE

F-2.1 This test method evaluates the effect of a chemical environment on pipe when in a deflected condition. It has been found that effects of chemical environments can be accelerated by strain induced by deflection. This information is useful and necessary for the design and application of buried fibreglass pipe.

NOTE — Pipe of the same diameter but of different wall thickness will develop different strains with the same deflection. Also, pipes having the same wall thickness but different constructions making up the wall may develop different strains with the same deflection.

F-3 SUMMARY OF TEST METHOD

F-3.1 The test method consists of exposing the interior of a minimum of 18 specimens of pipe to a corrosive test solution while the pipe is constantly maintained in a deflected condition at different strain levels and measuring the time of failure for each strain level. Testing should be carried out at ambient temperatures.

F-3.2 The long term resistance of the pipe to the test solution is obtained by an extrapolatation to 100 000 h or 50 years or both of a log-log linear regression line for initial strain level *versus* time.

F-4 APPARATUS

The apparatus shall consist of two parallel steel plates (channels) between which the test specimen is placed, and a means of uniformally loading the pipe with a vertical load. The apparatus should be suitable to maintain a constant deflection on the pipe. In order to achieve uniform strain along the pipe, 6 mm thick elastomeric pad should be used between parallel plates surfaces and the pipe ring. An example of the apparatus is shown in Fig. 7.

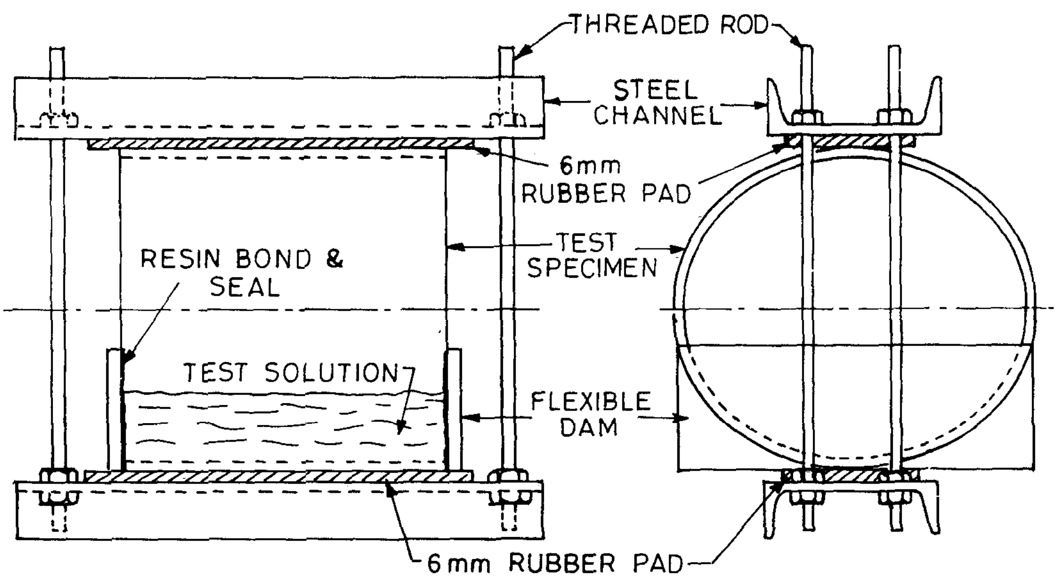

FIG. 7 STRAIN-CORROSION TEST APPARATUS

F-5 TEST SPECIMEN

The test specimen shall have a minimum length of one nominal pipe diameter or 300 mm, whichever is less.

F-6 TEST CONDITION

Test shall be carried out at ambient temperatures.

F-7 SUMMARY OF METHOD A

F-7.1 Procedure consists of exposing a minimum of 18 specimens of pipe to constant strain level at differing pressure levels and measuring the time to failure for each strain level.

F-7.2 Measure the wall thickness to the nearest 0.025 mm in at least five equally spaced places along the bottom of the pipe specimen on a line parallel with the pipe axis and average the measurements.

F-7.3 Measure the vertical inside diameter to the nearest 0.25 mm at both ends prior to deflection and average the measurements.

NOTE — Vertical inside diameter shall be measured with the axis vertical.

F-7.4 Place the pipe specimen in the test apparatus with the measured wall thickness at the bottom and apply force to the apparatus to deflect the specimen while keeping the top and bottom plates of the apparatus as near parallel as possible. When the desired deflection is obtained, lock the apparatus to maintain the specimen in the deflected condition.

NOTE — Alignment of the specimen within the channels is critical. The channels must not only be parallel with the load points 180° opposite but the pipe must be centred between the rods.

F-7.5 Measure the vertical inside diameter of the deflected pipe specimen at both ends to the nearest 0.25 mm. Average the measurements and determine, the deflection by substracting the avarage vertical inside diameter after deflection from the measurement determined in **F-7.3**.

F-7.6 Calculate the initial strain level using the following equation which includes compensation for increased horizontal diameter with increasing deflection or strain initial level can be directly obtained from the readings of these strain gauges placed one in the middle and the other two at the quarter points along the invert of the specimen. Strain gauge readings should be recorded within 2 min, after locking the apparatus.

$$\varepsilon_T = 428\ (t)\ (\Delta)\ /\ (D_m + \Delta/2)^2$$

where

ε_T = Initial strain, percent,

t = Average wall thickness at bottom, in mm,

Δ = Average deflection, in mm,

D_m = Mean diameter, in mm,
= $D + t$, and

D = Average inside pipe diameter, free state, in mm.

NOTE — Deflection in excess of 28 percent of diameter may cause local flattening of the pipe and lead to erratic strain distribution. For deflections approaching 28 percent, improved accuracy is obtained by use of strain gauges or by establishing for a typical pipe a calibration of deflection *versus* measured strain.

F-7.7 When using strain gauges, verify the strain levels using the formula also, or when using formula, verify the results by strain gauges also for at least one specimen in every nine.

If the calculated strain and the indicated strain do not vary more than 10 percent, consider strain levels accurate.

F-7.8 After the initial strain is obtained install chemically inert dams using a flexible sealant so that only the interior surface of the pipe will be exposed to the test environment. The dam shall not add support to the pipe specimen.

F-7.9 Place the apparatus containing the specimens in a chemically resistant trough or pan and introduce the test solution. The solution should be added within 30 min of locking the apparatus and the time noted accordingly.

CAUTION — Since the failure mode could be catastropic, precautions should be taken to contain any sudden leakage that can occur by using spacers under the apparatus to reduce attack of apparatus after failure of the sample.

F-7.10 Periodically check and maintain the test solution within ±5 percent of the specified strength for the duration of the test.

F-7.11 Record the following data:

i) Average pipe wall thickness;

ii) Average inside pipe diameter before deflection;

iii) Average inside pipe diameter after deflection;

iv) Percent deflection;

v) Initial strain and method of determination;

vi) Type, location and time of any distress of the pipe wall;

vii) Time to end point. Times are measured from the addition of the solution.

F-7.12 To determine the regression line and the lower confidence level for the report, a minimum of 18 samples is required.

Distribution of data points should be as under:

Hours	*Failure Points*
10 – 1 000	At least 4
1 000 – 6 000	At least 3
6 000 – 10 000	At least 3
After 10 000	At least 1

F-7.13 Perform inspection of the test samples as follows:

Hours	*Inspection At least*
10 to 20	Every hour
20 to 40	Every 2 h
40 to 60	Every 4 h
60 to 100	Every 8 h
100 to 600	Every 24 h
600 to 6 000	Every 48 h
After 6 000	Every week

Record the time to end point for each specimen.

F-7.14 Analyze the test results by using for each specimen the logarithm of the strain in percent and the logarithm of the time to failure as described in **F-11** of IS 12709 : 1994. Calculate the strain at 100 000 h and at 50 years.

F-7.15 Those specimens that have not failed after more than 10 000 h may be included as failures to establish the regression line.

F-7.16 Determine the final line for extrapolation to 100 000 h by the method of least squares using all end points along with those non-failure points. Calculate the lower confidence limit at 100 000 h using the least square method, in accordance with **F-12** of IS 12709 : 1994.

F-7.17 If M is zero or negative or b in the equation $h = a + bf$ is positive, consider the data unsuitable.

F-7.18 If the lower confidence value at 100 000 h differs from the extrapolated value at 100 000 h by more than 15 percent, consider the data unsuitable.

F-7.19 Plot time to failure *vs* strain on log-log diagram, in accordance with **F-7.16**, with time plotted on the horizontal (x) axis and strain plotted on the vertical (y) axis.

F-8 SUMMARY OF METHOD B (RECONFIRMATION OF STRAIN CORROSION REGRESSION LINE)

F-8.1 When a piping product has an existing strain corrosion regression line, any significant change in material, manufacturing process, construction or liner thickness will necessitate a screening evaluation as described in **F-8.2**, **F-8.3**, **F-8.4**, **F-8.5** and **F-8.6**.

F-8.2 Obtain failure points for at least two sets of specimens, each set consisting of three or more specimens, tested at the same strain level, as follows:

Hours to Failure	*Failure Points*
10 to 200	At least 3
More than 1 000	At least 3
Total :	At least 6

Include as failure those specimens which have not failed after 3 000 h provided they exceed the existing regression line.

F-8.3 Calculate and plot the 95 percent confidence limits and the 95 percent prediction limits of the original regression line in accordance with **F-13** of IS 12709 : 1994.

NOTE — Prediction limit define the bounds for single observation, whereas confidence limits define the bounds for the regression line.

F-8.4 Consider any changes in material or manufacturing process minor and permissible if the results of **F-8.2** meet the criteria given in **F-8.4.1** to **F-8.4.3**.

F-8.4.1 The average time to failure for each strain level falls on or above the 97.5 percent lower confidence limit of the original regression line.

F-8.4.2 The earliest individual failure time at each strain level falls on or above the 97.5 percent lower prediction limit of the original regression line.

F-8.4.3 The failure points are distributed about the originally determined regression line. No more than two thirds of the individual failure points may fall below the original regression line.

F-8.5 Alternative to **F-8.4**, consider any changes in material or manufacturing process permissible if the results of **F-8.2** meet the criteria given in **F-8.5.1** and **F-8.5.2**.

F-8.5.1 All data points fall above the 97.5 percent lower confidence limit of the original regression line.

F-8.5.2 At least two points exceed 3 000 h failure time.

F-8.6 Data meeting the criteria of **F-8.4** or **F-8.5** may be assumed to be part of the original data set and a new regression line determined using all failure points.

F-8.7 If the data fails to satisfy the criteria of **F-8.4** or **F-8.5** the changes are considered major and a new regression line shall be established. While the new test programme is being conducted, an interim strain corrosion value for the material or process change may be taken as the lower of:

a) The 97.5 percent lower confidence limit of the value obtained by extrapolating the failure points of **F-8.2** to 438 000 h (50 years) by the procedure described in **F-7.14**.

b) The 97.5 percent lower confidence limit of the original regression line at 50 years.

F-9 REPORT

F.9.1 The report shall include the following.

F-9.1.1 Complete identification of the pipe wall composition, manufacturers' code, size and minimum wall thickness and the test procedure used.

F-9.1.2 Notations of any type of distress observed in the specimen, whether it be discolouration, leakage, small fracture, surface crazing or complete cracking together with the time and date of occurrence and the location of distress. Indicate the location of distress using the bottom centre as the reference point.

F-9.1.3 *Complete Description of the Test Solution*

F-9.1.4 *Test Temperature*

F-9.1.5 *Graph of* **F-7.19**

F-9.1.6 *Strain at 100 000 h (see* **F-7.14**)

F-9.1.7 *Lower Confidence Limit at 100 000 h*

F-9.1.8 *Strain at 50 Years*

ANNEX G
(*Clause* 17)

SAMPLING AND FREQUENCY AND CRITERIA FOR CONFORMITY

G-1 ACCEPTANCE TESTS

G-1.1 One pipe selected at random from a lot (*see* **G-1.2**) shall be checked for conformance to the dimensions (7), workmanship (9), stiffness (10) longitudinal strength test (13), and hoop tensile strength (14).

The lot shall be declared as conforming to the requirements of this specification, if the sample pipe meets requirements of all the tests, otherwise not.

G-1.2 Unless otherwise agreed upon between the purchaser and the supplier, one lot shall consist of 100 lengths or part thereof, of same pressure class, stiffness class, and size of pipes produced under relatively uniform composition and condition of manufacture.

G-2 TYPE TEST

G-2.1 Sampling for type test is not required unless otherwise agreed upon between the manufacturer and the purchaser. Test certificates shall be furnished when requested by the purchaser, for the following:

i) Long term hydrostatic design pressure test (15), and

ii) Long term chemical requirement test (16).

G-2.2 Type tests shall be performed whenever a significant change is made in the design, composition or process of manufacture. Even if no changes are envisaged, the frequency of the type test shall be at least once in three years.

ANNEX H

(*Foreword*)

COMMITTEE COMPOSITION

Plastic Pipes and Fittings Sectional Committee, CED 50

Chairman	*Representing*
SHRI K. PRABHAKRA RAO	Engineer-in- Chief's Branch (Ministry of Defence), New Delhi
Members	
SHRI GULAM AHMED	Public Health Engineering Zone, Government of Karnataka
SHRI S. S. BHANDARI	Wavin India Ltd, Ghaziabad
CHIEF ENGINEER (PPR&D)	U. P. Jal Nigam, Lucknow
MATERIALS MANAGER (*Alternate*)	
CHIEF ENGINEER (DESIGNS)	Central Pulic Works Department, New Delhi
SUPERINTENDING ENGINEER (S&S) (*Alternate*)	
SHRI R. C. CHOUDHRY	Office of the Chief Engineer, Public Health, Bhubaneshwar, Orissa
SHRI M. S. DATT	Polyolefins Industries Ltd, Bombay
SHRI N. N. SHAH (*Alternate*)	
DEPUTY CHIEF ENGINEER	Public Health Engineering Department, Government of Kerala, Trivandrum
DIRECTOR (MATERIALS MANAGEMENT)	Delhi Development Authority, New Delhi
SUPERINTENDING ENGINEER (DESIGNS) (*Alternate*)	
SHRI R. B. DOCTOR	Ahmedabad Municipal Corporation, Ahmedabad
SHRI R. A. PATEL (*Alternate*)	
ENGINEERING DIRECTOR	Tamil Nadu Water Supply and Drainage Board, Madras
CHIEF ENGINEER (WESTERN REGION) (*Alternate*)	
EXECUTIVE DIRECTOR	PVC Pipe Development Organization, New Delhi
HYDRAULIC ENGINEER	Municipal Corporation of Greater Bombay, Mumbai
DEPUTY HYDRAULIC ENGINEER (*Alternate*)	
SHRI M. S. IDNANI	Garware Plastics and Polyester Ltd, Mumbai
SHRI C. P. SATHE (*Alternate*)	
SHRI V. K. JAIN	Public Health Engineering Department, Government of Rajasthan, Jaipur
SHRI M. K. M. JOSHI (*Alternate*)	
SHRI K. L. KHANNA	EPC Industries Pvt Ltd, Mumbai
SHRI VINAYAK V. SHEMBEKAR (*Alternate*)	
SHRI G. K. LALCHANDANI	Central Institute of Plastics Engineering and Technology, Madras
DR A. P. DAS (*Alternate*)	
SHRI WILLIAM MENDONCA	Supreme Industries Ltd, Mumbai
SHRI H. D. YADAV (*Alternate*)	
LT COL L. P. DASIKA	Ministry of Defence, New Delhi
SHRI R. N. SINHA, AEE (*Alternate*)	
SHRI K. P. NANAVATY	Reliance Industries Ltd, Mumbai
DR Y. N. SHARMA (*Alternate*)	
DR R. PARMASIVAM	National Environmental Engineering Research Insitute (CSIR), Nagpur
SHRIMATI S. S. DHAGE (*Alternate*)	
DR S. M. PATEL	Institute of Co-operative Management, Ahmadabad
DR M. K. PANDEY (*Alternate*)	
SHRI S. PRAKASH	Delhi Water Supply and Sewage Disposal Undertaking, Delhi
CHIEF ENGINEER (C) (*Alternate*)	
SHRI RAJENDRA PRASAD	Directorate General of Supplies and Disposals, New Delhi
SHRI JAY KUMAR (*Alternate*)	
SHRI P. S. RAJVANSHI	Central Public Health and Environment Engineering Organization (Ministry of Works and Housing), New Delhi
SHRI M. S. NARAYANAN (*Alternate*)	
DR P. S. RANA	Housing and Urban Development Corporation Ltd, New Delhi
SHRI K. SUBRAMANIAM (*Alternate*)	

(*Continued on page* 19)

(*Continued from page* 18)

Members	*Representing*
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DR DHANANJAY RAU	Finolex Industries Limited, Pune
SHRI B. B. NANIWADEKAR (*Alternate*)	
SHRI L. K. AGARWAL	Central Building Research Institute (CSIR), Roorkee
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