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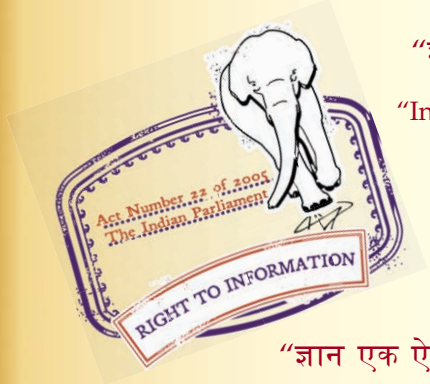
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 4985 (2000): Unplasticized PVC Pipes for Potable Water Supplies - [CED 50: Plastic Piping System]

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Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"


"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 4985:2000

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भारतीय मानक

# पेय जल की पूर्ति के लिए असुघट्यित पी. वी. सी. पाइप – विशिष्टि

( तीसरा पुनरीक्षण )

*Indian Standard*

# UNPLASTICIZED PVC PIPES FOR POTABLE WATER SUPPLIES — SPECIFICATION

*( Third Revision )*

First Reprint MARCH 2005

ICS 83.140.30, 91.140.60



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

*May* 2000 **Price Group 9**

# AMENDMENT NO. 1 MARCH 2006
# TO
# IS 4985:2000 U1VPLASTICIZED PVC PIPES FOR POTABLE WATER SUPPLIES — SPECIFICATION

***(Third Revision)***

( *Third cover page, Foreword, para* 7 ) — Insert the following new para at the end.

'These pipes can be used for agricultural uses also.'

( *Page* 1, *clause* 1.3, *Note* ) — Delete.

( *Page* 3, *clause* 6.2 ) — Insert the following new clause at the end:

**'6.3** Conformity of pipes to this standard is tested by carrying out the tests specified in this standard. Pipes meeting the requirements of these tests are deemed to meet the requirements of the standard.'

( *Page* 4, *clause* **7.1.2**, *para 1, line* 1 ) — Insert '(both for solvent cementing and elastomeric sealing ring joints)' after 'pipe'.

{ *Page* 4, *clause* **7.1.2**, *para 2, line* 1 ) — Insert 'The above' before 'wall' and substitute 'three' *for* 'two'.

( *Page* 4, *clause* **7.1.2**, *para* 2, *line 2* ) — Substitute 'IS 12235 ( Part 1)' *for* 'IS 12235 ( Part 2 )'

( *Page* 5, *Table* 1, *col* 4 *and* 5, *col heading* ) — Substitute 'Outside

Diameter at Any Point[1)] *for* 'Outside Diameter at Any Point'.

(P*age 5, Table* 1, *col 6 to* 23, *col heading* ) — Substitute **'wail Thickness**,

mm *'for* "**Working Pressure, MPa**'.

( *Page* 5, *Table* 1, *col* 6, 7 *and* 8, *sub-heading* ) — Substitute '0,25 MPa' *for* '0.25

( *Page* 5, *Table I, col* 9, 10 *and* 11, *sub-heading*) — Substitute '0.40 MPa' *for* '0.40'.

(*Page* 5, *Table I, col* 12,13 *and* 14, *sub-heading)* — Substitute '0.60 MPa' *for '0.60'*

( *Page* 5, *Table* 1, *col* 15,16 *and* 17, *sub-heading* ) — Substitute '0.80 MPs' for '0.80'

**Price Group 2**

( *Page 5, Table* 1, *col* 18, 19 *and* 20, *sub-heading* ) — Substitute '1.00 MPa' *for* '1.00'.

( *Page* 5. *Table I, col* 21, 22 *and* 23, *sub-heading*) — Substitute '1.25 *MP*a *for* '1.25'.

( *Page* 5, *Table I, col* 3 ) — Substitute '25.3' *for* '25.0' against the nominal outside diameter of 25.

( *Page* 5, *Table* 1, *col* 12 ) —, Substitute '2.7' *for* '3.7' against the nominal outside diameter of 63.

{ *Page* 5, *Table* 1, *col* 11 ) — Read the misprint as '2.2' against the nominal outside diameter of 75.

( *Page 5, Table I, col* 12 ) — Substitute '6.2' *for* '6.3' against the nominal outside diameter of 160.

( *Page* 5, *Table* 1, *col* 15 ) — Substitute '12.6' *for* '12.4' against the nominal outside diameter of 250.

( *Page* 5, *Table* 1, *Notes, last line* ).— Substitute [1)] For class 1, 2 and 3 ……cases' *for* 'For class 1, 2 and 3 ……. cases.'

[ *Page* 6, *Fig.* 2(b), *Title* ] — Substitute 'SOCKETED PIPE FOR ELASTOMERIC SEALING RING JOINT' for the existing.

( *Page 1, clause* **7.2.1.2**, *lines* 1 *to* 6 ) — Substitute following for the existing:

'These shall conform to the dimensions given in Table 4 and Fig. 4. The wall thickness of elastomeric sealing ring type sockets at any point, except the sealing ring groove, shall not be less than the minimum wall thickness of the connecting pipe. The wall thickness of the sealing ring groove shall not be less than 0.8 times the minimum wall thickness of connecting pipe.'

[ *Page* 7, *clause* **7.2.1.2(b),** *last line)* — Substitute 'Table *T for* 'Table 6'.

[ *Page* 7, *clause* **7.2.1.2(c**) ] — Delete.

( *Page* 8, *Fig.* 4 ) — Substitute *'$d_{im}$' for '$d_i$'*

(*Page* 8, *clause* **10.1**) — Insert the following at the end of the clause:

'The pipes may also be supplied in any other colour as agreed to between the buyer and seller.'

(*Page* 8, *clause* **10.2** ) — Insert the following at the end of the clause:

'The convex (outer) surface of the pipe specimen shall face the light source.'

( *Page* 8, *clause* **10.3**, *line* **4** ) — Delete 'IS 12235 (Part 11)'.

( *Page* 9, *Table 4, Title )* — Substitute 'Elastomeric' *for* 'Elastometric'.

(*Page 9, Table 4, col 2)* — Substitute '502.6' *for* '502.1' and *'633.1' for* '632.3' against Nominal Outside Diameters 500 and 630 respectively.

(*Page 9, clause* **10.5** ) — Substitute the following for the existing:

**'10.5 Vicat Softening Temperature**

When tested by the method prescribed in IS 12235 (Part 2), the Vicat Softening Temperature of the specimen shall not be less than 80°C.'

(*Page 9, clause* **10.6**) — Substitute the following for the existing: **'10.6 Density**

When determined in accordance with IS 12235 (Part 14), the density of the pipe shall be between 1.40 and 1.46 gms/$cm^3$.'

(*Page* 10, *clause* **11.1**, *line* 3) — Substitute '( Part 8/Sec 1 *y for* \ Part 8 )'.

(*Page* 10, *clause* **11.1**) — Insert the following before the last sentence:

'When tested in accordance with the method prescribed in IS 12235( Part 8/ Sec 4 ), the joints made with elastomeric sealing ring sockets shall fulfill the requirements given in Table 7.'

**Amend No. 1 to IS 4985 : 2000**

(*Page* 11, *Annex* A ) — Substitute the following for the existing Annex:

**ANNEX A**

(*Clause* 2)

**LIST OF REFERRED INDIAN STANDARDS**

| *IS No.* | *Title* |
|---|---|
| 4669: 1968 | Methods of test for polyvinyl chloride resins Methods for |
| 4905 : 1968 | random sampling |
| 5382: 1985 | Rubber sealing rings for gas mains, water mains and sewers *{first revision)* |
| 10148:1982 | Positive list of constituents of polyvinyl chloride resins and its copolymers for safe use in contact with food-stuffs, pharmaceuticals and drinking water |
| 10151:1982 | Specification for polyvinyl chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water |
| 12231: 1987 | Specification for UPVC (rigid) pipes for use in suction and delivery lines of agricultural pumps |
| 12235 | Thermoplastics pipes and fittings — Methods of test |
| (Part 1): 2004 | Measurement of dimensions |
| (Part 2): 2004 | Determination of Vicat softening temperature |
| (Part 3 ): 2004 | Test for opacity |
| (Part4):2004 | Deteimining the detrimental effect on the composition of water |
| (Part 5): 2004 | Longitudinal reversion |
| (Part 8/Sec 1): 2004 | Resistance to internal hydrostatic pressure, Section 1 Resistance to internal hydrostatic pressure at constant internal water pressure |
| ( Part 8/Sec 4 ): 2004 | Resistance to internal hydrostatic pressure, Section 4 Leak tightness of elastomeric sealing ring type socket joints under positive internal pressure without angular deflection |
| (Part 10) : 2004 | Detennination of organotin as tin aqueous solution |
| (Part 14): 2004 | Determination of density/relative density (specific gravity) |
| 12818 : 1992 | Unplasucized PVC screen and casing pipes for bore/tube - well - Specification *{first revision)* |

(*Page* 11, *clause* **B-3.1**) — Substitute the following for the existing:

'**B-3.1** Silica or platinum crucible inert to the material tested. The size shall be sufficient so that the crucible is not more than half filled by the test portion sample.'

(*Page* 13, *clause* **C-4.1.1,** *last sentence*) — Delete.

( *Page* 18, *Table* 15, *col* 6 ) — Substitute '2' *for* V against the value given for Second Sample for Number of Pipes in the lot Up to 10 000.

(**CED** 50)

Reprography Unit, BIS, New Delhi, India

# AMENDMENT NO. 2 APRIL 2007
# TO
# IS 4985 : 2000 UNPLASTICIZED PVC PIPES FOR POTABLE WATER SUPPLIES — SPECIFICATION

***( Third Revision )***

*(Page* 1, *clause* **3.13**, *line* 1) — Substitute *'sbC/or* 'four'.

*(Page* 10, *clause* **11.1**, *line* 4) — Substitute 'temperatures, duration and test pressures' *for* 'temperatures and duration'.

*(Page* 10, *clauses* **13.1, 13.1.1, 13.1.2** *and* **13.1.3**) — Substitute the following for the existing:

**13.1** Each pipe shall be clearly and indelibly marked in colour using ink/paint as per **13.1.1** at intervals of not more than 3 meters. Alternatively, inkjet printing in any contrasting colour can also be used for marking at intervals of not more than 3 metres. The markings shall show the following:

a) Manufacturer's name or trade-mark,
b) Outside diameter,
c) Class of pipe and pressure rating,
d) Batch or lot number, and
e) The word plumbing in the case of plumbing pipes.

**13.1.1** The information according to **13.1** shall be marked in colour as indicated below for different classes of pipes (in the case of indelible marking by ink/paint). In the case of inkjet printing, the pipes shall also be provided near the end with a circumferential colour band as indicated below for different classes of pipes to identify the class of pipe:

| *Class of Pipe* | *Colour* |
|---|---|
| Class 1 | Red |
| Class 2 | Blue |
| Class 3 | Green |
| Class 4 | Brown |
| Class 5 | Yellow |
| Class 6 | Black |
| Plumbring pipes | Pink |

(CED 50)

Reprography Unit, BIS, New Delhi, India

# AMENDMENT NO. 3 JANUARY 2009
# TO
# IS 4985 : 2000 UNPLASTICIZED PVC PIPES FOR POTABLE WATER SUPPLIES — SPECIFICATION

***( Third Revision )***

*(Third cover page, Foreword, lines* 3 *and A)* — Delete.

*(Page* 8, *clause* 10.3, *lines* 8 *to* 10) — Delete '(based Geneva 1984)'.

*(Page* 8, *clause* 10.3, *line* 13) — Substitute '0.05 mg/1 (0.05 ppm by *mass)' for* '0.3 mg/1 (0.3 ppm by mass)'.

(CED 50)

Reprography Unit, BIS, New Delhi, India

Plastic Piping System Sectional Committee, CED 50

FOREWORD

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

This standard (Third Revision) was first issued in 1968 covering pipes of sizes 16 to 315 mm. A revision of the standard was issued in 1981 incorporating dimensions of bell or socket end pipes and pipes suitable for plumbing work in buildings. Provision of reversion test by the oven method as an alternative to the immersion method and additional test on resistance to sulphuric acid were also incorporated. Long-term and short-term hydraulic tests were replaced by internal hydrostatic pressure tests in line with ISO/DIS 4422 'Unplasticized polyvinyl chloride (PVC) pipes and fittings for water supply—Specification'. Sampling clauses were reviewed after carrying out a detailed study of the process of manufacture and statistically analyzing the data collected from the manufacturers of unplasticized PVC pipes. Later, through an amendment, the range of pipe sizes covered was increased up to 630 mm.

The second revision of this standard incorporated further changes made necessary in the light of the experience gained in the use of UPVC pipes in India and technological advancements in the manufacture of these pipes in India and abroad. The changes included additional test methods on determination of cadmium and mercury contents. The opacity test was modified in line with the ISO standard and an alternate test method for determination of opacity was included. Further, the committee responsible for the preparation of that standard felt that the test methods should be published separately in parts to facilitate further review of each part as this would also be in line with ISO procedure. Accordingly, the various test methods were covered in a separate standard IS 12235 (Parts 1 to 11): 1986 'Methods of test for unplasticized PVC pipes for potable water supplies'.

Further technological advancements in this field advocated the inclusion of UPVC pipes with sockets for use with elastomeric sealing rings in this standard. With the advent of globalization and the likelihood of exports, the committee felt that this standard should be brought more in line with ISO 4422 than it is at present. With this in mind, further two classifications have been added. In the light of experience gathered, the oven method for determination of reversion has again been deleted, as has been the test for resistance to sulphuric acid and stress-relief test. Additional tests for specific gravity, Vicat softening temperature and sulphated ash content test, have also been included. The impact resistance test has been modified to be in line with ISO 3127 to the extent possible.

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

| | |
|---|---|
| ISO/161/1-1978 | Thermoplastic pipes for the transport of fluids — Nominal outside diameters and nominal pressures — Part 1 : Metric series |
| ISO/DIS 727-1985(E) | Fittings of unplasticized PVC, chlorinated PVC or ABS with plain sockets for pipes under pressure — Dimensions of sockets — Metric series |
| ISO 2045 : 1988 | Single sockets for UPVC and CPVC pressure pipes with elastic sealing ring type joints — Minimum depths of engagement |
| ISO 3127 : 1994(E) | Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method |
| ISO 3603 : 1977 | Fittings for unplasticized poly vinyl chloride pressure pipes with elastomeric sealing ring type joints — Pressure test for leakproofness |
| ISO 4422 : 1992 | Unplasticized poly vinyl chloride pipes and fittings for water supply Specifications |

*(Continued on last cover)*

# *Indian Standard*

# UNPLASTICIZED PVC PIPES FOR POTABLE WATER SUPPLIES — SPECIFICATION

*( Third Revision )*

## 1 SCOPE

**1.1** This standard covers requirements for plain as well as socket-ended pipes, including those for use with elastomeric sealing rings, for potable water supplies.

**1.2** This standard does not cover unplasticized PVC pipes for use in suction and delivery lines of agricultural pumps,' which have been covered in IS 12231.

**1.3** The pipes covered in this standard are not suitable for use as casing pipes in tube wells. Such pipes are being covered in IS 12818.

NOTE — A separate specification is Under preparation detailing the use of unplasticized PVC pipes for sewerage application. However, UPVC pipes of nominal outside diameter 90 mm and above and of class 3 (0.6 MPa) and above may be used for sewerage application til! such a time the separate specification for sewerage application is published.

## 2 NORMATIVE REFERENCES

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

## 3 TERMINOLOGY

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

### 3.1 Nominal Size (DN)

The numerical designation for the size of a pipe, other than a pipe designated by thread size, which is a convenient round number approximately equal to the manufacturing dimension in millimetres (mm).

### 3.2 Nominal Outside Diameter ( $4_o$)

The specified outside diameter, in millimetres assigned to a nominal size.

### 3.3 Outside Diameter at any Point ($d_e$)

The value of the measurement of the outside diameter of a pipe through its cross section at any point of the pipe, rounded off to the next higher 0.1 mm.

### 3.4 Mean Outside Diameter ( $4_{em}$ )

The quotient of the outer circumference of a pipe and 3.142 *(n)* in any cross-section, rounded off to the next higher 0.1 mm.

### 3.5 Minimum Mean Outside Diameter ($d_{em}$, min)

The minimum value for the mean outside diameter as specified for a given nominal size.

### 3.6 Maximum Mean Outside Diameter ($d_{em}$, max)

The maximum value for the mean outside diameter as specified for a given nominal size.

### 3.7 Mean Inside Diameter at Mid Point of Socket Length ($d_{im}$)

The arithmetical mean of two measured inside diameters perpendicular to each other at the mid point of the socket length.

### 3.8 Out-of-Roundness (Ovality)

The difference between the measured maximum and the measured minimum outside diameter in the same cross-section of the pipe.

### 3.9 Nominal Wall Thickness ( $e_n$)

A numerical designation of the wall thickness of a component which is a convenient round number, approximately equal to the manufacturing dimension in millimetres (mm).

### 3.10 Wall Thickness at any Point ( $e$ )

The value of the measurement of the wall thickness at any point around the circumference of a pipe, rounded off to the next higher 0.1 mm.

### 3.11 Minimum Wall Thickness at any Point ($e_{min}$)

The minimum value for the wall thickness at any point around the circumference of a pipe, rounded off to the next higher 0.1 mm.

### 3.12 Maximum Wall Thickness at any Point ($e_{max}$ )

The maximum value for the wall thickness at any point around the circumference of a pipe, rounded off to the next higher 0.1 mm.

### 3.13 Mean Wall Thickness ( $e_m$)

The arithmetical mean of at least four measurements

regularly spaced around the circumference and in the same cross-section of a pipe, including the measured minimum and the measured maximum values of the wall thickness in that cross-section and rounded off to the next higher 0.1 mm.

**3.14 Tolerance**

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

**3.15 Working Pressure *(PN)***

The numerical designation of a pipe related to the mechanical charcteristics of that pipe used for reference purposes. For plastics piping systems, it corresponds to the allowable operating pressure, in bar, conveying water at 27°C.

**3.16 Allowable Operating Pressure *(PFA)***

The maximum hydrostatic pressure, excluding surge, which is allowed in continuous use with water within the temperature range concerned. It is calculated using the following equation:

$$[PFA] = fT \times [PN]$$

where

fT = derating factor depending on water temperature; and

PN = working pressure.

NOTE — In cases where a further derating (or uprating) factor depending on the application is required:

$$[PFA] = fA \times fT \times [PN]$$

where

fA = factor depending on the application

**3.17 Hydrostatic Stress (a)**

The stress induced in the wall of a pipe when a pressure is applied using water as a medium. The hydrostatic stress is related to the applied pressure, *P*, the wall thickness at any point, *e*, and the mean outside diameter, *d* , of a pipe and calculated using the following approximation equation;

$$\sigma = \frac{P(d_{em} - e)}{2e}$$

where *б* and *P* are in same units.

**3.18 Long-Term Hydrostatic Stress**

The constant hydrostatic stress that is maintained during a sustained period of time.

3.19 Socket-Ended Pipe

Unplasticized PVC pipes whose one end is expanded after heating for the purpose of jointing by solvent cement or jointing using an elastomeric sealing ring, to the plain ends of unplasticized PVC pipes.

**3.20 Tests**

**3.20.1** *Type Tests*

Tests carried out whenever a change is made in the composition or in the size/series in order to establish the suitability and the performance capability of the pipes.

**3.20.2** *Acceptance Tests*

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

**3.21 Virgin Material**

Material in such form as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocess-able or recyclable material(s) have been added.

**3.22 Own Rework Material**

Material prepared from rejected unused pipes, including trimmings from the production of pipes, that will be reprocessed in a manufacturer's plant by a process such as extrusion and for which the complete formulation is known.

**4 NOTATION**

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

| | | |
|---|---|---|
| $d_n$ | = | Nominal outside diameter |
| $d_e$ | = | Outside diameter at any point |
| $d_{em}$ | = | Mean outside diameter |
| $d_{em}$, max | = | Maximum mean outside diameter |
| $d_{em}$, min | = | Minimum mean outside diameter |
| $d_{im}$ | = | Mean inside socket diameter at midpoint of socket length |
| $DN$ | = | Nominal size |
| $e$ | = | Wall thickness at any point |
| $e_m$ | = | Mean wall thickness |
| $e_{max}$ | = | Maximum wall thickness at any point |
| $e_{min}$ | = | Minimum wall thickness at any point |
| $e_n$ | = | Nominal wall thickness |
| $L_o$ | = | Overall length of pipe |
| $L_e$ | = | Effective length of pipe |
| $L_s$ | = | Minimum socket length |
| $PN$ | = | Nominal pressure (Working pressure) |
| $fA$ | = | Derating (or uprating) factor for application |
| $fT$ | = | Derating factor for water temperatures |

p = Material density
$G$ = Hydrostatic stress
$б_s$ = Design stress

## 5 CLASSIFICATION OF PIPES

**5.1** The pipes shall be classified by pressure ratings (working pressures) at 27°C as follows:

| *Class of pipe* | *Working pressure (PN)* |
|---|---|
| Class 1 | 0.25 MPa ( 2.5 kg/cm$^2$) |
| Class 2 | 0.4 MPa ( 4.0 kg/cm$^2$) |
| Class 3 | 0.6 MPa ( 6.0 kg/cm$^2$) |
| Class 4 | 0.8 MPa ( 8.0 kg/cm$^2$) |
| Class 5 | 1.0 MPa (10.0 kg/cm$^2$) |
| Class 6 | 1.25 MPa (12.5 kg/cm$^2$) |

NOTE — The above pipes are recommended for water temperatures ranging from +1 to +45°C. The recommended maximum safe working stress for these pipes is 8.6 MPa at 27°C. At higher temperature up to 45 °C, the strength of the pipe reduces and the working pressure shall be modified in accordance with Fig. I. Occasional rise in temperature as in summer season with concurrent corresponding reduction in temperature during nights has no deleterious effect on the life/working pressure of the pipes considering the total life of pipes.

## 6 COMPOSITION

**6.1** The material from which the pipe is produced shall consist substantially of unplasticized polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of the pipe and the production of sound and durable pipe of good surface finish, mechanical strength and opacity under conditions of use. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic, organoleptic or microbial growth hazard, or materially to impair the fabrication or welding properties of the pipe, or to impair its chemical and physical or mechanical properties (in particular long-term mechanical strength and impact strength) as defined in this Indian Standard. The additives to be used shall be selected from IS 10148 and shall be uniformly dispersed.

**6.1.1** The monomer content (VCM content) in the resin shall be within the limits specified in 3.3.1 of IS 10151, when tested as per Annex A of IS 10151.

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

NOTE—A test report or conformity certificate may be obtained from the resin manufacturer for the VCM content *(see* 6.1.1) and K - value *(see* 6.1.2) of the resin being used, unless the same is tested in an independent laboratory. The frequency of this test report or conformity certificate shall be once in every three months.

**6.2** The addition of the manufacturer's own rework material is permissible. The quantity of the rework material used is to be declared by the manufacturer. No other rework material shall be used.

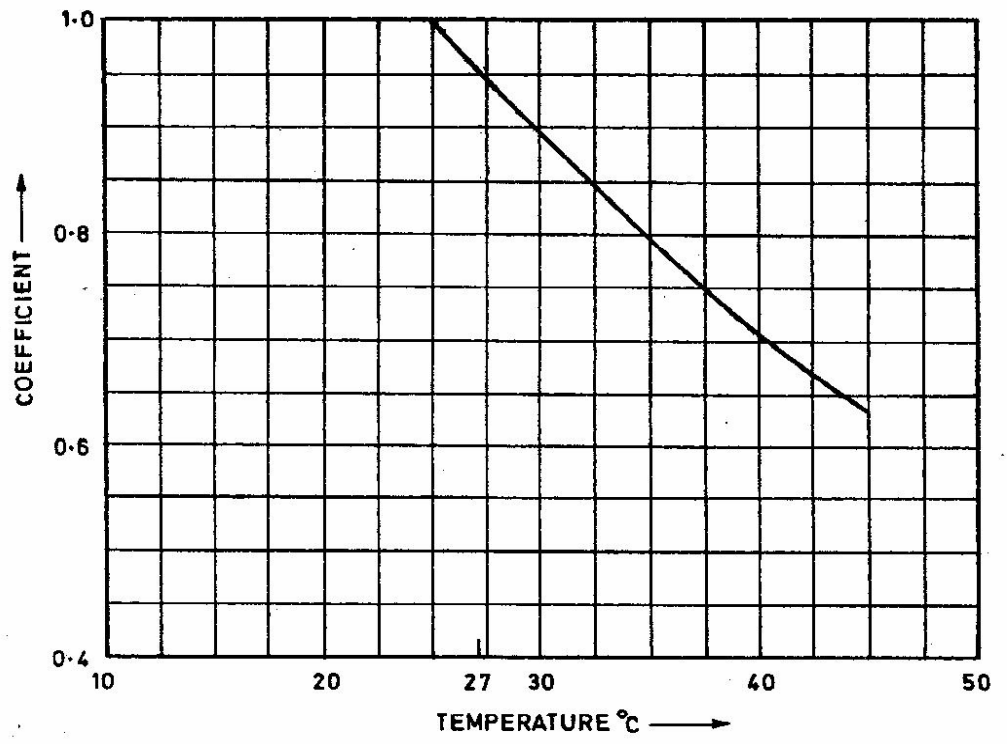



FIG. 1 GRAPH FOR MORE PRECISE CALCULATIONS GIVING THE MAXIMUM CONTINUOUS WORKING PRESSURE (COEFFICIENT) FOR TEMPERATURE UPTO 45°C

## 7 DIMENSIONS

### 7.1 Dimensions of Pipes

**7.1.1** *Diameters*

The mean outside diameter, outside diameter at any point and their tolerances shall be as given in Table 1. This shall be measured according to the method given in IS 12235 (Part 1).

**7.1.1.1** *Mean outside diameters*

The permissible variation ($d_{em}$ - $d_n$) between the mean outside diameter ($d_{em}$' ) and the nominal outside diameter ($d_n$) of a pipe shall be positive in the form +x, where x is less than or equal to the greater of the following two values:

a) 0.3 mm, and
b) 0.003 $d_n$ rounded off to the next higher 0.1 mm.

**7.1.1.2** *Diameter at any point*

The permissible variation between the outside diameter at any point ($d_e$) and the nominal diameter ($d_a$) of a pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

a) 0.5 mm, and
b) 0.012 $d_n$ rounded off to the next higher 0.1 mm.

**7.1.2** *Wall Thickness*

The wall thickness of plain pipe and the plain portion of socket ended pipe shall be as given in Table 1.

Wall thickness shall be measured by any of the two methods given in 2.1.1 and 2.1.2 of IS 12235 (Part 2). To check the conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non-destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

**7.1.2.1** *Tolerance on wall thickness*

a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness ($e_{min}$.) and the wall thickness at any point ($e$), ($e$ - $e_{min}$) shall be positive in the form of +y, where y = 0.1 $e_{min}$ + 0.2mm.
b) For pipes of minimum wall thickness greater than 6 mm, the permissible variation of wall thickness shall again be positive in the form of +y, where y would be applied in two parts.
c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute maximum and the absolute minimum values. The tolerance applied to this average wall thickness from these measurements shall be within the range 0.1 $e_{min}$. +0.2 mm (*see* Table 1).
d) The maximum wall thickness at any point shall be within the range 0.15 e - (*see* Table 1).
e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

7.1.3 The mean outside diameter, outside diameter at any point, and wall thickness of plumbing pipes shall be as given in Table 2.

**7.1.4** *Length*

**7.1.4.1** *Effective length* ($L_e$) — If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 4, 5, or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

a) *Plain ended pipe* — For plain ended pipes, the overall length measured shall be the effective length as shown in Fig. 2(a).
b) *Socketed pipe for elastomeric sealing ring jointing*—The effective length of such pipes shall be determined by subtracting from the overall length the insertion length as shown in Fig. 2(b).
c) *Socketed pipe for solvent cement jointing* — The effective length of such pipes shall be determined by subtracting from the overall length the socket length as shown in Fig. 2(c).

### 7.2 Dimensions of Sockets

**7.2.1** Sockets formed on the ends of the pipes shall be reasonably parallel to the axis of the pipe.

**7.2.1.1** *Sockets for solvent cement jointing* — These shall conform to dimensions given in Table 3 and Fig. 3.

## Table 1 Dimensions of Unplasticised PVC Pipes

(*Clauses* 7.1.1 *and* 7.1.2)

All dimensions in millimetres.

| Nominal Outside Diameter (Nominal Size) | Mean Outside Diameter | | Outside Diameter At Any Point | | Working Pressure, MPa | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Class 1 0.25 | | | Class 2 0.40 | | | Class 3 0.60 | | | Class 4 0.80 | | | Class 5 1.00 | | | Class 6 1.25 | | |
| | *Min* | *Max* | *Min* | *Max* | *Avg Max* | *Min* | *Max* | *Avg Max* | *Min* | *Max* | *Avg Max* | *Min* | *Max* | *Avg Max* | *Min* | *Max* | *Avg Max* | *Min* | *Max* | *Avg Max* | *Min* | *Max* |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) |
| 20 | 20.0 | 20.3 | 19.5 | 20.5 | | | | | | | | | | | | | 1.5 | 1.1 | 1.5 | 1.8 | 1.4 | 1.8 |
| 25 | 25.0 | 25.0 | 24.5 | 25.5 | | | | | | | | | | 1.6 | 1.2 | 1.6 | 1.8 | 1.4 | 1.8 | 2.1 | 1.7 | 2.1 |
| 32 | 32.0 | 32.3 | 31.5 | 32.5 | | | | | | | | | | 1.9 | 1.5 | 1.9 | 2.2 | 1.8 | 2.2 | 2.7 | 2.2 | 2.7 |
| 40 | 40.0 | 40.3 | 39.5 | 40.5 | | | | | | | 1.8 | 1.4 | 1.8 | 2.2 | 1.8 | 2.2 | 2.7 | 2.2 | 2.7 | 3.3 | 2.8 | 3.3 |
| 50 | 50.0 | 50.3 | 49.4 | 50.6 | | | | | | | 2.1 | 1.7 | 2.1 | 2.8 | 2.3 | 2.8 | 3.3 | 2.8 | 3.3 | 4.0 | 3.4 | 4.0 |
| 63 | 63.0 | 63.3 | 62.2 | 63.8 | | | | 1.9 | 1.5 | 1.9 | 3.7 | 2.2 | 2.7 | 3.3 | 2.8 | 3.3 | 4.1 | 3.5 | 4.1 | 5.0 | 4.3 | 5.0 |
| 75 | 75.0 | 75.3 | 74.1 | 75.9 | | | | 2.2 | 1.8 | 2.2 | 3.1 | 2.6 | 3.1 | 4.0 | 3.4 | 4.0 | 4.9 | 4.2 | 4.9 | 5.9 | 5.1 | 5.9 |
| 90 | 90.0 | 90.3 | 88.9 | 91.1 | 1.7 | 1.3 | 1.7 | 2.6 | 2.1 | 2.6 | 3.7 | 3.1 | 3.7 | 4.6 | 4.0 | 4.6 | 5.7 | 5.0 | 5.7 | 7.0 | 6.1 | 7.1 |
| 110 | 110.0 | 110.4 | 108.6 | 111.4 | 2.0 | 1.6 | 2.0 | 3.0 | 2.5 | 3.0 | 4.3 | 3.7 | 4.3 | 5.6 | 4.9 | 5.6 | 7.0 | 6.1 | 7.1 | 8.5 | 7.5 | 8.7 |
| 125 | 125.0 | 125.4 | 123.5 | 126.5 | 2.2 | 1.8 | 2.2 | 3.4 | 2.9 | 3.4 | 5.0 | 4.3 | 5.0 | 6.4 | 5.6 | 6.4 | 7.8 | 6.9 | 8.0 | 9.6 | 8.5 | 9.8 |
| 140 | 140.0 | 140.5 | 138.3 | 141.7 | 2.4 | 2.0 | 2.4 | 3.8 | 3.2 | 3.8 | 5.5 | 4.8 | 5.5 | 7.2 | 6.3 | 7.3 | 8.7 | 7.7 | 8.9 | 10.7 | 9.5 | 11.0 |
| 160 | 160.0 | 160.5 | 158.0 | 162.0 | 2.8 | 2.3 | 2.8 | 4.3 | 3.7 | 4.3 | 6.3 | 5.4 | 6.2 | 8.2 | 7.2 | 8.3 | 9.9 | 8.8 | 10.2 | 12.2 | 10.9 | 12.6 |
| 180 | 180.0 | 180.6 | 177.8 | 182.2 | 3.1 | 2.6 | 3.1 | 4.9 | 4.2 | 4.9 | 7.0 | 6.1 | 7.1 | 9.0 | 8.0 | 9.2 | 11.1 | 9.9 | 11.4 | 13.7 | 12.2 | 14.1 |
| 200 | 200.0 | 200.6 | 197.6 | 202.4 | 3.4 | 2.9 | 3.4 | 5.3 | 4.6 | 5.3 | 7.7 | 6.8 | 7.9 | 10.0 | 8.9 | 10.3 | 12.3 | 11.0 | 12.7 | 15.2 | 13.6 | 15.7 |
| 225 | 225.0 | 225.7 | 222.3 | 227.7 | 3.9 | 3.3 | 3.9 | 6.0 | 5.2 | 6.0 | 8.6 | 7.6 | 8.8 | 11.2 | 10.0 | 11.5 | 13.9 | 12.4 | 14.3 | 17.1 | 15.3 | 17.6 |
| 250 | 250.0 | 250.8 | 247.0 | 253.0 | 4.2 | 3.6 | 4.2 | 6.5 | 5.7 | 6.5 | 9.6 | 8.5 | 9.8 | 12.4 | 11.2 | 12.9 | 15.4 | 13.8 | 15.9 | 18.9 | 17.0 | 19.6 |
| 280 | 280.0 | 280.9 | 276.6 | 283.4 | 4.8 | 4.1 | 4.8 | 7.3 | 6.4 | 7.4 | 10.7 | 9.5 | 11.0 | 14.0 | 12.5 | 14.4 | 17.2 | 15.4 | 17.8 | 21.1 | 19.0 | 21.9 |
| 315 | 315.0 | 316.0 | 311.2 | 318.8 | 5.3 | 4.6 | 5.3 | 8.2 | 7.2 | 8.3 | 12.0 | 10.7 | 12.4 | 15.6 | 14.0 | 16.1 | 19.3 | 17.3 | 19.9 | 23.8 | 21.4 | 24.7 |
| 355 | 355.0 | 356.1 | 350.7 | 359.3 | 5.9 | 5.1 | 5.9 | 9.2 | 8.1 | 9.4 | 13.4 | 12.0 | 13.8 | 17.6 | 15.8 | 18.2 | 21.8 | 19.6 | 22.6 | 26.8 | 24.1 | 27.8 |
| 400 | 400.0 | 401.2 | 395.2 | 404.8 | 6.6 | 5.8 | 6.7 | 10.3 | 9.1 | 10.5 | 15.1 | 13.5 | 15.6 | 19.8 | 17.8 | 20.5 | 24.4 | 22.0 | 25.3 | 30.2 | 27.2 | 31.3 |
| 450 | 450.0 | 451.4 | 444.6 | 455.4 | 7.4 | 6.5 | 7.5 | 11.6 | 10.3 | 11.9 | 17.0 | 15.2 | 17.5 | 22.2 | 20.0 | 23.0 | 27.5 | 24.8 | 28.6 | 33.8 | 30.5 | 35.1 |
| 500 | 500.0 | 501.5 | 494.0 | 506.0 | 8.2 | 7.2 | 8.3 | 12.8 | 11.4 | 13.2 | 18.8 | 16.9 | 19.5 | 24.8 | 22.3 | 25.7 | 30.5 | 27.5 | 31.7 | 37.5 | 33.9 | 39.0 |
| 560 | 560.0 | 561.7 | 553.2 | 566.8 | 9.2 | 8.1 | 9.4 | 14.3 | 12.8 | 14.8 | 21.0 | 18.9 | 21.8 | 27.6 | 24.9 | 28.7 | 34.1 | 30.8 | 35.5 | 42.0 | 38.0 | 43.7 |
| 630 | 630.0 | 631.9 | 622.4 | 637.6 | 10.3 | 9.1 | 10.5 | 16.1 | 14.4 | 16.6 | 23.7 | 21.3 | 24.5 | 31.0 | 28.0 | 32.2 | 38.4 | 34.7 | 40.0 | 47.2 | 42.7 | 49.2 |

NOTES

1 The table is based on metric series of pipe dimensions given in ISO 161/1 in respect of pipe dimensions and ISO DIS 4422.

2 The wall thickness of pipes is based on a safe working stress of 8.6 MPa at 27°C and the working pressure gets reduced at sustained higher temperatures. Occasional rise in temperature as in summer season with concurrent corresponding reduction in termperature during nights has no deleterious effect on the life working pressure of the pipes considering the total life of pipes.

For class 1, 2 and 3 of all sizes, this requirement need not to be satisfied as the ratio of minimum wall thickness to nominal outside diameter does not exceed 0.035 in these cases.

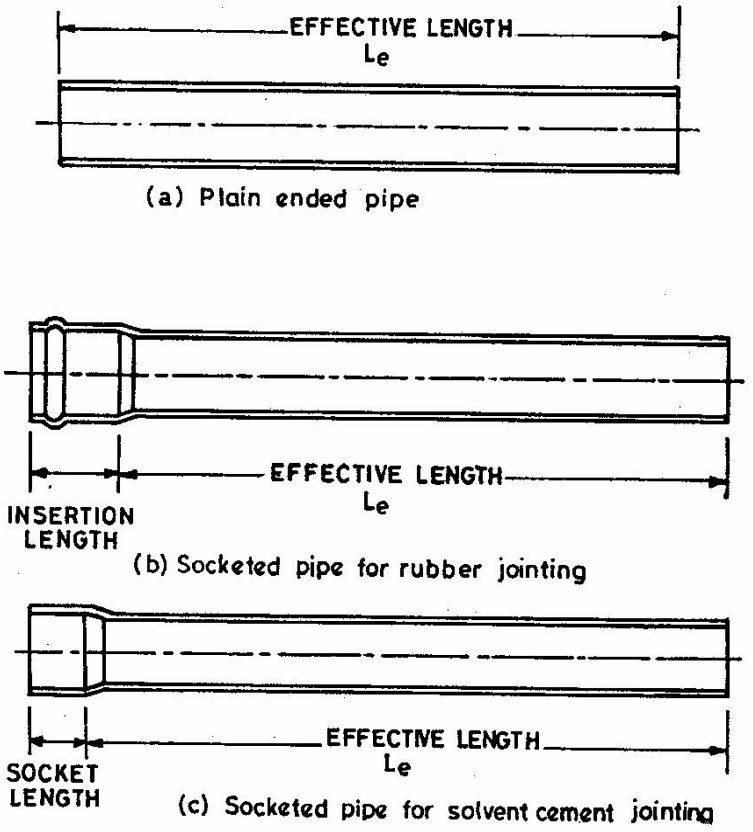
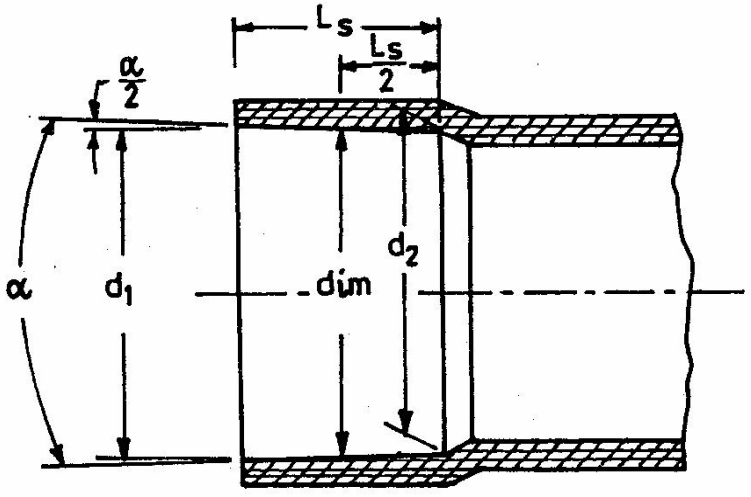



FIG. 2 EFFECTIVE LENGTHS OF PIPE




$d_{im}$ = diameter at mid point of socket length
$d_1$ = diameter at mouth
$d_2$ = diameter at root
$l_s$ = socket length
α = total included angle of taper

FIG. 3 SOCKET DIMENSIONS FOR SOLVENT CEMENT JOINTS

The minimum length of any socket shall be given by the expression $L_s = 0.5\ d_n + 6$ mm,

where

$L$ = minimum socket length, and

$d_n$ = nominal outside diameter of the pipe.

NOTES

1 The mean inside diameter of the socket is defined as die arithmetical mean of two diameters measured at 90 degrees to each other at the mid-point of the socket length. The diameter of the socket may be decreased from the mouth to the root; for all pipe sizes, the total included angle of taper shall not exceed 0° 30[1].

2 Only the manufacturer of the pipe is equipped to measure the socket inside diameter. Since the socket length is minimum (No tolerance is given to this dimension), it is not practical, other than for the manufacturer, to establish the exact position of the mid point of the socket. He can therefore, tool up to measure his own pipe but such equipment will not .necessarily give the correct figures for a pipe of other manufacturer.

**Table 2 Dimensions of UPVC Plain End Pipe for Plumbing in Buildings**

*(Clause* 7.1.3)

All dimensions in millimeters.

| Nominal Outside Diameter $d_n$ | Mean Outside Diameter $d_{em}$ | | Outside Diameter at Any Point $d_e$ | | Wall Thickness $e$ | |
|---|---|---|---|---|---|---|
| | *Min* | *Max* | *Min* | *Max* | *Min* | *Max* |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 20 | 20.0 | 20.3 | 19.5 | 20.5 | 2.8 | 3.3 |
| 25 | 25.0 | 25.3 | 24.5 | 25.5 | 2.9 | 3.4 |
| 32 | 32.0 | 32.3 | 31.5 | 32.5 | 3.4 | 3.9 |
| 40 | 40.0 | 40.3 | 39.5 | 40.5 | 3.6 | 4.2 |
| 50 | 50.0 | 50.3 | 49.4 | 50.6 | 3.7 | 4.3 |

**7.2.1.2** *Sockets for elastomeric sealing ring joints*

These shall conform to the dimensions given in Table 4 and Fig. 4, The wall thickness of the socket, including the portions constituting the ring groove and the neck ($e_3$), shall be not less than the minimum wall thickness of the plain portion of the pine as specified in Table 1, The requirements for inside diameter *d.* of sockets relate to the middle of the depth of engagement *m.*

a) Minimum depth of engagement for sockets for use with elastomeric sealing rings is calculated from the following formulae and rounded off to the next higher integer and shall conform to Table 5 and Fig. 5:

i) For nominal diameters $d < 280$ mm $m > 50$ mm + 0.22 $d_a$, and

ii) For nominal diameters $d > 280$ mm $m > 70$ mm+ 0.15 $d$ .

b) Maximum inner diameter of groove in combination with the inner diameter of the sealing ring and the average outer diameter of the pipe shall ensure that the joint conforms to the required pressure rating as given in Table 6. c) Joints incorporating elastomeric sealing rings shall comply with the hydrostatic pressure requirements of the pipe. The minimum wall thickness of the sockets at any point, except the sealing ring groove, shall not be less than the minimum wall thickness of the connecting pipe.

## 8 SEALING RINGS

These shall be in accordance with one of the types (Type 1 to Type-6) as per IS 5382. The manufacturer has to however specify the type of sealing ring (namely 1,2,3,4, 5 or 6) that is being offered. The design of the profile of the sealing ring is left to the manufacturer as long as the pipe with sealing ring meets the requirements of the specification.

NOTE—A test reriort or conformity certificate may be obtained from the manufacturer of the sealing ring for conformity to IS 5382. The frequency of this test report or conformity certificate shall be once in three months.

**Table 3 Dimensions of Sockets for Solvent Cement Jointing**

***(Clause 7.2.1.1 and** Fig.* **3)**

(toed **on ISO 727)**

All dimensions in millimeters.

| Nominal Size *DN* | Socket Length $L_s$ | Mean Socket internal Diameter at Mid-Point of Socket Length, $d_{im}$ | |
|---|---|---|---|
| | *Min* | *Min* | *Max* |
| (1) | (2) | (3) | (4) |
| 20 | 16.0 | 20.1 | 20.3 |
| 25 | 19.0 | 25.1 | 25.3 |
| 32 | 22.0 | 32.1 | 32.3 |
| 40 | 26.0 | 40.1 | 40.3 |
| 50 | 31.0 | 50.1 | 50.3 |
| 63 | 37.5 | 63.1 | 63.3 |
| 75 | 43.5 | 75.1 | 75.3 |
| 90 | 51.0 | 90.1 | 90.3 |
| 110 | 61.0 | 110.1 | 110.4 |
| 125 | 68.5 | 125.1 | 125.4 |
| 140 | 76.0 | 140.2 | 140.5 |
| 160 | 86.0 | 160.2 | 160.5 |
| 180 | 96.0 | 180.2 | 180.5 |
| 200 | 106.0 | 200.3 | 200.6 |
| 225 | 118.5 | 225.3 | 225.7 |
| 250 | 131.0 | 250.4 | 250.8 |
| 280 | 146.0 | 280.4 | 280.9 |
| 315 | 163.5 | 315.4 | 316.0 |
| 355 | 183.5 | 355.4 | 356.0 |
| 400 | 206.0 | 400.4 | 401.0 |
| 450 | 231.0 | 450.4 | 451.0 |
| 500 | 256.0 | 500.4 | 501.0 |
| 560 | 286.0 | 560.4 | 561.0 |
| 630 | 321.0 | 630.4 | 631.0 |

NOTE — For nominal sizes 20 mm to 225 mm, the dimensions are based on IS 727-1985 (E).

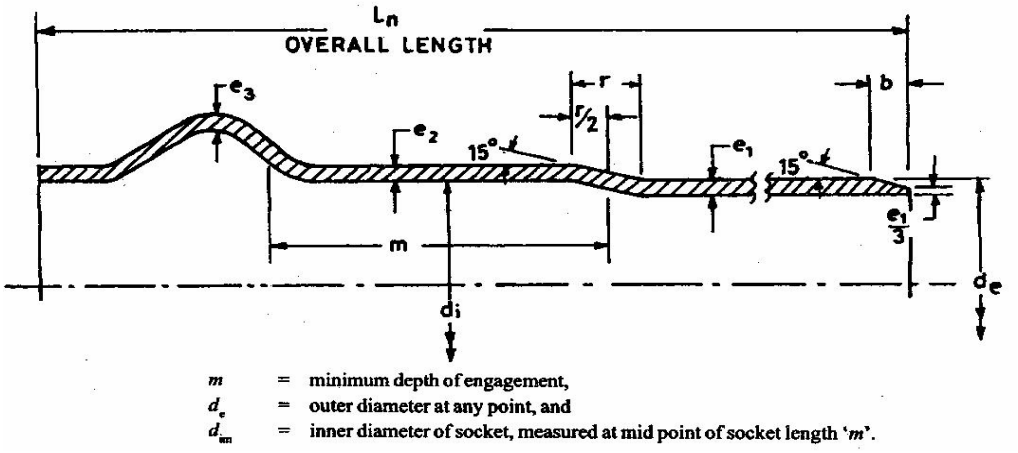



FIG. 4 SOCKETS FOR USE WITH ELASTOMERIC SEALING RINGS

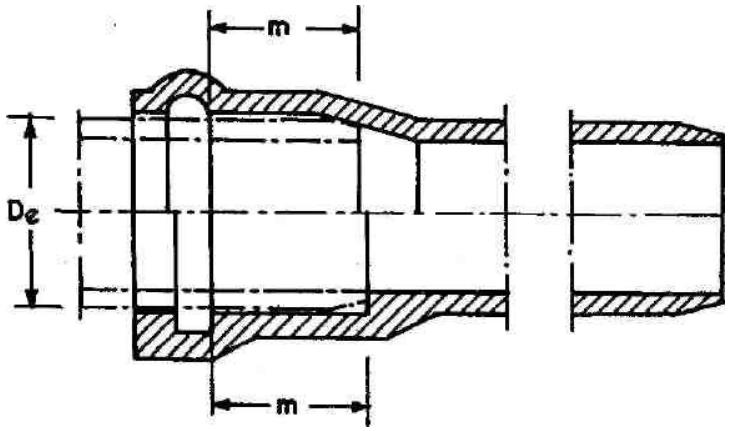



FIG. 5 MINIMUM DEPTH OF ENGAGEMENT

## 9 PIPE ENDS

**9.1** The ends of the pipes meant for solvent cementing (both plain and bell ended) shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

**9.2** Pipes with plain end(s) to be used for elastomeric sealing ring type joints shall be chamfered at approximately 15 degrees to the axis of the pipe. Approximately two thirds of the full wall thickness shall be chamfered as shown in Fig. 6.

**FIG. 6 PIPE ENDS**

## 10 PHYSICAL AND CHEMICAL CHARACTERISTICS

**10.1 Visual** Appearance

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

**10.1.1** The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. Slight shallow longitudinal grooves or irregularities in the pipe shall be permissible provided the wall thickness remains within the permissible limits.

**10.2 Opacity**

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

**10.3 Effect on Water**

The pipes shall not have any detrimental effect on the composition of water flowing through them. When

**Table 4 Inner Diameters** of **Sockets for use with Elastometric Sealing Rings**

*{Clause* 7.2.1.2)

All dimensions in millimeters.

| Nominal Outer Diameter $d_n$ (1) | Socket Inner Diameter $d_{im}$ (2) |
|---|---|
| 63 | $63.6^{+0.7}_{-0.0}$ |
| 75 | $75.6^{+0.7}_{-0.0}$ |
| 90 | $90.7^{+0.8}_{-0.0}$ |
| 110 | $110.8^{+0.9}_{-0.0}$ |
| 125 | $125.9^{+1.0}_{-0.0}$ |
| 140 | $140.9^{+1.0}_{-0.0}$ |
| 160 | $161.0^{+1.1}_{-0.0}$ |
| 180 | $181.1^{+1.1}_{-0.0}$ |
| 200 | $201.2^{+1.1}_{-0.0}$ |
| 225 | $226.4^{+1.1}_{-0.0}$ |
| 250 | $251.5^{+1.1}_{-0.0}$ |
| 280 | $281.6^{+1.4}_{-0.0}$ |
| 315 | $316.8^{+1.5}_{-0.0}$ |
| 355 | $357.0^{+1.7}_{-0.0}$ |
| 400 | $402.2^{+1.9}_{-0.0}$ |
| 450 | $452.5^{+2.0}_{-0.0}$ |
| 500 | $502.1^{+2.0}_{-0.0}$ |
| 560 | $562.8^{+2.4}_{-0.0}$ |
| 630 | $632.3^{+2.6}_{-0.0}$ |

tested by the method.described in IS 12235 (Part 4), IS 12235 (Part 10) and IS 12235 (Part 11), the quantities of lead, dialkyl tin C4 and higher homologues (measured as tin), and any other toxic substances extracted from the internal walls of the pipes shall not exceed the following concentrations (based on 'Guidelines for Drinking Water: Recommendations' — WHO, Geneva, 1984) in the test solution:

| | |
|---|---|
| Lead (first extraction) | 1.0 mg/1 (1.0 ppm by mass) |
| Lead (third extraction) | 0.3 mg/1 (0.3 ppm by mass) |
| Dialkyl tin C4 and higher homologues measured as tin (third extraction) | 0.02mg/l (0.02ppm by mass) |
| Cadmium (for all three extracts) | 0.01mg/l (0.01 by ppm mass) |
| Mercury (for all three extracts) | 0.001 mg/1 (0.001 ppm by mass) |
| Other toxic substances such as 'di-n-octyl-tin-s-s bis iso-octyl mercapto acetate' and 'butyl stearate' (third extraction) | 0.01 mg/1 (0.01 ppm by mass) |

**Table 5 Minimum Depths of Engagement**

*[Clause* 7.2.1.2 (a)]

All dimensions in millimeters.

| Nominal Outer Diameter of Pipe $d_n$ (1) | Minimum Depth of Engagement $m$ (2) |
|---|---|
| 63 | 64 |
| 75 | 67 |
| 90 | 70 |
| 110 | 75 |
| 125 | 78 |
| 140 | 81 |
| 160 | 86 |
| 180 | 90 |
| 200 | 94 |
| 225 | 100 |
| 250 | 105 |
| 280 | 112 |
| 315 | 118 |
| 355 | 124 |
| 400 | 130 |
| 450 | 138 |
| 500 | 145 |
| 560 | 154 |
| 630 | 165 |

**103.1** The manufacturer, for the purpose of these tests, shall disclose any other toxic substances present. The limit of all the 'other toxic substances', including the two mentioned in **10.3** shall not exceed the specified limit of 0.01 mg/1.

### 10.4 Reversion Test

When tested by the immersion method prescribed in IS 12235 (Part 5), a length of pipe 200 ± 20 mm long shall not alter in length by more than 5 percent. In the case of socket end pipes, this test shall be carried out on the plain portion of the pipe taken at least 100 mm away from the root of the socket.

### 10.5 Vicat Softening Temperature

When tested by the method prescribed in IS 6307, the Vicat softening temperature of the specimen shall not be less than 80°C.

### 10.6 Density

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

### 10.7 Sulphated Ash Content Test

When tested as per Annex B, the sulphated ash content in the pipe shall not exceed 11 percent.

## 11 MECHANICAL PROPERTIES

### 11.1 Hydrostatic Characteristics

When subjected to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8), the pipe shall not fail during the prescribed test duration. The temperatures and duration of the test shall conform to the requirements given in Table 6. The test shall be carried out not earlier than 24 h after the pipes have been manufactured. The requirements for integral sealing ring sockets are given in Table 7.

**Table 6 Requirements of Pipes for Internal Hydrostatic Pressure Test**

| Test | Test Temperature (*Min*) °C | Test Duration (Minimum Holding Time) h | Test Pressure (*Min*) MPa |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Type test | 60 | 1 000 | 1.16 × *PN* (MPa) |
| Acceptance test | 27 | 1 | 4.19 × *PN* (MPa) |

**Table 7 Requirements of Integral Sealing Ring Sockets for Internal Hydrostatic Pressure Test**

| Diameter Range mm | Test | Test Temp. (*Min*) °C | Time h | Test Pressure (*Min*) MPa |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| $d_n < 90$ | Acceptance test | 27 | 1 | 2.88 × *PN* [MPa] |
| | Type test | 27 | 1 000 | 2.20 × *PN* [MPa] |
| $d_n \geq 90$ | Acceptance test | 27 | 1 | 3.60 × *PN* [MPa] |
| | Type test | 27 | 1 000 | 2.74 × *PN* [MPa] |

**11.1.1** Acceptance test at 27°C as given in Table 6 shall not apply to plumbing pipes. For plumbing pipes, the test pressure for acceptance test at 27°C shall be 3.6 MPa for 1 h, as these pipes are designed with a higher wall thickness for rigidity and not for providing a higher working pressure.

The type tests do not apply to plumbing pipes due to the same reason as above.

### 11.2 Resistance to External Blows at 0°C

When tested by the method prescribed in Annex C, the pipe shall have a True Impact Rate of not more than 10 percent. In case of socket-ended pipes, this test shall be carried out on the plain portion of the pipe taken at least 100 mm away from the root of the socket.

## 12 SAMPLING AND CRITERIA FOR CONFORMITY

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

## 13 MARKING

**13.1** Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 metres, in colour as indicated in **13.1.1,** or 13.1.2. The markings shall show the following:

a) Manufacturer's name or trade-mark,
b) Outside diameter,
c) Class of pipe and pressure rating,
d) Batch or lot number, and
e) The word plumbing in the case of plumbing pipes.

**13.1.1** The information according to 13.1 and **13.2** shall be marked in colour as indicated below for different classes of pipes:

| *Class of Pipe* | *Colour* |
|---|---|
| Class 1 | Red |
| Class 2 | Blue |
| Class 3 | Green |
| Class 4 | Brown |
| Class 5 | Yellow |
| Class 6 | Black |

**13.1.2** In the case of plumbing pipes, the information given in 13.1 and 13.2 shall be marked in pink colour.

**13.1.3** In the case of hot embossing, the pipes shail also be provided near the end with a circumferential colour band as indicated in **13.1.1,** so as to identify the class of pipe.

### 13.2 BIS Certification Marking

**13.2.1** Each pipe may also be marked with the Standard Mark.

**13.2.2** The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. Details of conditions under which a licence 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.

## ANNEX A

*(Clause* 2)

**LIST OF REFERRED INDIAN STANDARDS**

| *IS No.* | *Title* | *IS No.* | *Title* |
|---|---|---|---|
| 4669 : 1968 | Methods of test for poly vinyl chloride resins | 12235 | Methods of test for unplasticized PVC pipes for potable water supplies |
| 4905 : 1968 | Methods for random sampling | Part 1 : 1986 | Measurement of outside diameter |
| 5382 : 1985 | Rubber sealing rings for gas mains, water mains and sewers (*first revision*) | Part 2 : 1986 | Measurement of wall thickness |
| | | Part 3 : 1986 | Test for opacity |
| | | Part 4 : 1986 | Determining the detrimental effect on the composition of water |
| 6307 : 1985 | Specification for rigid PVC sheets (*first revision*) | Part 5 : 1986 | Reversion test |
| | | Part 8 : 1986 | Internal hydrostatic pressure test |
| 10148 : 1982 | Positive list of constituents of poly vinyl chloride resins and its copolymers for safe use in contact with food-stuffs, pharmaceuticals and drinking water | Part 10 : 1986 | Method for determination of organotin as tin aqueous solution |
| | | Part 11 : 1986 | Extractability of cadmium and mercury occurring as impurities |
| 10151 : 1982 | Specification for poly vinyl chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water | 12818 : 1992 | Unplasticized PVC screen and casing pipes for bore/tube well — Specification (*first revision*) |
| | | 13360 (Part 3)/ Sec 1) : 1995 | Plastics — Methods of testing: Part 3 Physical and dimensional properties, Sec 1 Determination of density and relative density of non-cellular plastics |
| 12231 : 1987 | Specifications for UPVC (rigid) pipes for use in suction and delivery lines of agricultural pumps | | |

## ANNEX B

*{Clause* 10.7)

**SULPHATED ASH CONTENT TEST**

B-l **PRINCIPLE**

Calcination with sulphuric acid treatment after combustion, that is, by burning the substance and transforming the residue into sulphates using concentrated sulphuric acid and, finally, heating the residue at 850°C until constant mass is reached.

**B-2 REAGENTS**

**B-2.1** Sulphuric acid (density 1 840 kg/$m^3$).

**B-3 APPARATUS**

**B-3.1** Silica or platinum crucible, diameter of upper portion 45 mm to 75 mm, height equal to the diameter. The size shall be sufficient so that the crucible is not more than half filled by the test portion sample.

**B-3.2** Analytical balance with 0.1 mg accuracy. B-33

Bunsen burner with silica triangle and tripod or other suitable heating device.

**B-3.4** Muffle furnace capable of being maintained 850 ± 10°C.

**B-3.5** Pipette of appropriate capacity.

**B-3.6** Dessicator containing an effective drying agent that does not react chemically with the ash components.

NOTE—In some cases, the affinity of the ash for water may be greater than that of drying agents commonly used.

**B-4 PROCEDURE**

**B-4.1** Prepare the crucible by heating in the muffle furnace at 850 ± 10°C until constant mass is reached. Allow it to cool in the dessicator to room temperature, but for at least one hour and weigh to the nearest 0.1 mg *($M_1$).*

**B-4.2** Introduce into the crucible 2 g to 5 g of the

sample and reweigh to the nearest 0.1 mg *($M_2$).* Heat the crucible directly on the heating device so that the sample burns slowly and loss of ash is avoided. Continue this operation until no more smoke is evolved.

**B-4.3** After allowing the crucible and contents to cool, add sulphuric acid dropwise by means of a pipette of suitable capacity until the residue is soaked completely. Heat carefully on the heating device untii the evolution of smoke ceases, taking care to avoid spattering of the contents of the crucible.

**B-4.4** If, after allowing the crucible to cool, carbon is still evident, add 1 to 5 drops of sulphuric acid and reheat untii evolution of white fumes has ceased.

**B-4.5** Place the crucible at the entrance of the muffle furnace maintained at 850 ± 10°C (the temperature in the entrance zone is about 300 to 400°C), then advance the crucible slowly into the furnace. Calcine slowly (to prevent loss of ash particles) for 30 min at 850±10°C.

**B-4.6** Remove the crucible from the furnace. Place it in the dessicator, allow to cool to room temperature, but for at least one hour, and weigh to the nearest 0.1mg($M_3$).

**B-4.7** Calcine again, under the same conditions until constant mass is reached, that is, until the results of two consecutive weighings do not differ by more than 0.5 mg. The duration of heating in the furnace shall not, however, exceed 3 h if constant mass is not attained after this time, the mass after 3 h shall be used for calculating the test result. The residue after calcination shall be white.

### B-5 NUMBER OF DETERMINATIONS

Carry out two determinations. Calculate the arithmatic mean of the results. If the individual test results differ from each other by more that 10 percent of their mean, repeat the procedure until two successive results do not differ from each other by more than 10 percent of their mean.

### B-6 EXPRESSION OF RESULTS

The sulphated ash content shall be calculated as follows:

$$\text{Sulphated ash content percent, by mass} = \frac{M_3 - M_1}{M_2 - M_1} \times 100$$

where

$M_x$ — Mass of the crucible,

$M_2$ = Mass of the crucible and test portion sample, and

$M_3$ = Mass of the crucible and residue.

## ANNEX C

*(Clause 11.2)*

## METHOD OF TEST FOR RESISTANCE TO EXTERNAL BLOWS AT 0°C

### C-I SCOPE

**C-l.I** This annex specifies the method for the determination of the resistance to external blows of UPVC pipes manufactured according to this standard.

### C-2 DEFINITIONS

For the purposes of this annex, the following definitions shall apply.

### C-2.1 True Impact Rate (TIR)

The total number of failures divided by the total number of blows, as a percentage, as if the whole batch had been tested.

NOTE — In practice, test pieces are drawn at random from the batch and the result is only an estimate of the TIR for that batch.

### C-2.2 Failure

Shattering or any crack or split on the inside of the pipe that was caused by the impact and that can be seen by the naked eye (lighting devices may be used to assist in examining the specimens).

**C-2.2.1** Indentation of the test piece is not considered a failure.

### C-3 Principle

**C-3.1** Test pieces are subjected to blows from a falling striker, of specified mass and shape, dropped from a known height on to specified positions around the circumference of the test piece. The true impact rate (TIR) of the batch, or production run from an extruder, is estimated.

**C-3.2** The severity of this test method can be adjusted by changing the mass of the striker and/or by changing the drop height. It is not technically correct to vary the severity of the test by choosing values of the TIR other than those specified below.

The maximum acceptable values for the TIR is taken to be 10 percent.

NOTE — It shall be appreciated that a completely definitive result can be reached only by testing the whole batch, but in practice, a balance is necessary between the statistical possibility of a definitive result and the cost of further testing.

## C-4 APPARATUS

### C-4.1 Falling Weight Testing Machine

Incorporating the following basic components *(see* Fig. 7).

**C-4.1.1** *Main Frame*

With guide rails or tube, which can be fixed in the true vertical position, to accommodate a striker *(see* C-4.1.2) and release mechanism to release the striker to fall vertically and freely. The speed of the striker at the moment of impact shall be not less than 95 percent of the theoretical-speed.

**C-4.1.2** *Striker*

Having a nose comprising all or part of a hemisphere, combined with a stem at least 10 mm long, and having dimensions conforming to Fig. 8 and Table 8. The mass of the striker, including any associated weights, shall be selected from the values given in Table 9. Below the stem, the nose shall be of solid steel, polished and free from flats, indentations or other imperfections which may influence the result.

**C-4.1**.3 *Rigid specimen support*

Consisting of a 120° V-block at least 200 mm long, positioned so that the vertical projection of the point of impact of the falling striker is within 2.5 mm of the axis of the V-block *(see* Fig. 7).

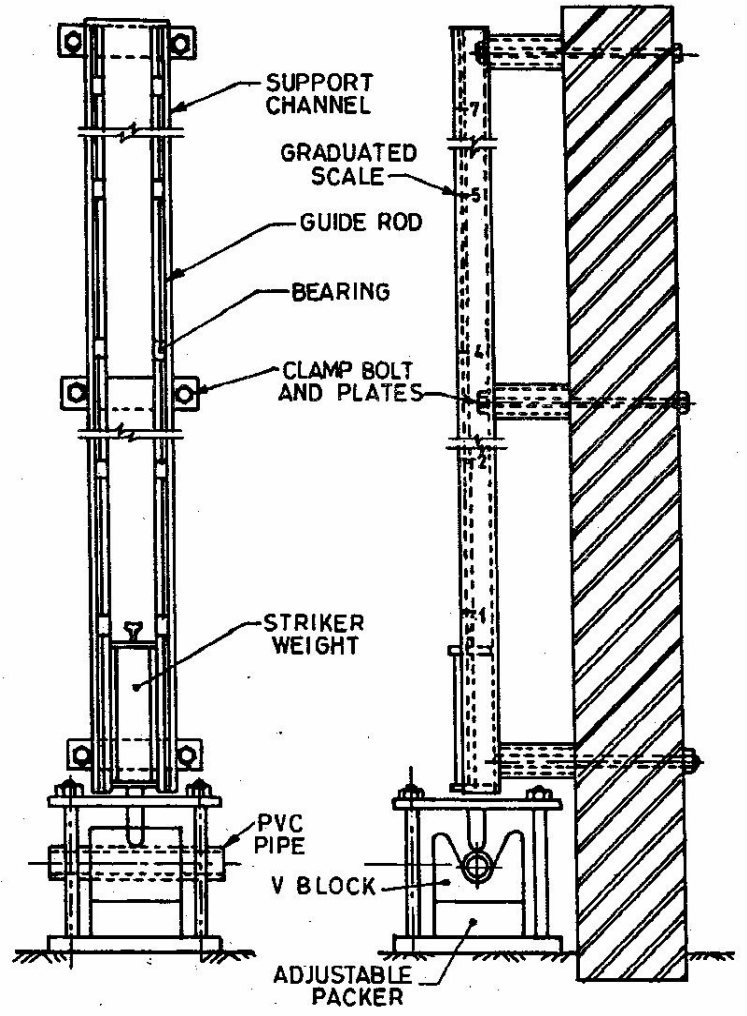
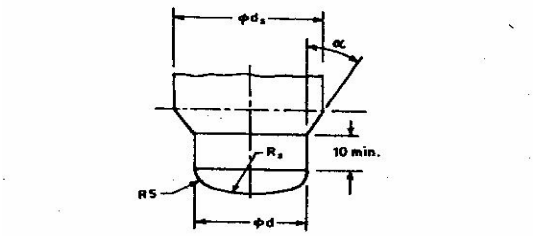
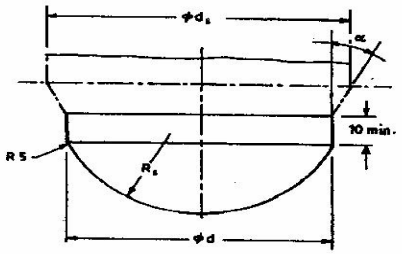



FIG. 7 IMPACT TESTING MACHINE




a) Type $d_{25}$ (for strikers of mass 0.25 kg and 0.5 kg)




b) Type $d_{90}$ (for strikers of mass equal to or greater than 1 kg)

FIG. 8 NOSES OF THE STRIKERS

**Table 8 Dimensions for the Nose of the Striker**

*(Clause* C-4.1.2)

All dimensions in millimeters.

| Type | $R_s$ | $d$ | $d_s$ | $\alpha_s$ |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| $d_{25}$ | 50 | 25 ± 1 | Free | Free |
| $d_{90}$ | 50 | 90 ± 1 | Free | Free |

**Table 9 Classified Striker Mass and Drop Height Conditions for the Falling Weight Impact Test**

*(Clauses* C-4.1.2 *and* C-8.1)

| Nominal Outside Diameter of Pipes, $d_n$ mm | Mass of Falling Weight, kg | Fall Height, mm |
|---|---|---|
| (1) | (2) | (3) |
| Up to and including 25 | 0.25 ± 0.5 % | 500 ± 10 |
| " 32 | 0.25 ± 0.5 % | 1 000 ± 10 |
| " 40 | 0.25 ± 0.5 % | 1 000 ± 10 |
| " 50 | 0.25 ± 0.5 % | 1 000 ± 10 |
| " 63 | 0.25 ± 0.5 % | 2 000 ± 10 |
| " 75 | 0.25 ± 0.5 % | 2 000 ± 10 |
| " 90 | 0.50 ± 0.5 % | 2 000 ± 10 |
| " 110 | 0.50 ± 0.5 % | 2 000 ± 10 |
| " 125 and above | 1.00 ± 0.5 % | 2 000 ± 10 |

**C-4.1.4** *Release Mechanism*

Such that the striker can fall from a variable height which can be adjusted to any height up to at least 2 m, measured from the top surface of the test piece, with an accuracy of ±10 mm.

## C-5 TEST PIECES

Test pieces of length 200 ±10 mm shall be cut from the pipe selected at random from the batch, or the production run from an extruder. The cut ends shall be square to the axis of the pipe, clean and free from damage. For pipes with outside diameters greater than 40 mm, a straight line shall be drawn along the length of each test piece at a random position. Further lines shall be drawn at equal distances around the pipe piece so that each test piece has a number of lines given in Table 10. The number of blows required is given in C-6. For pipes with outside diameters less than or equal to 40 mm, only one blow per test piece shall be made.

**Table 10 Number of Equidistant Lines to be drawn on Test Pieces**

*(Clause* C-5)

| Nominal Outside Diameter of Pipe mm | Number of Equidistant Lines to be Drawn |
|---|---|
| (1) | (2) |
| Up to and including 40 | – |
| " 50 | 3 |
| " 63 | 3 |
| " 75 | 4 |
| " 90 | 4 |
| " 110 | 6 |
| " 125 | 6 |
| " 140 | 8 |
| " 160 | 8 |
| " 180 | 8 |
| " 200 | 12 |
| " 225 | 12 |
| " 250 | 12 |
| " 280 and above | 16 |

## C-6 SAMPLING TO CONFIRM VALUE OF TIR ON ISOLATED BATCHES

**C-6.1** If the number of failures from a sample falls into region *A* of Fig. 9 (for a TIR of less than or equal to 10 percent), then reasonable confirmation is obtained that the batch has a TIR less than or equal to the specified level.

**C-6.2** If the number of failures falls into the region *C* of Fig. 9, the batch can be judged to have a TIR greater than the specified value.

**C-6.3** If the number of failures falls into the region *B* of Fig. 9, in general further test pieces should be taken so that a decision shall be arrived at.

**C-6.4** The decision shall be made by using the cumulative result of all the test pieces examined from the batch under consideration.

**C-6.5** Fig. 9 is a guideline to indicate the principle of the test method. Evaluation of the test result shall be obtained based on Table 11. If the number of blows exceed 124, Fig. 9 shall be referred for assessment of the result.

## C-7 CONDITIONING

**C-7.1** The test pieces shall be conditioned in a liquid bath or in air at a temperature of 0° ± 1°C for at least the period given in Table 12.

**C-7.I.1** In case of disputes over the results, a liquid bath shall be used.

**C-7.2** Test pieces with wall thickness up to 8.6 mm shall be tested within 10 seconds of their removal from air conditioning, or within 20 seconds of their removal from liquid conditioning, as applicable.

**C-7.3** Test pieces with wall thickness greater than 8.6 mm shall be tested within 20 seconds of their removal from air conditioning or within 30 seconds of their removal from liquid conditioning, as applicable.

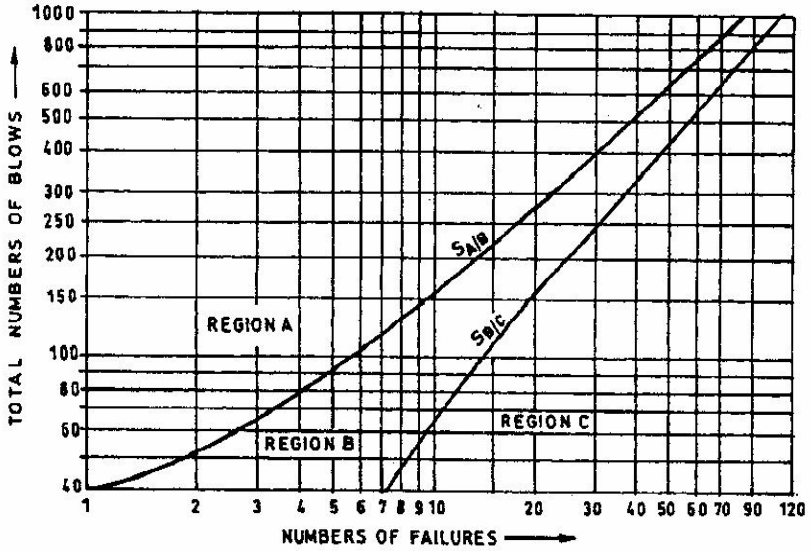
**C-7.4** If this interval is exceeded, the test piece shall be returned immediately to the unit for reconditioning for further period of at least 10 minutes.

## C-8 PROCEDURE

**C-8.1** The mass of the falling striker and the drop height appropriate to the pipe shall be as specified in Table 9.

**C-8.2** For pipes of outside diameter 40 mm or less, subject the test piece to a single blow only.

**C-8.3** For pipes of outside diameter greater than 40 mm, subject the test piece to a blow by allowing the striker to fall on one of the marked lines. If the test piece passes the test, rotate it in the V-block to the next marked line and again subject it to a blow from the falling striker, after reconditioning if necessary *{see* **C**-7).




Boundaries between regions are calculated using the following equations

$$S_{A/B} = np - 0.5 - \mu\sqrt{np(1-p)}$$

$$S_{B/C} = np + 0.5 + \mu\sqrt{np(1-p)}$$

where

$\mu$ = 1.282 (10% one-sided)
$p$ = 0.10(TIR)
$n$ = number of blows

NOTES

1 Initially a minimum of 25 blows shall be made. In case of no failure, the lot is deemed to have passed the test. In case of four or more failures, the lot is treated as rejected. The test shall be continued further if one or two or three failures occur till the results fall into either region A or region C of Table 11 to arrive at a decision for acceptance or rejection respectively.

2 It is necessary to have achieved at least 25 blows without failure before the test is discontinued.

FIG. 9 NUMBER OF TEST PIECES FOR 10 PERCENT TIR (AT 90 PERCENT CONFIDENCE LEVEL)

**Table 11 Number of Blows and Failures**

*{Clause* C-6.5)

| Number of Blows | Number of Failures | | | Number of Blows | Number of Failures | | |
|---|---|---|---|---|---|---|---|
| | Accept Region A | Continue Test Region B | Reject Region C | | Accept Region A | Continue Test Region B | Reject Region C |
| (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| 25 | 0 | 1 to 3 | 4 | 75 | 3 | 4 to 10 | 11 |
| 26 | 0 | 1 to 4 | 5 | 76 | 3 | 4 to 10 | 11 |
| 27 | 0 | 1 to 4 | 5 | 77 | 3 | 4 to 10 | 11 |
| 28 | 0 | 1 to 4 | 5 | 78 | 3 | 4 to 10 | 11 |
| 29 | 0 | 1 to 4 | 5 | 79 | 3 | 4 to 10 | 11 |
| 30 | 0 | 1 to 4 | 5 | 80 | 4 | 5 to 10 | 11 |
| 31 | 0 | 1 to 4 | 5 | 81 | 4 | 5 to 11 | 12 |
| 32 | 0 | 1 to 4 | 5 | 82 | 4 | 5 to 11 | 12 |
| 33 | 0 | 1 to 5 | 6 | 83 | 4 | 5 to 11 | 12 |
| 34 | 0 | 1 to 5 | 6 | 84 | 4 | 5 to 11 | 12 |
| 35 | 0 | 1 to 5 | 6 | 85 | 4 | 5 to 11 | 12 |
| 36 | 0 | 1 to 5 | 6 | 86 | 4 | 5 to 11 | 12 |
| 37 | 0 | 1 to 5 | 6 | 87 | 4 | 5 to 11 | 12 |
| 38 | 0 | 1 to 5 | 6 | 88 | 4 | 5 to 11 | 12 |
| 39 | 0 | 1 to 5 | 6 | 89 | 4 | 5 to 12 | 13 |
| 40 | 1 | 2 to 6 | 7 | 90 | 4 | 5 to 12 | 13 |
| 41 | 1 | 2 to 6 | 7 | 91 | 4 | 5 to 12 | 13 |
| 42 | 1 | 2 to 6 | 7 | 92 | 5 | 6 to 12 | 13 |
| 43 | 1 | 2 to 6 | 7 | 93 | 5 | 6 to 12 | 13 |
| 44 | 1 | 2 to 6 | 7 | 94 | 5 | 6 to 12 | 13 |
| 45 | 1 | 2 to 6 | 7 | 95 | 5 | 6 to 12 | 13 |
| 46 | 1 | 2 to 6 | 7 | 96 | 5 | 6 to 12 | 13 |
| 47 | 1 | 2 to 6 | 7 | 97 | 5 | 6 to 12 | 13 |
| 48 | 1 | 2 to 6 | 7 | 98 | 5 | 6 to 13 | 14 |
| 49 | 1 | 2 to 7 | 8 | 99 | 5 | 6 to 13 | 14 |
| 50 | 1 | 2 to 7 | 8 | 100 | 5 | 6 to 13 | 14 |
| 51 | 1 | 2 to 7 | 8 | 101 | 5 | 6 to 13 | 14 |
| 52 | 1 | 2 to 7 | 8 | 102 | 5 | 6 to 13 | 14 |
| 53 | 2 | 3 to 7 | 8 | 103 | 5 | 6 to 13 | 14 |
| 54 | 2 | 3 to 7 | 8 | 104 | 5 | 6 to 13 | 14 |
| 55 | 2 | 3 to 7 | 8 | 105 | 6 | 7 to 13 | 14 |
| 56 | 2 | 3 to 7 | 8 | 106 | 6 | 7 to 14 | 15 |
| 57 | 2 | 3 to 8 | 9 | 107 | 6 | 7 to 14 | 15 |
| 58 | 2 | 3 to 8 | 9 | 108 | 6 | 7 to 14 | 15 |
| 59 | 2 | 3 to 8 | 9 | 109 | 6 | 7 to 14 | 15 |
| 60 | 2 | 3 to 8 | 9 | 110 | 6 | 7 to 14 | 15 |
| 61 | 2 | 3 to 8 | 9 | 111 | 6 | 7 to 14 | 15 |
| 62 | 2 | 3 to 8 | 9 | 112 | 6 | 7 to 14 | 15 |
| 63 | 2 | 3 to 8 | 9 | 113 | 6 | 7 to 14 | 15 |
| 64 | 2 | 3 to 8 | 9 | 114 | 6 | 7 to 15 | 16 |
| 65 | 2 | 3 to 9 | 10 | 115 | 6 | 7 to 15 | 16 |
| 66 | 2 | 3 to 9 | 10 | 116 | 6 | 7 to 15 | 16 |
| 67 | 3 | 4 to 9 | 10 | 117 | 7 | 8 to 15 | 16 |
| 68 | 3 | 4 to 9 | 10 | 118 | 7 | 8 to 15 | 16 |
| 69 | 3 | 4 to 9 | 10 | 119 | 7 | 8 to 15 | 16 |
| 70 | 3 | 4 to 9 | 10 | 120 | 7 | 8 to 15 | 16 |
| 71 | 3 | 4 to 9 | 10 | 121 | 7 | 8 to 15 | 16 |
| 72 | 3 | 4 to 9 | 10 | 122 | 7 | 8 to 15 | 16 |
| 73 | 3 | 4 to 10 | 11 | 123 | 7 | 8 to 16 | 17 |
| 74 | 3 | 4 to 10 | 11 | 124 | 7 | 8 to 16 | 17 |

**Table 12 Conditioning Period**

*(Clause C-7 A)*

| Wall Thickness *e* mm (1) | Conditioning Period minutes | |
|---|---|---|
| | Liquid bath (2) | Air (3) |
| up to 8.6 | 15 | 60 |
| 8.6 to 14.1 | 30 | 120 |
| above 14.1 | 60 | 240 |

**C-8.4** Continue this procedure until the test piece fails the test, or until all the marked lines have been struck one blow.

**C-8.5** If required, carry out the test on subsequent test pieces, subjecting each one to the required number of blows.

## ANNEXD

*(Clause* 12)

## SAMPLING AND CRITERIA FOR CONFORMITY

### D-l ACCEPTANCE

**D-l.1** Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot.

### D-l .2 Lot

All PVC pipes in a single consignment of the same class, same size and manufactured under essentially similar conditions shall constitute a lot.

**D-l .3** For ascertaining conformity of the lot to the requirements of the specification, samples shall be tested from each lot separately.

### D-l.4 Visual and Dimensional Requirements

**D-1.4.1** The number of test samples to be taken from a lot shall depend on the size of the lot and the outside diameter of the pipes, and shall be in accordance with Table 13.

**D-l.4.2** These pipes shall be selected at random from the lot and in order to ensure the randomness of selection, a random number table shall be used. For guidance and use of random number tables, IS 4905 may be referred to. In the absence of a random number table, die following procedure may be adopted:

> Starting from any pipe in the lot, count them as 1, 2, 3, etc, upto *r* and so on, where *r* is the integral part of *N/n, N* being the number of pipes in the lot, and « the number of pipes in the sample. Every rth pipe so counted shall be withdrawn so as to constitute the required sample size.

**D-l.4.3** The number of pipes given for the first sample in col 3 of Table 13, shall be taken from the lot and examined for visual and dimensional requirements given in 7 and 10.1 of this specification. A pipe failing to satisfy any of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 5 of Table 13. The lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 6 of Table 13. If, however, the number of defectives found in the first sample lies between the corresponding acceptance and rejection numbers given in col 5 and 6, a second sample of the size given in col 3 shall be taken and examined for these requirements. The lot shall be considered to have satisfied these requirements if the cumulative sample is less than or equal to the corresponding acceptance number given in col 5, otherwise not.

**Table 13 Scale of Sampling for Visual Appearance and Dimensional Requirements**

*(Clauses* D-1.4.1 *and D-l.4.3)*

| Number of Pipes in the Lot | Sample Number | Sample Size | Cumulative Sample Size | Acceptance Number | Rejection Number |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Up to 1 000 | First | 13 | 13 | 0 | 2 |
| | Second | 13 | 26 | 1 | 2 |
| 1 001 to 3 000 | First | 20 | 20 | 0 | 2 |
| | Second | 20 | 40 | 1 | 2 |
| 3 001 to 10 000 | First | 32 | 32 | 0 | 3 |
| | Second | 32 | 64 | 3 | 4 |
| 10 001 and above | First | 50 | 50 | 1 | 4 |
| | Second | 50 | 100 | 4 | 5 |

### D-1.5 Reversion Test

**D-l.5.1** The lot, having satisfied visual and dimensional requirements, shall be tested for reversion.

**D-l.5.2** For this purpose, the number of pipes given for the first sample in col 3 of Table 14 shall be taken from the lot. The sample pipe failing the reversion test shall be considered as defective. The lot shall be deemed to have met the requirements given in this specification for the reversion test, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 5. The lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 6. If, however, the number of defectives in the first sample lies between the corresponding acceptance and rejection numbers given in col 5 and col 6, a second sample of size given in col 3 shall be taken and examined for the requirement. The lot shall be considered to have satisfied the 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, otherwise not.

### D-1.6 Vicat Softening Test

**D-l.6.1** The lot, having satisfied visual and dimensional requirements shall be tested for Vicat softening temperature.

**D-1.6.2** For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for reversion under D-l.5.2 using Table 14.

### D-1.7 Density

**D-l.7.1** The lot, having satisfied the visual and dimensional requirements, shall be tested for density.

**D-l.7.2** For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for reversion under D-l.5.2, using Table 14.

### D-1.8 Suiphated Ash Content Test

**D-1.8.1** The lot, having satisfied the visual and dimensional requirements, shall be subjected to the suiphated ash content test.

**D-l.8.2** For this purpose, the procedure adopted for sampling and criteria for conformity shall be as per Table 15.

**Table 14 Scale of Sampling for Reversion, Vicat Softening Temperature and Density Test**

*(Clauses* D-1.5, D-1.6 *and* D-1.7)

| Number of Pipes in the Lot | Sample Number | Sample Size | Cumulative Sample Size | Acceptance Number | Rejection Number |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Up to 1 000 | First | 5 | 5 | 0 | 2 |
| | Second | 5 | 10 | 1 | 2 |
| 1 001 to 3 000 | First | 8 | 8 | 0 | 2 |
| | Second | 8 | 16 | 1 | 2 |
| 3 001 to 10 000 | First | 13 | 13 | 0 | 2 |
| | Second | 13 | 26 | 1 | 2 |
| 10 001 and above | First | 20 | 20 | 0 | 3 |
| | Second | 20 | 40 | 3 | 4 |
| *For $d_n$ above 110 mm* | | | | | |
| Up to 3 000 | First | 3 | 3 | 0 | 2 |
| | Second | 3 | 6 | 1 | 2 |
| 3 001 to 10 000 | First | 5 | 5 | 0 | 2 |
| | Second | 5 | 10 | 1 | 2 |
| 10 001 and above | First | 8 | 8 | 0 | 2 |
| | Second | 8 | 16 | 1 | 2 |

**Table 15 Scale of Sampling for Sulphated Ash Content Test**

(*Clause* D-1.8)

| Number of Pipes in the Lot | Sample Number | Sample Size | Cumulative Sample Size | Acceptance Number | Rejection Number |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Up to 10 000 | First | 2 | 2 | 0 | 1 |
| | Second | 2 | 4 | 1 | 1 |
| Above 10 000 | First | 3 | 3 | 0 | 2 |
| | Second | 3 | 6 | 1 | 2 |

### D-1.9 Resistance to External Blows at 0°C

**D-l.9.1** The lot, having been found satisfactory according to **D-1.4, D-1.5, D-1.6, D-1.7** and **D-1.8**, shall be tested for resistance to external blows at 0°C.

**D-l.9.2** For this purpose, the procedure adopted for sampling and criteria for conformity shall be as specified in Annex C and Table 16.

### D-1.10 Internal Hydrostatic Pressure Test (Acceptance Test)

**D-1.10.1** The lot, having been found satisfactory according to **D-1.4, D-1.5, D-1.6, D-1.7, D-1.8** and **D-1.9**, shall be subjected to the requirements of the acceptance test for internal hydraulic pressure. The number of pipes to be taken from the lot shall depend on the size of the lot and shall be according to Table 17.

**Table 16 Scale of Sampling for Resistance to External Blows at 0°C**

*(Clause D*-1.9.2)

| Number of Pipes in the Lot | Sample Number | Sample Size | Cumulative Sample Size | Acceptance Number | Rejection Number |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Up to 3 000 | First | 3 | 3 | 0 | 2 |
| | Second | 3 | 6 | 1 | 2 |
| 3 001 to 10 000 | First | 5 | 5 | 0 | 2 |
| | Second | 5 | 10 | 1 | 2 |
| 10 001 and above | First | 8 | 8 | 0 | 2 |
| | Second | 8 | 16 | 1 | 2 |

NOTE — The number mentioned in col 3 to 6 in the above table represent the number of times the test is to be carried out and do not represent either the number of pipe samples or number of blows or number of failures.

D-1.10.2 The pipes shall be taken at random from the lot. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

D-l .10.3 *Number of Tests and Criteria for Conformity*

The number of test samples shall be as given in Table 17. The lot shall be considered to have satisfied the requirements for this test, if the number of test samples failing in this requirement is equal to the corresponding acceptance number given in col. 3 of Table 17.

**Table 17 Scale of Sampling for Internal Hydrostatic Test**

*(Clauses* D-l. 10.1 *and* D-l. 10.3)

| Number of Pipes in the Lot | Sample Size | Acceptance Number |
|---|---|---|
| (1) | (2) | (3) |
| Up to 3 000 | 2 | 0 |
| 3 001 to 10 000 | 3 | 0 |
| 10 001 and above | 5 | 0 |

D-2 TYPE TESTS

D-2.1 Type tests are intended to prove the suitability and performance of a new composition or a new size of pipe. Such tests, therefore, need to be applied only when a change is made in polymer composition or when a new size of pipe is to be introduced. Type tests for compliance with 10.2,103 and 11.1 (type test only) shall be carried out.

D-2.1.1 *Opacity*

For this test, the manufacturer or the supplier shall furnish to the testing authority one sample of the pipe of the thinnest wall section, selected preferably from a regular production lot.

D-2.1.1.1 The sample so selected shall be tested for compliance with requirements for opacity as given in 10.2.

D-2.1.1.2 If the sample passes the requirements of the opacity test, the type of the pipe under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

D-2.1.13 In case the sample fails in the test, the testing authority, at its discretion, may call for a fresh sample and subject the same to the opacity test If the sample passes the repeat test, the type of pipe under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

D-2.1.1.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for a fresh sample for opacity test for the purpose of type approval.

D-2.1.2 *Test for Effect on Water*—For this type test, the manufacturer or the supplier shall furnish to the testing authority three samples of the smallest size of pipe taken from each machine (selected preferably from a regular production lot).

D-2.1.2.1 Three samples so selected shall be tested for compliance with the requirements for effect on water as given in 10.3.

D-2.1.2.2 If all three samples pass the requirements for effect on water, the type test of the pipe under consideration shall be considered to be eligible for approval, which shall be normally valid for a period of one year.

D-2.1.2.3 In case any of the samples fails in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number, and subject them to the test for effect on water. If, in the repeat test, no single failure occurs, the type of pipe under consideration shall be considered eligible for type approval. If any of the samples fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

D-2.1.2.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for effect on water test for the purpose of type approval.

D-2.1.3 *Internal Hydrostatic Pressure Test (Type Test)*

For this type test, the manufacturer or the supplier shall furnish to the testing authority, three samples of pipes of different diameters and different classes

(selected preferably from a regular production lot).

**D-2.1.3.1** Three samples so selected shall be tested for compliance with the requirements of type test given in Table 6 and Table 7.

**D-2.1.3.2** If all the three samples pass the requirements of the quality test, the type of pipe under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

**D-2.1.3.3** In case any of the samples fail in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number and subject them to the type test. If, in the repeat test, no single failure occurs, the type of pipe shall be considered for type approval. If any of the samples fails in the repeat tests, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

**D-2.1.3.4** At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for type test for the purpose of type approval.

# ANNEXE

## *(Foreword)*

### COMMITTEE COMPOSITION

Plastic Piping System Sectional Committee, CED 50

| | |
|---|---|
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| MATERIALS MANAGER *(Alternate)* | |
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*(Continued on page* 22)

*{Continued from page* 21)

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*Member-secretary*
SHRI R.K. GUPTA
Joint Director (Civ Engg), BIS

## Panel for UPVC Piping System for Water Supply, CED 50:P9

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*(Continued from second cover)*

| | |
|---|---|
| ISO/DIS 4422-2-1996 | Pipes and fittings made of unplasticized PVC for water supply—Specifications |
| ISO 9852 : 1995(E) | Unplasticized PVC pipes—Dichloromethane resistance at specified temperature |
| ISO/DIS 12162 | Guidelines for drinking water : Recommendations |
| WHO, Geneva, 1984 | |
| prEN 1452-1 : 1994 | Plastics piping systems for water supply |
| prEN 1452-2 : 1994 Drafts | Unplasticized polyvinyl chloride) (PVC-U) — Part 1 : General and Part 2 Pipes |

For guidelines on methods of laying and jointing of UPVC pipe work system, including storage, reference may be made to IS 7634 (Part 3) : 1975 'Code of practice for plastic pipe work for potable water supplies: Part 3 Laying and jointing of UPVC pipes'.

This standard contains clause **7.1.4.1** which permits the purchaser to use his option for selection to suit his requirements at the time of placing orders.

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

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the 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.

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