भारतीय मानक
Indian Standard

IS 16534 : 2017

स्वचालित स्प्रिंकलर अग्निशमन तंत्र के लिए क्लोरीनकृत पॉलीविनायल क्लोराइड (सीपीवीसी) पाइप फिटिंग — विशिष्टि

Chlorinated Polyvinyl Chloride (CPVC) Pipe Fittings for Automatic Sprinkler Fire Extinguishing System — Specification

ICS 23.040.20;13.220.10

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली-110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

October 2017 **Price Group 7**

Fire Fighting Sectional Committee, CED 22

FOREWORD

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

This standard covers general requirements regarding material, methods of tests, inspection and marking of different types of CPVC fittings intended for use with chlorinated poly vinyl chloride pipes for automatic fire extinguishing system. The use of CPVC fittings with standard BIS certification marking shall ensure adequate reliability and quality assurance of CPVC piping systems for the installation of automatic fire extinguishing systems in our country.

The following different fittings have been covered by this standard:

> Elbow 90, Tees, Couplers, Cross Tee, Cap, Elbow 45, Red. Coupler, Red. Bush, Flanges, Plastic to Metal Transition Tee, Plastic to Metal transition Elbow, Plastic to Metal transition Coupler, Plastic to Metal transition Bush, Plastic to Metal transition Male Adapter, Plastic to Metal transition Female Adapter, Plastic to Metal transition Tee.

This standard lays down specification for chlorinated polyvinyl chloride (CPVC) fittings to be used with CPVC pipes as per IS 16088 : 2012 'Chlorinated polyvinyl chloride (CPVC) pipes for automatic sprinkler fire extinguishing system — Specification' meant for installation of automatic sprinkler fire extinguishing systems to IS 15105 : 2002 'Design and installation of fixed automatic sprinkler fire extinguishing systems — Code of priactice' for light hazard occupancies . These CPVC fittings are recommended for wet piping system only.

This standard is based on IS 16088 : 2012 and the dimension of CPVC pipe fittings covered in this standard are in IPS (Iron Pipe Size) and are fully compatible with IS 16088.

The detailed recommendatory information regarding jointing for CPVC pipes with fittings procedure and installation techniques for automatic sprinkler fire extinguishing system has been already provided in IS 16088.

The composition of the Committee responsible for the formulation of this standard is given in Annex G.

For the purpose of deciding whether the particular requirement of this standard is complied with the final value, observed or calculated, expressing the results of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE FITTINGS FOR AUTOMATIC SPRINKLER FIRE EXTINGUISHING SYSTEM — SPECIFICATION

1 SCOPE

This standard covers requirements, test methods and methods of marking for chlorinated polyvinyl chloride fittings to be used with CPVC pipes as per IS 16088 meant for installation of automatic sprinkler fire extinguishing systems to IS 15105 for light hazard occupancies. These CPVC fittings are recommended for wet piping system only.

2 REFERENCES

The standards listed in Annex A contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to 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

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

3.1 Nominal Size (DN) — The numerical designation for the size of a fitting which is a convenient round number approximately equal to the manufacturing dimensions in millimetres.

3.2 Inside Diameter of Socket at Entry (d_{s1}) — Arithmetic mean of two measured inside diameters perpendicular to each other at the entry of socket.

3.3 Inside Diameter of Socket at Shoulder (d_{s2}) — Arithmetic mean of two measured inside diameters perpendicular to each other at the shoulder(bottom) of socket.

3.4 Out-of-Roundness (Ovality) – Difference between the measured maximum inside diameter and the measured minimum inside diameter in the same cross Sectional plane of a socket.

3.5 Minimum Wall Thickness (e_{min}) — The minimum value of the measurement of the wall thickness at any point around the circumference of component.

3.6 Tolerance — The permitted variations of the specified value of a quantity, expressed as the difference between the permitted maximum and the permitted minimum values.

3.7 Working Pressure (PN) — The numerical designation of a fitting related to the mechanical characteristics of that fitting used for reference purposes.

3.8 Tests

3.8.1 *Type Tests* — Tests carried out whenever a change is made in the composition or in the size in order to establish the suitability and the performance capability of the fitting.

3.8.2 *Acceptance Tests* — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.9 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 re-processible or recyclable material(s) have been added.

3.10 Own Rework Material — Material prepared from rejected unused fittings, including the runners from the production of fitting, which will be reprocessed in a manufacturer's plant by a process such as injection moulding and for which the complete formulation is known.

3.11 Sprinkler System — The entire means of providing sprinkler protection in the premises comprising one or more sprinkler installation, the fitting work to the installation and the water supply/ supplies except town mains and bodies of water such as lakes or canals.

3.12 Installation, Wet Pipe Fitting — An installation in which the fitting work is always charged with water.

3.13 Light Hazard Occupancies — Non-industrial occupancies where the areas of rooms, corridors, halls, etc, are not more than 125 m^2 and above are bounded by masonry/ or RCC walls up to the roof and door openings therein protected by doors.

3.14 Hangers — An assembly for suspending pipe and fitting work from the elements of building structure.

3.15 Thermoplastic Compounds — Mixture of a polymer with other ingredients such as fillers, stabilizers, catalysts, processing aids, lubricants, modifiers, pigments.

4 NOTATION

The following notation (symbols) shall apply in this standard.

DN = nominal size
d_{s1} = inside diameter of the socket at entry
d_{s2} = inside diameter of the socket at shoulder (bottom)
L = socket length
l_0 = free length
r = bending radius
z = laying length (Z – length)
α_n = nominal angle of fitting
e_{min} = minimum wall thickness at any point
PN = nominal pressure (working pressure)
fT = de-rating factor for water temperatures
ρ = material density
σ = hydrostatic stress
σ_s = design stress
E_w = radius at inside diameter of the socket at entry
E_x = chamber height at inside diameter of the socket at entry
E_z = chamber height at inside diameter of the socket at entry

5 CLASSIFICATION OF FITTINGS

The working pressure of fittings is 2.17 MPa (315 psi) at 23°C and 1.21 MPa (175 psi) at 65°C.

6 COMPOSITION

6.1 The compound from which the fitting is produced shall consist substantially of chlorinated polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of the fitting and the production of sound and durable fitting 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 to impair the chemical, physical or mechanical properties (in particular long-term mechanical strength and impact strength) as defined in this standard.

6.2 Compound Properties

6.2.1 The compound shall meet the requirement of IS 15225 for chlorinated polyvinyl chloride compound used for fittings. It shall have minimum performance designation of G.I.108-3-3-3 as per designation system given in **4.2** of IS 15225.

6.2.2 *Compound Chlorine Content*

The chlorinated polyvinyl chloride fittings compounds containing additives such as modifiers, lubricants, fillers, etc, from which the pipes are to be manufactured, shall have chlorine content not less than 55 percent when tested as per Annex B of IS 15778.

6.2.3 *Density*

The chlorinated polyvinyl chloride fittings compounds containing additives such as modifiers, lubricants, fillers, etc, from which the pipes are to be manufactured, shall have a density between 1 500 kg/m^3 and 1 640 kg/m^3, when tested in accordance with IS 13360 (Part 3/Sec 1).

7 DIMENSIONS OF FITTINGS

7.1 The inside diameter of the socket at entry, inside diameter of the socket at shoulder (bottom), socket length and wall thickness shall be as given in Table 1 and Table 2.

7.1.1 *Diameter*

The inside diameter of the socket at entry, inside diameter of the socket at shoulder (bottom) as given in Table 1 shall be measured according to the method given in IS 12235 (Part 1).

7.1.2 *Wall Thickness*

The socket and wall thickness of the fittings shall be as given in Table 1.

8 PHYSICAL AND CHEMICAL CHARACTERISTICS

8.1 Visual Appearance

The colour of the fitting shall be orange.

8.1.1 When viewed without magnification, the internal and external surfaces of fittings shall be smooth, clean and free from scoring, cavities and other surface defects to an extent that would prevent conformance with this standard. The material shall not contain visible impurities. Slight variations in the appearance of the colour shall be permitted.

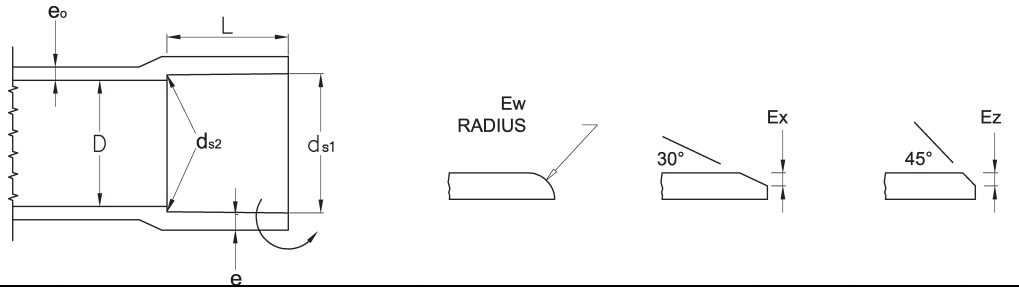
8.2 Opacity

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

Table 1 Inside Diameter of the Socket at Entrty, Inside Diameter of the Socket at Shoulder (Bottom), Socket Length and Wall Thickness

(*Clauses* 7.1 *and* 7.1.1)

All dimensions in millimetres.



Sl No.	Nominal Size DN mm	Socket Entrance Diameter d_{s1}			Socket Bottom Diameter d_{s2}			Socket Length, *L*	Inside Diameter, *D*	Wall Thickness *Min*	
		Diameter	Tolerance on Nominal Diameter	Maximum Out-of-Round	Diameter	Tolerance on Nominal Diameter	Maximum Out-of-Round	*Min*	*Min*	e	e_0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	20	26.90	0.10	0.5	26.60	0.10	0.5	18.30	17.70	2.90	3.60
ii)	25	33.70	0.13	0.5	33.30	0.13	0.5	22.20	23.10	3.40	4.20
iii)	32	42.40	0.13	0.6	42.00	0.13	0.6	23.80	31.20	3.60	4.50
iv)	40	48.60	0.15	0.6	48.10	0.15	0.6	34.90	36.70	5.10	6.40
v)	50	60.60	0.15	0.6	60.20	0.15	0.6	38.10	47.80	5.50	7.00
vi)	65	73.40	0.18	0.8	72.90	0.18	0.8	44.50	57.20	7.00	8.80
vii)	80	89.30	0.20	0.8	88.70	0.20	0.8	47.60	71.60	7.60	9.50

NOTE — In plastic to metal fittings — Such as Plastic to Metal transition Tee, Plastic to Metal transition Elbow, Plastic to Metal transition Coupler, Plastic to Metal transition Bush, Plastic to Metal transition Male Adapter, Plastic to Metal transition Female Adapter, dimensions of sockets at plastic side should be as per Table 1 and dimensions at metal side should be as per manufacturer's specification.

8.3 Stress Relief Test

The test specimen shall not show blisters, excessive delamination or cracking or signs of weld line splitting when tested in accordance with IS 12235 (Part 6). The weld line or lines may become pronounced during the test, but this shall not be deemed to constitute failure.

8.4 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 108°C.

8.5 Density

When tested in accordance with IS 12235 (Part 14), the density of the fittings shall be between 1 500 kg/m^3 and 1 640 kg/m^3.

8.6 Fire Exposure Test

CPVC pipes and fittings shall be fire tested for 10 min as per the test procedure given in Annex B of IS 16088. During the fire testing pipe and fittings assemblies shall not burst, separate or leak and shall maintain the sprinkler in the intended operating position. Following the fire exposure, the pipe and fitting assemblies shall withstand an internal hydrostatic pressure equal to the maximum rated pressure for 5 min without rupture or leaks.

8.7 Flammability Test

The CPVC specimen should be tested for flammability test as per Annex C of IS 16088 and shall match the V-0 rating. The specimen shall be prepared as per Annex B of IS 15225.

9 MECHANICAL PROPERTIES

9.1 Hydrostatic Characteristics

9.1.1 *Short Term*

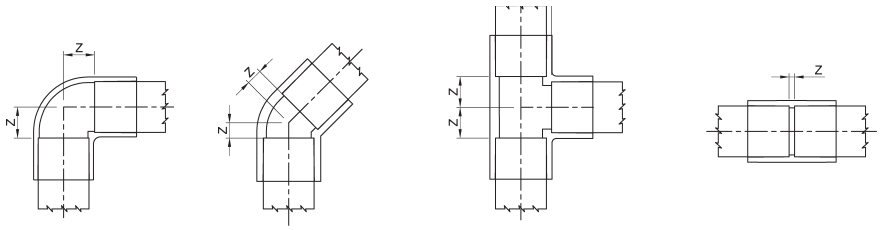
When subjected to internal hydrostatic pressure test in accordance with the procedure given in Annex B, the representative fitting sample shall withstand for 1 min without rupture, separation or leakage at an internal hydrostatic pressure of 5 times the rated pressure at room temperature.

9.1.2 *Long Term*

When subjected to internal hydrostatic pressure test in

Table 2 Minimum Laying Lengths (Z-Lengths) of Elbows, Tees and Couplers (Double-Sockets)
(*Clause* 7.1.2)

All dimensions in millimetres.



A) 90° ELBOW B) 45° ELBOW C) 90° TEE D) COUPLER

Sl No.	Nominal Size DN	Minimum Laying Lengths (Z-lengths) — Type of Fitting			Couplers
		90° Elbow/ Plastic to Metal Transition Elbow	45° Elbow	90° TEE/Cross TEE/ Plastic to Metal transition Tee	
(1)	(2)	(3)	(4)	(5)	(6)
i)	20	14.30	7.90	14.30	2.40
ii)	25	17.50	7.90	17.50	2.40
iii)	32	22.20	9.50	22.20	2.40
iv)	40	25.40	11.20	25.40	2.30
v)	50	31.80	16.00	31.80	2.30
vi)	65	38.10	17.50	38.10	4.80
vii)	80	46.00	19.10	46.00	4.80

NOTE — For fittings type other than above such as Cross Tee, Cap, and Red. Coupler, Red. Bush, Flanges, Plastic to Metal transition Tee, Plastic to Metal transition Elbow, Plastic to Metal transition Coupler, Plastic to Metal transition Bush, Plastic to Metal transition Male Adapter, Plastic to Metal transition Female Adapter, the minimum laying length shall be also as per above table with respect to corresponding sizes.

accordance with the procedure given Annex B, the representative fitting sample shall withstand for 1 000 h without rupture, separation or leakage at an internal hydrostatic pressure of 2.55 MPa at 65°C.

9.2 Vibration Test

Representative pipe and fitting assemblies shall withstand the effects of vibration for 30 h in accordance with the procedure given in Annex C without deterioration of performance characteristics. Following the vibration test, each test assembly shall comply with the short term test given in **9.1.1**.

9.3 Ten Day Moist Ammonia Air Stress Cracking Test

After being subjected to the conditions described in Annex D, a representative brass part containing more than 15 percent zinc shall show no evidence of cracking when examined using 25 X magnification.

9.4 Flexural Strength

Representative pipe and fitting joints shall sustain a bending moment as mentioned in Annex E.

10 SAMPLING AND CRITERIA FOR CONFORMITY

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

11 MARKING

11.1 Marking elements shall be printed or formed directly on the fitting in such a way that after storage, handling, and installation legibility is maintained. The marking shall show the following:

a) Manufacturer's name or trade-mark;
b) Nominal fitting size;
c) The word 'CPVC';
d) Batch or Lot number (or) Date/time of manufacture; and
e) Class of fitting and pressure rating/ temperature.

11.2 BIS Certification Marking

Each fitting may also be marked with the Standard Mark.

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

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
4905 : 1968	Methods for random sampling	15105 : 2002	Design and installation of fixed automatic sprinkler fire extinguishing systems — Code of practice
12235	Thermoplastic pipes and fittings – Methods of test:	15225 : 2002	Chlorinated polyvinyl chloride compounds used for pipes and fittings — Specification
(Part 1) : 2004	Measurement of dimensions	15778 : 2007	Chlorinated poly vinyl chloride (CPVC) pipes for potable hot and cold water distribution supplies — Specification
(Part 2) : 2004	Determination of vicat softening temperature	16088 : 2012	Chlorinated polyvinyl chloride (CPVC) pipe for automatic sprinkler fire extinguishing system — Specification
(Part 3) : 2004	Test for opacity		
(Part 6) : 2004	Stress relief test		
(Part 14) : 2004	Determination of density/relative density (specific gravity)		
13360 : (Part 3/ Sec 1) : 1995	Plastics — Method of testing: Part 3 Physical and dimensional properties, Section 1 Determination of density and relative density of non-cellular plastics		

ANNEX B

(*Clauses* 9.1.1 *and* 9.1.2)

SHORT TERM HYDROSTATIC PRESSURE TESTING

B-1 APPARATUS

Equipment which permits the application of an internal hydrostatic pressure of 5 times the rated pressure at room temperature for at least 30 min on the fitting to be tested.

B-2 TEST SPECIMEN

B-2.1 Each test specimen shall consist of a fitting, solvent welded to a section of pipe having a minimum length of 250 mm and capable of withstanding an internal pressure of at least 5 times the rated pressure of the fitting. A period of at least 24 h shall be allowed to ensure satisfactory setting of the joint.

B-2.2 Fitting fixtures or jigs are also allowed to perform the test. In this case the procedure remains same except there is no need of pipes to make assemblies.

B-3 PROCEDURE

B-3.1 The free end of the pipe section shall be connected to the hydrostatic pressure testing equipment. The other end(s) of the test specimen shall be closed by any appropriate means.

B-3.2 The test specimen thus assembled shall be subjected for 1 min to an internal pressure of 5 times the rated pressure of the fitting, at a temperature of 23 ± 2°C.

B-3.3 Thought the test, the specimen shall be suspended or placed in such a manner that the induced stress is not limited by external forces.

B-4 INTERPRETATION OF RESULTS

A fitting shall be considered as having passed the test if it shows no signed of deterioration, leakage, fracture or other failure under specified conditions. The test shall be repeated if the pipe bursts or if the solvent-welded joints leak.

ANNEX C

(*Clause* 9.2)

VIBRATION TEST

C-1 Pipe and fitting assemblies shall withstand the effects of vibration for 30 h without deterioration of performance characteristics. Following the vibration test, each test assembly shall comply with the specified requirements given in the hydrostatic pressure test (*see* **9.1.1**).

C-2 For pipe and fitting sizes greater than nominal 1/2 inch, representative pipe and fitting arrangements, assembled in accordance with the installation and design manual and consisting of approximately 2 feet (610 mm) lengths of pipe attached to each outlet of a tee, are to be placed horizontally and attached to a vibration table. The pipe branch lines are to be attached to the vibration table on each side of the tee outlets in accordance with the installation and design manual. The side tee outlet branch line is to have a fitting on the end of the branch line pipe and is to be supported with a pipe support located near the end fitting. The pipe support which is most expected to cause pipe damage or abrasion is to be selected based on the type of pipe supports specified in the installation and design manual. The pipe support is to be located at the maximum distance from the end fitting as specified in the installation and design manual and attached to a fixed (non-vibrating) support. A load equivalent to the weight of a 4 feet (1.2 m) length of water-filled pipe is to hang freely from the fitting located on the end of the side outlet pipe branch line. *See* Fig. 1 for the general test arrangement.

C-3 For nominal 1/2 inch pipe and fitting sizes, representative pipe and fitting arrangements, assembled in accordance with the installation and design manual and consisting of approximately 2 feet (610 mm) lengths of pipe, a multi-port manifold fitting, and a multi-port sprinkler adapter fitting are to be placed horizontally and attached to a vibration table. The outer ports of the manifold fitting are to be attached to the inner ports of the sprinkler adapter fitting with pipe. The other ports of both the manifold fitting and sprinkler adapter fitting are to be attached to pipe. The sprinkler adapter fitting is to be attached to the vibration table in accordance with the installation and design manual. The manifold fitting and the outer pipe branch lines of the sprinkler adapter fitting are to be attached to a fixed (non vibrating) support. The inner pipe branch lines of the manifold fitting are to be supported near the end fitting with pipe supports attached to the vibration table. The pipe supports which are most

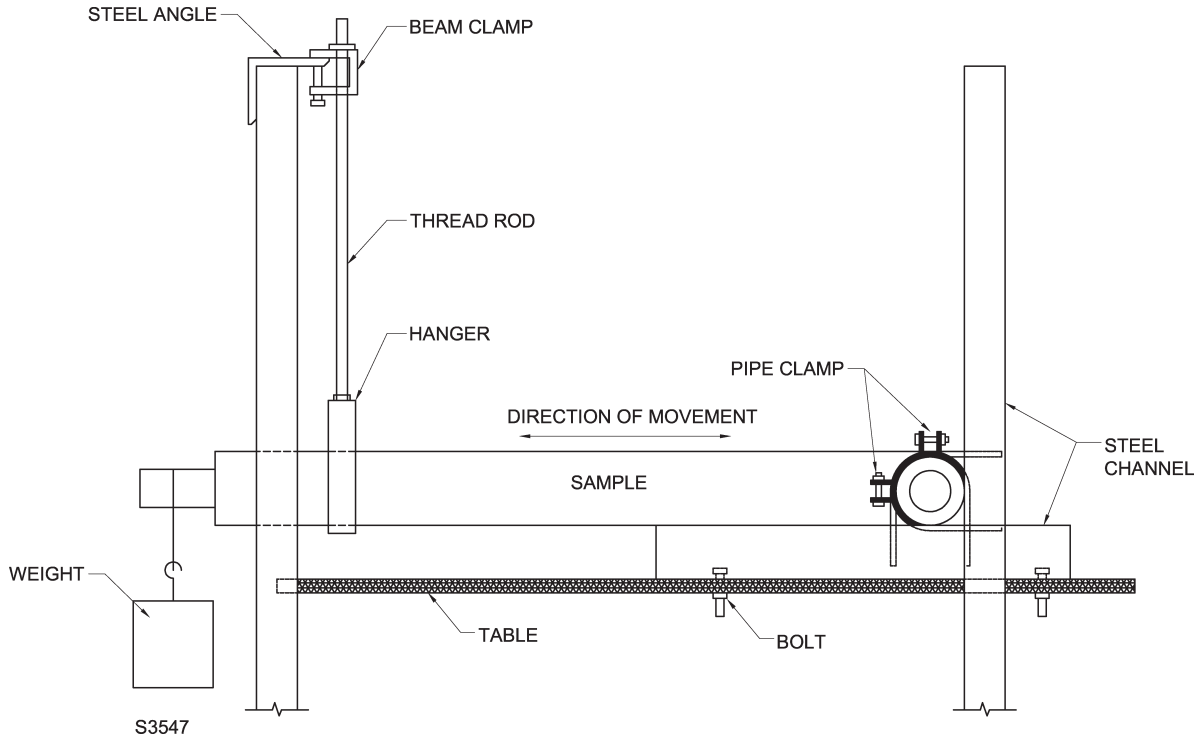


FIG. 1 GENERAL TEST ARRANGEMENT — VIBRATION TEST

expected to cause pipe damage or abrasion are to be selected from those specified in the installation and design manual.

C-4 For flexible piping products, representative pipe and fitting arrangements, assembled in accordance with the installation and design manual and consisting of approximately 2 feet (610 mm) lengths of pipe are to be bent to the minimum bending radius specified in the installation and design manual and attached to a vibration table. One end of the pipe is to be attached to the vibration table and the other end is to be attached to a fixed (non vibrating) support. The pipe supports which are most expected to cause pipe damage or abrasion are to be selected from those specified in the installation and design manual.

C-5 Unpressurized sample assemblies are to be subjected to a vibration of 0.02 inch (0.51 mm) amplitude at a varying frequency ranging from 18 to 37 Hz for a period of 5 h. The cycle period is to be 25 ± 5 s. If one or more resonant points are clearly detectable, the assemblies are to be vibrated at that frequency or frequencies for periods of the remaining 25 h of the test proportionate to the number of resonant frequencies discovered. If no resonant frequency is detected, then tests are to be conducted at the amplitudes, frequencies, and time periods noted in Table 3. Amplitude is the maximum displacement of sinusoidal motion from position of rest or one-half of the total table displacement.

Table 3 Amplitude of Vibration
(*Clause* C-5)

Sl No.	Amplitude inch (mm)	Total Displacement inch (mm)	Frequency Hz	Time h
(1)	(2)	(3)	(4)	(5)
i)	0.010 (0.25)	0.020 (0.51)	28	5
ii)	0.020 (0.51)	0.040 (1.02)	28	5
iii)	0.075 (1.90)	0.150 (3.81)	28	5
iv)	0.020 (0.51)	0.040 (1.02)	18–37 (variable)	5
v)	0.035 (0.89)	0.070 (1.78)	18–37 (variable)	5

C-6 After being subjected to the required vibration, the sample is to be examined for wear or damage, and then subjected to the Hydrostatic Pressure Test (*see* **9.1.1**).

ANNEX D

(*Clause* 9.3)

TEN DAY MOIST AMMONIA AIR STRESS CRACKING TEST

D-1 After being subjected to the conditions described in **D-2** to **D-4**, a brass part containing more than 15 percent zinc shall show no evidence of cracking when examined using 25 X magnification.

Exception: Cracking is allowed when it does not impact the ability of the product to comply with the requirements of this standard.

D-2 Each test sample is to be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses are to be applied to the sample prior to and maintained during the test. Samples with threads, intended to be used for installing the product in the field, are to have the threads engaged and tightened to the torque specified in Table 4. Teflon tape or pipe compounds are not to be used on the threads.

D-3 Three samples are to be degreased and then continuously exposed in a set position for ten days to a moist ammonia-air mixture maintained in a glass chamber 12 ± 1 × 12 ± 1 by 12 ± 1 inches (304.8 ± 25.4 × 304.8 ± 25.4 × 304.8 ± 25.4 mm) having a glass cover.

Table 4 Torque Requirements for Threaded Connections
(*Clause* D-2)

Sl No.	Nominal Size Inch (mm)	Torque	
		pound-inches	(N·m)
(1)	(2)	(3)	(4)
i)	¾ (20)	600	(68)
ii)	1 (25)	1 200	(136)
iii)	1¼ (32)	1 450	(164)
iv)	1½ (40)	1 550	(175)
v)	2 (50)	1 650	(186)
vi)	3 (80)	1 800	(203)

D-4 600 ml of aqueous ammonia having a specific gravity of 0.94 is to be maintained at the bottom the glass chamber below the samples. The samples are to be positioned $1.5^{+0.5}_{-0}$ inch ($38.1^{+12.7}_{-0}$ mm) above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber is to be maintained at atmospheric pressure and at a temperature of 93 ± 2°F (34 ± 1°C).

ANNEX E

(*Clause* 9.4.1)

FLEXURAL STRENGTH

E-1 Representative samples of piping joints shall sustain a bending moment equivalent to twice the weight of the water filled pipe over twice the hanger spacing distance without kinking, leaking, or other signs of permanent damage.

E-2 The samples are to be installed using two pipe hangers that are located at twice the maximum spacing as specified in Table 7 of IS 16088. The pipe joint is to be centered between hangers. The pipe assembly is to be filled with water and pressurized to the rated pressure. A point load of one-half the weight of the water filled pipe between the hangers is to be applied to the sample at the center point between the two hangers and held for 1 min (*see* Fig. 2). A test method using shorter hanger spacing's with a corresponding increase in applied load to achieve an equivalent bending moment is also allowed, using the following formula:

$$p = \left(2wL_r^2 - wL_t^2\right) / 2L_t$$

where

P = point load to be applied in pounds;

w = weight per unit length of water filled pipe in pounds per feet;

L_r = twice the maximum support spacing distance specified in Table 7 of IS 16088; and

L_t = the distance between supports in test set-up in feet.

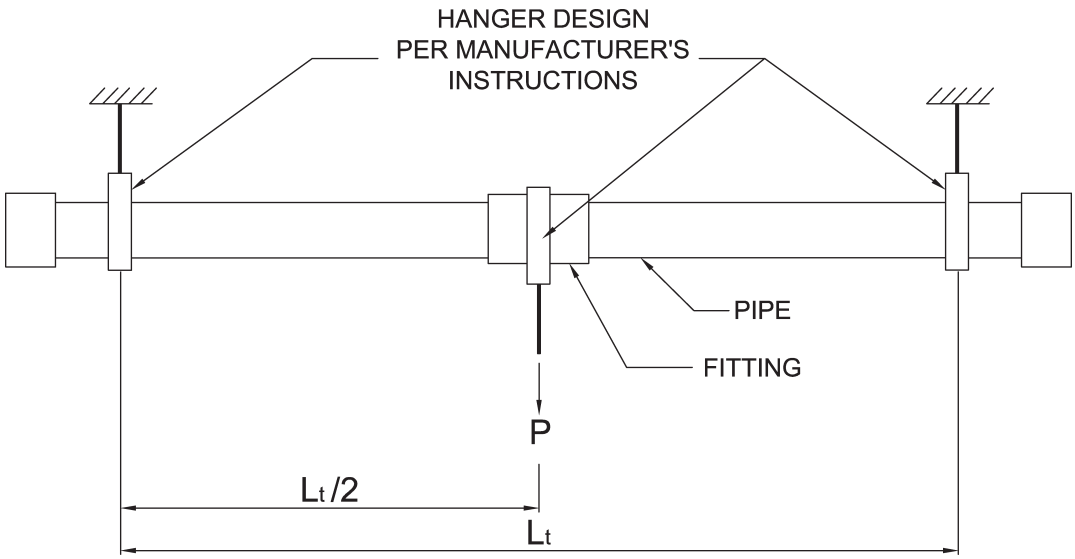


FIG. 2 FLEXURAL TEST CONFIGURATION

ANNEX F

(*Clause* 10)

SAMPLING AND CRITERIA FOR CONFORMITY

F-1 ACCEPTANCE TESTS

F-1.1 Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot.

F-1.2 Lot

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

F-1.3 For ascertaining conformity of the lot to the requirements of the specification, samples shall be tested from each lot separately.

F-1.4 Visual and Dimensional Requirements

F-1.4.1 The number of test samples to be taken from a lot shall depend on the size of the lot and nominal diameter of the fittings, and shall be in accordance with Table 5.

F-1.4.2 These fittings 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, the following procedure may be adopted:

Starting from any fitting in the lot, count them as 1, 2, 3, etc, up to *r* and so on, where *r* is the integral part of *N/n*, *N* being the number of fittings in the lot, and *n* the number of fittings in the sample. Every *r*-th fitting so counted shall be withdrawn so as to constitute the required sample size.

F-1.4.3 The number of fittings given for the first sample in col 4 of Table 5, shall be taken from the lot and examined for visual and dimensional requirements given in **7** and **8.1**. A fitting 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 6 of Table 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 7 of Table 5. If, however, the number of defectives found in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7 of Table 5, a second sample of the size given in col 4 of Table 5 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 6 of Table 5, otherwise not.

F-1.5 Stress Relief Test

F-1.5.1 The lot, having satisfied visual and dimensional requirements, shall be tested for stress relief test as given in **8.3**.

F-1.5.2 For this purpose, the number of fitting given for the first sample in col 3 of Table 6 shall be taken from the lot. The sample fitting failing the Stress Relief Test test shall be considered as defective. The lot shall be deemed to have met the requirements given in this standard for the Stress Relief-Test, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 6 of Table 6. This 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

Table 5 Scale of Sampling for Visual Appearance and Dimensional Requirements

(*Clauses* F-1.4.1 *and* F-1.4.3)

Sl No.	No. of Fittings in the Lot	Sample Number	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Up to 1 000	First	13	13	0	2
		Second	13	26	1	2
ii)	1 001 to 3 000	First	20	20	0	2
		Second	20	40	1	2
iii)	3 001 to 1 0000	First	32	32	0	3
		Second	32	64	3	4
iv)	10 001 and above	First	50	50	1	4
		Second	50	100	4	5

Table 6 Scale of Sampling for Stress Relief, Vicat Softening Temperature and Density Test
(*Clauses* F-1.5.2, F-1.6.2 *and* F-1.7.2)

Sl No.	Number of Fittings in the Lot	Sample Number	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Up to 1 000	First	5	5	0	2
		Second	5	10	1	2
ii)	1 001 to 3 000	First	8	8	0	2
		Second	8	16	1	2
iii)	3 001 to 10 000	First	13	13	0	2
		Second	13	26	1	2
iv)	10 001 and above	First	20	20	0	3
		Second	20	40	3	4

number given in col 7 of Table 6. If, however, the number of defectives in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7 of Table 6, a second sample of size given in col 4 of Table 6 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 6 of Table 6, otherwise not.

F-1.6 Vicat Softening Test

F-1.6.1 The lot, having satisfied visual and dimensional requirements shall be tested for Vicat softening temperature as given in **8.4**.

F-1.6.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for stress relief test under **F-1.5.2** using Table 6.

F-1.7 Density

F-1.7.1 The lot, having satisfied the visual and dimensional requirements, shall be tested for density as given in **8.5**.

F-1.7.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that for stress relief test under **F-1.5.2** using Table 6.

F-1.8 Short Term Hydrostatic Pressure Test

F-1.8.1 The lot, having been found satisfactory according to **F-1.4, F-1.5, F-1.6,** and **F-1.7**, shall be subjected to the requirements of the acceptance test for internal hydrostatic pressure as given in **9.1.1**. The number of fittings to be taken from the lot shall depend on the size of the lot and shall be according to Table 7.

F-1.8.2 The fittings shall be taken at random from the lot. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

F-1-8.3 *Number of Tests and Criteria for Conformity*

The number of test samples shall be as given in Table 7. 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 7.

Table 7 Scale of Sampling for Internal Hydrostatic Test
(*Clauses* F-1.8.1 *and* F-1.8.3)

Sl No.	Number of Fittings in the Lot	Sample Size	Acceptance Number
(1)	(2)	(3)	(4)
i)	Up to 3 000	2	0
ii)	3 001 to 10 000	3	0
iii)	10 001 and above	5	0

F-2 TYPE TESTS

F-2.1 Type tests are intended to prove the suitability and performance of a new composition or a new size of fitting. Such tests, therefore, need to be applied only when a change is made in polymer composition or when a new size of fitting is be introduced. Type tests for compliance with **6.2.1**, **6.2.2**, **8.6**, **8.7**, **9.1.2**, **9.3** and **9.4** shall be carried out.

F-2.2 Performance Designation and Chlorine Content

For this test, the manufacturer or the supplier shall furnish to the testing authority one sample of the fitting of any size or CPVC compound as mentioned in **6**.

F-2.2.1 The sample so selected shall be tested for compliance with requirements for performance designation as mentioned in **6.2.1** and chlorine content as mentioned in **6.2.2**.

F-2.2.2 If the sample passes the requirements of the test, the class of the fitting under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

F-2.2.3 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 test. If the sample passes the repeat test, the class of fitting under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.2.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for a fresh sample for test for the purpose of type approval.

F-2.3 Opacity

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

F-2.3.1 The sample so selected shall be tested for compliance with requirements for opacity as given in **8.2**.

F-2.3.2 If the sample passes the requirements of the opacity test, the class of the fitting under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

F-2.3.3 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 class of fitting under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the class of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.3.4 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.

F-2.4 Fire Exposure Test

For this type test, the manufacturer or the supplier shall furnish to the testing authority, one sample of fitting of any size preferably 40 mm (1½") for testing.

F-2.4.1 The sample so selected shall be tested for compliance with the requirements of type test given in **8.6**.

F-2.4.2 If the sample pass the requirement of the quality test, the class of fitting under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of 1 year.

F-2.4.3 In case the sample fails in this test, the testing authority, at its discretion, may call for fresh sample not exceeding the original number and subject them to the type test. If, in the repeat test no single failure occurs, the class of fitting shall be considered for type approval. If sample fail in the repeat tests, the class of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.4.4 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.

F-2.5 Flammability Test

For this type test, the manufacturer or the supplier shall furnish to the testing authority, one sample as per specimen requirements of **8.7**.

F-2.5.1 The sample so selected shall be tested for compliance with the requirements of type test given in **8.7**.

F-2.5.2 If the sample pass the requirement of the quality test, the class of fitting under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of 1 year.

F-2.5.3 In case the sample fails in this test, the testing authority, at its discretion, may call for fresh sample not exceeding the original numbers and subject them to the type test. If, in the repeat test no single failure occurs, the class of fitting shall be considered for type approval. If any of the sample fail in the repeat tests, the class of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.5.4 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.

F-2.6 Long Term Hydrostatic Testing

For this type test, the manufacturer or the supplier shall furnish to the testing authority, one sample of any fitting size.

F-2.6.1 The sample so selected shall be tested for compliance with the requirements of type test given in **9.1.2**.

F-2.6.2 If the sample pass the requirement of the quality test, the class of fitting under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

F-2.6.3 In case the sample fails in this test, the testing authority, at its discretion, may call for fresh sample not exceeding the original numbers and subject them

to the type test. If, in the repeat test no single failure occurs, the class of fitting shall be considered for type approval. If any of the sample fail in the repeat tests, the class of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.6.4 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.

F-2.7 Vibration Test

For this type test, the manufacturer or the supplier shall furnish to the testing authority, one sample as per specimen requirements of **9.2**.

F-2.7.1 The sample so selected shall be tested for compliance with the requirements of type test given in **9.2**.

F-2.7.2 If the sample pass the requirement of the quality test, the class of fitting under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

F-2.7.3 In case the sample fails in this test, the testing authority, at its discretion, may call for fresh sample not exceeding the original numbers and subject them to the type test. If, in the repeat test no single failure occurs, the class of fitting shall be considered for type approval. If any of the sample fail in the repeat tests, the class of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.7.4 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.

F-2.8 Ten Day Moist Ammonia Air Stress Cracking Test

For this type test, the manufacturer or the supplier shall furnish to the testing authority, one sample as per specimen requirements of **9.3**.

F-2.8.1 The sample so selected shall be tested for compliance with the requirements of type test given in **9.3**.

F-2.8.2 If the sample pass the requirement of the quality test, the class of fitting under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

F-2.8.3 In case the sample fails in this test, the testing authority, at its discretion, may call for fresh sample not exceeding the original numbers and subject them to the type test. If, in the repeat test no single failure occurs, the class of fitting shall be considered for type approval. If any of the sample fail in the repeat tests, the class of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.8.4 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.

F-2.9 Flexural Strength Test

For this type test, the manufacturer or the supplier shall furnish to the testing authority, one sample as per requirements of **9.4**.

F-2.9.1 The sample so selected shall be tested for compliance with the requirements of type test given in **9.4**.

F-2.9.2 If the sample pass the requirement of the quality test, the class of fitting under consideration shall be considered to be eligible for type approval which shall be normally valid for a period of one year.

F-2.9.3 In case the sample fails in this test, the testing authority, at its discretion, may call for fresh sample not exceeding the original numbers and subject them to the type test. If, in the repeat test no single failure occurs, the class of fitting shall be considered for type approval. If any of the sample fail in the repeat tests, the class of fitting shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

F-2.9.4 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.

ANNEX G

(*Foreword*)

COMMITTEE COMPOSITION

Fire Fighting Sectional Committee, CED 22

Organization	*Representative(s)*
Ministry of Home Affairs, New Delhi	Shri D K Shami (***Chairman***)
Aerostar Helmets Limited, New Delhi	Shri Kuljit S. Arora
Agni Controls, Chennai	Shri D. Balachandran
Airport Authority of India, New Delhi	Shri Subhash Kumar Shri P. K. Deshmukh (*Alternate*)
Bhabha Atomic Research Centre, Mumbai	Chief Fire Officer
Brijbasi Hitech Udyog Ltd, New Delhi	Shri Mahesh C. Aggarwal Shri Rajesh K. Aggarwal (*Alternate*)
Building Fire Research Centre, Mysore	Dr N. Suresh Shri Y. M. Manjunath (*Alternate*)
Central Building Research Institute, Roorkee	Dr R. S. Chimote Shri Survir Singh (*Alternate*)
Central Industrial Security Force, New Delhi	Dr K. C. Wadhwa Shri S. D. Ingle (*Alternate*)
Central Public Works Department, New Delhi	Shri Chaitanya Kumar Verma Shri D. K. Tulani (*Alternate*)
Centre for Fire & Explosive Environment Safety (DIFR), New Delhi	Shri V. K. Sharma Shri M. K. Jain (*Alternate*)
Chennai Petroleum Corporation Ltd, Chennai	Shri J. P. K. Hepat
Chhatariya Rubber & Chemicals Industries, Mumbai	Shri S. A. Haveliwala Shri H. S. Haveliwala (*Alternate*)
Controllerate of Quality Assurance, Pune	Col V. V. Kadam Col N. K. N. Rao (*Alternate*)
Council of Architecture, New Delhi	President
Delhi Development Authority, New Delhi	Shri Sandip Mehta Shri S.K. Satija
Delhi Fire Services, New Delhi	Shri A. K. Sharma Dr G. C. Misra (*Alternate*)
Directorate of Fire and Emergency Services, Goa	Shri Ashok Menon Shri Rajendra A. Haldankar (*Alternate*)
Engineer-in-Chief's Branch, New Delhi	Dr Ram Verma Shri V. K. Gulati (*Alternate*)
Engineers India Ltd, New Delhi	Shri R. B. Bhutda Shri Vipan Goel (*Alternate*)
F.M. Engineering International India Branch, Bengaluru	Shri Sumit Khanna Shri Prasad Kulkarni (*Alternate*)
Fire & Emergency Services, J&K, Srinagar	Dr G. A. Bhat
Fire Protection Association of India, Mumbai	President
GAIL (India) Limited, New Delhi	Shri S. P. Garg Shri Sanjeev Kumar Kalkal (*Alternate*)
Gunnebo India Pvt Limited, Chennai	Shri K. Arul Prakash Shri Rajesh Sharma (*Alternate*)
H.D. Fire Protect Co, Thane	Shri Harish N. Dharamshi Shri K. T. Chaudhari (*Alternate*)
Indian Oil Corporation Limited, Noida	Shri Aashish R Gokhale
Institution of Fire Engineers, New Delhi	President General Secretary (*Alternate*)

Organization	*Representative(s)*
K. V. Fire Chemicals (India) Pvt Ltd, Navi Mumbai	Shri Rajesh H. Sabadra Shri Uday K. Shroff (*Alternate*)
Karnataka State Fire and Emergency Services, Bengaluru	Shri K. U. Ramesh Shri K. Srinivasa (*Alternate*)
Maharashtra Fire Services, Mumbai	Shri M. V. Deshmukh Shri S. S. Warick (*Alternate*)
Mumbai Fire Brigade, Mumbai	Shri S. V. Joshi Shri S. H. Nesrikar (*Alternate*)
National Fire Service College, Nagpur	Director
National Institute of Engineering, Mysore	Dr N. Suresh
National Thermal Power Corporation, New Delhi	Shri S. K. Jha Shri Sanjay verma (*Alternate*)
Newage Industries, Mumbai	Shri Ashok M. Shah Shri Shetul A. Shah (*Alternate*)
Oil Industry Safety Directorate, New Delhi	Shri S. K. Nandy
Prakash Suraksha Devices, Delhi	Shri Pramod Prakash Shri Amod Prakash (*Alternate*)
Reliance Industries Limited, Mumbai	Shri Varadendra Koti Shri Umesh Khandalkar (*Alternate*)
RESQ Technologies, Ahmedabad	Shri Rohit V. Shah
Safex Fire Services Limited, Mumbai	Shri Jitendra Shah Shri Sandip Shah (*Alternate*)
Shah Bhogilal Jethalal & Bros, Ahmedabad	Shri Mukesh M. Shah Shri Abhay D Purandare (*Alternate*)
State Bank of India, Mumbai	Shri Vijay S. Nalhe
Surex Production and Sales Private Limited, Kolkata	Shri Debashis Neogi
Swastik Synergy Engineering Pvt Ltd, Mumbai	Shri Mukesh D. Shah Shri Kunal Zatakia (*Alternate*)
Tamil Nadu Fire and Rescue Services Department, Chennai	Shri S. Vijayasekar Shrimati N. Priya (*Alternate*)
Tyco Fire & Security India Pvt Ltd, Mumbai	Shri Manoj Shenoy Shri Riyazuddin Siddiqui (*Alternate*)
UL India Pvt Limited, Bengaluru	Shri Jagdish V. Shri S. P. Tej Kumar Behara (*Alternate*)
Uttar Pradesh Fire Services, Lucknow	Shri P. K. Rao Shri Aman Sharma (*Alternate*)
Wadia Body Builders	Representative
West Bengal Fire and Emergency Service, Kolkata	Shri D. P. Biswas Shri G. K. Bhattacharya (*Alternate*)
Zenith Fire Services (India) Pvt Ltd, Mumbai	Shri B. C. Shah Shri D. C. Shah (*Alternate*)
In personal capacity (*B-152, Ist Floor, East of Kailash, New Delhi*)	Shri Hemant Kumar
In personal capacity (*K-33-A, Green Park, New Delhi*)	Shri S. K. Dheri
In personal capacity (*P/4, Belgacuta Villa, Kolkata*)	Shri S. N. Kundu
In personal capacity (*A-45, Sector-70, Noida*)	Dr H. S. Kaprwan
In personal capacity (*A-347, Defence Colony, New Delhi*)	Shri R. C. Sharma
In personal capacity (*SJR Verity, VIVA-305, Amrita College Road, Bangalore*)	Shri T. R. A. Krishnan
BIS Directorate General	Shri B. K. Sinha, Scientist 'E' & Head (Civil Engg) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri Srikanth Yajjala
Scientist 'C' (Civil Engg), BIS

Fire Detection Alarms and Suppression System Subcommittee, CED 22:4

Organization	*Representative(s)*
Ministry of Home Affairs, New Delhi	Shri D. K. Shami (***Convener***)
Agni Control, Chennai	Shri D. Balachandran
Astral Polytechnik Ltd, Ahmedabad	Shri Kanwar A. Singh Shri Manoj Dhar (*Alternate*)
Bhabha Atomic Research Centre, Mumbai	Chief Fire Officer
Central Building Research Institute, Roorkee	Shri R. S. Chimote Shri Rajiv Goel (*Alternate*)
Central Public Works Department, New Delhi	Shri Chaitanya Kumar Verma Shri D. K. Tulani (*Alternate*)
Centre for Fire & Explosive Environment Safety (DFIR), Delhi	Shri V. K. Sharma Shri M. K. Jain (*Alternate*)
Chennai Petroleum Corporation Ltd, Chennai	Shri J. P. K. Hepat
Controllerate of Quality Assurance, Pune	Col V. V. Kadam Col N. K. N. Rao (*Alternate*)
Delhi Fire Services, New Delhi	Shri A. K. Sharma Dr G. C. Misra (*Alternate*)
Engineers India Ltd, New Delhi	Shri R. B. Bhutda Shri Vipan Goel (*Alternate*)
Gunnebo Steelage Industry Ltd, Chennai	Shri G. Parthasarathy
Institution of Fire Engineers (India), New Delhi	President General Secretary (*Alternate*)
Municipal Corporation of Greater Bombay, Mumbai	Chief Fire Officer Deputy Chief Fire Officer (*Alternate*)
National Thermal Power Corporation, New Delhi	Shri D. K. Suryanarayan
Newage Industries, Mumbai	Shri Ashok M. Shah Shri Shetul A. Shah (*Alternate*)
Nitin Fire Proetection Industries Ltd, Mumbai	Shri Nitin M. Shah Shri Pravin Shah (*Alternate*)
Prakash Suraksha Devices, New Delhi	Shri Pramod Prakash
Reliance Industries Limited, Mumbai	Shri Verendra Koti Shri Umesh Khandalkar (*Alternate*)
Steel Authority of India, Salem	Shri D. Kumaresan
Tyco Fire & Security India Pvt Ltd, Mumbai	Shri Manoj Shenoy Shri Riyazuddin Siddiqui (*Alternate*)
West Bengal Fire and Emergency Service, Kolkata	Shri D. P. Biswas Shri G. K. Bhattacharya (*Alternate*)
In personal capacity (*K-33-A, Green Park, New Delhi*)	Shri S. K. Dheri
In personal capacity (*A-45, Sector-70, Noida*)	Dr H. S. Kaprwan
In personal capacity (*A-347, Defence Colony, New Delhi*)	Shri R. C. Sharma
In personal capacity (*SJR Verity, VIVA-305, Amrita College Road, Bengaluru*)	Shri T. R. A. Krishnan

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

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

This Indian Standard has been developed from Doc No.: CED 22 (7961).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices: *Telephones*

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi, KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, CHANDIGARH 160019 — 26 50206, 265 0290

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches: AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. DURGAPUR. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. JAMMU. JAMSHEDPUR. KOCHI. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAIPUR. RAJKOT. VISAKHAPATNAM.

Published by BIS, New Delhi