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“Knowledge is such a treasure which cannot be stolen”

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भवन निर्माण सामग्रियों से संबंधित भारतीय मानकों का सार **Summaries of Indian Standards for Building Materials**

(SP 21 : 2005)



भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDARDS

SP 21 : 2005

**SUMMARIES OF INDIAN STANDARDS
FOR
BUILDING MATERIALS**
(First Revision)

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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FOREWORD

Users of various Civil Engineering Codes felt the need for explanatory handbooks and other compilations based on Indian Standards. The need was further emphasized in view of the publication of the National Building Code of India in 1970 and its implementation. The Expert Group set up in 1972 by Department of Science and Technology, Government of India carried out in depth studies in various of Civil Engineering and Construction Practices. During the preparation of the Fifth Five Year Plan in 1975, the Group was assigned the task of producing a Science and Technology Plan for research, development and extension work in the sectors of housing and construction technology. One of the items of this plan was the formulation of design handbooks, explanatory handbooks and design aids based on the National Building Code and various Indian Standards and other activities in the promotion of the National Building Code. The Expert Group gave high priority to this item and on the recommendation of the Department of Science and Technology, the Planning Commission approved the following two projects which were assigned to the Bureau of Indian Standards (erstwhile Indian Standards Institution):

- a) Development programme on code implementation for building and civil engineering construction, and
- b) Typification for industrial buildings

A Special Committee for Implementation of Science and Technology Projects (SCIP) consisting of experts connected with different aspects was set up in 1974 to advise the BIS Directorate General in identifying the Handbooks and for guiding the development of the work. Under the first project, the Committee had identified several subjects for preparing explanatory handbooks/compilations covering appropriate Indian Standards/Codes/Specifications. One of the compilations suggested was the Handbook on Summaries of Indian Standards for Building Materials, SP 21, first published in 1983 for the standards referred in Part 5 of National Building Code of India.

Ensuring the quality and effectiveness of building materials used in the construction and storage are as important as the other phases of building activity like planning, designing and constructing the building itself. Therefore, the Handbook gives a brief summary of the contents of Indian Standards on building materials to indicate such aspects as quality requirements, dimensions, range of properties, limitations on use, etc. This, however, does not cover the standards relating to paints and other specifications not of direct concern to buildings. This Handbook assists the professional Engineer/Architect, etc to choose the material for the purpose of their design and estimation. The general format of the summaries is, scope; range of sizes; important requirements regarding physical, mechanical and other properties; reference to appropriate methods of testing and other related material specifications.

It may be noted that the Handbook does not form part of any Indian Standard on the subject and does not have the status of an Indian Standard. Wherever, if there is any dispute about the interpretation or opinion expressed in this Handbook, the provisions of the latest version of the Standards only shall apply; the provisions of this Handbook should be considered as only supplementary and informative.

As many of the Indian Standards referred in the Handbook have been revised and many new Standards have been formulated since its first publication, it was decided to revise this Handbook. This revised version, while basically retaining the structure of 1983 version, explicitly provides for:

- a) The summaries of all the latest available Indian Standards on Building Materials including those formulated after the first publication of Handbook (this takes into account all the standards published till 31 December 2004)
- b) More user friendly version by suitable rearrangements of standards within the chapter.

The Handbook is based on the draft prepared by Shri K. Raghavendran, Former Deputy Director General, Bureau of Indian Standards. The Draft Handbook scrutinized within BIS, was circulated for review to Shri A.K. Sarkar, Former Chairman-cum-Managing Director, National Building Construction Company, Building Materials and Technology Promotion Council, New Delhi, Central Building Research Institute, Roorkee and Central Public Works Department, New Delhi and views expressed by them were taken into consideration while finalizing the Handbook.

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SECTION 1

CEMENT AND CONCRETE

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SUMMARY OF
IS 383 : 1970 COARSE AND FINE AGGREGATES FROM NATURAL
SOURCES FOR CONCRETE
(Second Revision)

1. Scope — Requirements for aggregates, crushed or uncrushed, derived from natural sources for use in the production of structural concrete including mass concrete works.

2. Requirements

2.1 Aggregates shall consist of naturally occurring stones, gravel and sand, and shall be hard, strong, dense, durable, clear and free from veins, adherent coating and injurious amounts of disintegrated pieces and deleterious substances.

2.2 Deleterious Materials — Aggregates shall not contain harmful materials, such as pyrites, laminated material, alkali, seashells, and organic impurities and those which may attack the reinforcement, in excess of the limits given in Table 1 of the standard. Aggregates shall not be chemically reactive with alkalis of cement.

2.3 Aggregate crushing value shall not exceed 30

percent for concrete for wearing surfaces (such as runways and roads) and 45 percent for other concrete.

2.4 Aggregate impact value (alternative to 2.3) shall not exceed 30 percent by weight for concrete for wearing surface and 45 percent by weight for other concrete.

2.5 Aggregate abrasion value shall not exceed 30 percent for concrete for wearing surfaces and 50 percent for other concrete.

2.6 Soundness (for concrete liable to be exposed to frost action) — Coarse and fine aggregates shall pass a sodium or magnesium sulphate accelerated soundness test specified in IS : 2386 (Part V) 1963, for concrete liable to be exposed to the action of frost.

3. Size and Grading

3.1 Single-Sized and Graded Coarse Aggregates— Shall be supplied in normal sizes given in the following table:

IS Sieve Designation	Percentage Passing for Single-Sized Aggregate of Nominal Size						Percentage Passing for Graded Aggregate of Nominal Size			
	63 mm	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
80 mm	100	-	-	-	-	-	100	-	-	-
63 mm	85 to 100	100	-	-	-	-	-	-	-	-
40 mm	0 to 30	85 to 100	100	-	-	-	95 to 100	100	-	-
20 mm	0 to 5	0 to 20	85 to 100	100	-	-	30 to 70	95 to 100	100	100
16 mm	-	-	-	85 to 100	100	-	-	-	90 to 100	-
12.5 mm	-	-	-	-	85 to 100	100	-	-	-	90 to 100
10 mm	0 to 5	0 to 5	0 to 20	0 to 30	0 to 45	85 to 100	10 to 35	25 to 55	30 to 70	40 to 85
4.75 mm	-	-	0 to 5	0 to 5	0 to 10	0 to 20	0 to 5	0 to 10	0 to 10	0 to 10
2.36 mm	-	-	-	-	-	0 to 5	-	-	-	-

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3.2 Coarse Aggregates for Mass Concrete – Shall be in sizes specified in the following table.

<i>Class and Size</i>	<i>IS Sieve Designation</i>	<i>Percentage Passing</i>
Very large, 160-80 mm	160 mm	90-100
	80 mm	0-10
Large, 80-40 mm	80 mm	90-100
	40 mm	0-10
Medium, 40-20 mm	40 mm	90-100
	20 mm	0-10
Small, 20-4.75 mm	20 mm	90-100
	4.75 mm	0-10
	2.36 mm	0-2

3.3 Fine Aggregates – Grading in zones I to IV shall be within the following limits:

<i>IS Sieve Designation</i>	<i>Percentage Passing for</i>			
	<i>Grading</i>	<i>Grading</i>	<i>Grading</i>	<i>Grading</i>
	<i>Zone I</i>	<i>Zone II</i>	<i>Zone III</i>	<i>Zone IV</i>
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

3.4 All-in Aggregates – When available, grading shall be according to the following table:

<i>IS Sieve Designation</i>	<i>Percentage Passing for All in</i>	
	<i>Aggregate of Nominal Size</i>	
	<i>40 mm</i>	<i>20 mm</i>
80 mm	100	—
40 mm	95-100	10
20 mm	45-75	95-100
4.75 mm	25-45	30-50
600 micron	8-30	10-35
150 micron	0-6	0-6

Note 1 — For methods of tests, refer to all parts of IS : 2386 Methods of test for aggregates for concrete:

Note 2 — Description and physical characteristics of aggregates for concrete is given in Appendix C of the standard.

For detailed information, refer to IS 383:1970 Specification for coarse and fine aggregates from natural sources for concrete (second revision).

SUMMARY OF
IS 2116 : 1980 SAND FOR MASONRY MORTARS
(First Revision)

1. Scope — Requirements of naturally occurring sands, crushed stone sands and crushed gravel sands used in mortars for construction of masonry.

2. Requirements

2.1 General — The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in **2.3 (a)**.

2.2 Deleterious Material — The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.

2.3 Limits of Deleterious Material — The maximum quantities of clay, fine silt, fine dust and organic impurities in the sand shall not exceed the following limits:

a) Clay, fine silt and fine dust	
1) In natural sand or crushed gravel sand	Not more than 5 percent by mass
2) In crushed stone sand	Not more than 5 percent by mass
b) Organic impurities.	Colour of the liquid shall be lighter than that indicated by the standard solution.

2.4. Grading

(a) The particle size grading of sand for use in mortars shall be within the limits as specified below:

<i>IS Sieve Designation</i>	<i>Percentage Passing by Mass</i>
4.75 mm	100
2.36 mm	90 to 100
1.18 mm	70 to 100
600 micron	40 to 100
300 micron	5 to 70
150 micron	0 to 15

(b) Various sizes of particle of which the sand is composed shall be uniformly distributed throughout the mass.

Note — For methods of tests, refer to IS 2386 Methods of test for aggregates for concrete Part 1:1963 Particle size and shape; Part 2 : 1963 Estimation of deleterious materials and organic impurities.

For detailed information, refer to IS 2116:1980 Specification for sand for masonry mortars (first revision).

SUMMARY OF

IS 9142 : 1979 ARTIFICIAL LIGHTWEIGHT AGGREGATES FOR CONCRETE MASONRY UNITS

1. Scope — Requirements of artificial lightweight aggregates, such as foamed blast furnace slag, bloated clay aggregate, sintered fly ash aggregate and cinder aggregate intended for use in concrete masonry units in which prime consideration is lightness in mass.

2. Requirements

2.1 Grading — The grading of the aggregate, that is, its particle size distribution as obtained by sieve analysis shall be as given in Table 1.

2.2 Bulk Density — The dry loose bulk density of combined aggregate shall not exceed 1100 kg/m³.

2.3 Uniformity of Mass — The bulk density of successive supplies of lightweight aggregate shall not differ by more than 10 percent from that of the sample submitted for acceptance tests.

2.4 Deleterious Substances

2.4.1 Organic Impurities — Lightweight aggregates, upon being subjected to the test for organic impurities,

that produce a colour darker than the standard colour shall be rejected, unless it can be demonstrated that the discolouration is due to small quantities of materials not harmful to the concrete

2.4.2 Clay Lumps — Shall not exceed 2 percent by dry mass.

2.4.3 Loss on Ignition — Loss on ignition of aggregates except cinder aggregates shall not exceed 4 percent by dry mass. For cinder aggregates, loss on ignition shall be as specified in IS 2686:1977*.

2.5 Concrete Making Properties

2.5.1 Drying Shrinkage — Shall not exceed 0.10 percent.

2.5.2 Sulphate Content — Shall not be more than one percent when expressed as sulphuric anhydride (SO₃) by mass.

*Cinder as fine aggregates for use in lime concrete (first revision)

**TABLE 1 GRADING REQUIREMENTS FOR LIGHTWEIGHT COMBINED
AGGREGATES FOR CONCRETE MASONRY UNITS**

Sl No.	Size Designations	Percentages (By Mass) Passing IS Sieves						
		20 mm	12.5 mm	10 mm	4.75 mm	2.36 mm	1.18 mm	300 microns
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Fine aggregate (4.75 to 0 mm)	—	—	100	85-100	—	40-80	10-35
ii)	Coarse aggregate (12.5 to 4.75 mm) (10 to 2.36 mm)	100	90-100	40-80	0-20	0-10	—	—
		—	100	80-100	5-40	0-20	—	—
iii)	Combined fine and coarse aggregate (10 mm to 0)	—	100	90-100	65-90	35-65	—	10-25

Note — For methods of tests refer to IS 2185 (Part 2):1983 Concrete masonry units Part 2 Hollow and solid light weight concrete blocks (*first revision*), IS 2386:1963 Methods of tests for aggregates for concrete, (Part 1) Particle size and shape, (Part 2) Organic Estimation of deleterious materials and organic impurities, Part 3 Specific gravity, density, voids, absorption and bulking, (IS 2686:1977 Cinder aggregate for use in lime concrete, and IS 4032:1985 Method of chemical analysis of hydraulic cement (*first revision*)).

For detailed information, refer to IS 9142:1979 Specification for artificial lightweight aggregates for concrete masonry units.

SUMMARY OF
IS 269 : 1989 ORDINARY PORTLAND CEMENT, 33 GRADE
(Fourth Revision)

1. Scope — Covers the manufacture and chemical and physical requirements of 33 grade ordinary Portland cement.

2. Chemical Requirements — When tested in accordance with the methods given in IS 4032 : 1985, 33 grade ordinary Portland cement shall comply with the chemical requirements given in Table 1.

3. Physical Requirements

3.1 Fineness — Specific surface of cement shall not be less than 225 m²/kg.

3.2 Soundness — Un-aerated expansion shall be not more than 10 mm by 'Le Chatelier' method and 0.8 percent by autoclave test; if it fails, aerated sample shall not show more of than 5 mm and 0.6 percent when tested by 'Le Chatelier' method and autoclave method respectively.

3.3 Setting Time — The setting time of the cements, when tested by the vicat apparatus shall conform to the following requirements:

a) Initial setting time in minutes Not less than 30; and

b) Final setting time in minutes Not more than 600.

3.4 Compressive Strength — The average of at least three mortar cubes (area of face 50 cm²) composed of one part of cement, three parts of standard sand by mass

and $\left(\frac{P}{4} + 3.0\right)$ percent (of combined mass of cement plus sand) water and prepared, stored and tested shall be as follows:

a) 72 ± 1 hour : not less than 16 MPa,

b) 168 ± 2 hours : not less than 22 MPa, and

c) 672 ± 4 hours : not less than 33 MPa.

4. Delivery — Packed in specified bags of 50 kg, 25 kg, 10 kg, 5 kg, 2 kg or 1 kg net or in bulk with tolerances specified in the standard.

TABLE 1 CHEMICAL REQUIREMENTS FOR 33 GRADE ORDINARY PORTLAND CEMENT

Sl. No. (1)	Characteristics (2)	Requirement (3)
i)	Ratio of percentage of lime to percentage of silica, alumina and iron oxide, when calculated by the formula $\frac{CaO - 0.7 SO_3}{2.8 SiO_2 + 1.2 Al_2 O_3 + 0.65 Fe_2 O_3}$	Not greater than 1.02 and not less than 0.66
ii)	Ratio of percentage of alumina to that of iron oxide	Not less than 0.66
iii)	Insoluble residue, percent by mass	(a) In case no flyash, silica fume, rice, husk ash and metakaoline is added - not more than 5.0 (b) In case of addition of and / or silica fume and/or rice husk ash and /or metakoline - Not more than 5.0
iv)	Magnesia, percent by mass	Not more than 6.0 percent
v)	Total sulphur content calculated as sulphuric anhydride (SO ₃) percent by mass	Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively
vi)	Total loss on ignition	Not more than 5 percent

Note — For method of tests, refer to relevant parts of IS 4031 Methods of physical test for hydraulic cement; and IS: 4032-1985 Methods of chemical analysis of hydraulic cement (*first revision*).

For detailed information, refer to IS 269:1989 Specification for ordinary portland cement, 33 grade (fourth revision).

SUMMARY OF
IS 455 : 1989 PORTLAND SLAG CEMENT
(Fourth Revision)

1. Scope— Covers the manufacture and chemical and physical requirements for Portland slag cement.

2. Chemical Requirement

	<i>Percent, Max</i>
Magnesium oxide (MgO)	8.0
Sulphur trioxide (SO ₃)	3.0
Sulphide sulphur (S)	1.5
Loss on ignition	5.0
Insoluble residue	4.0

Notes 1—Total chloride content in cement shall not exceed 0.05 percent by mass for cement used in prestressed concrete structures and long span reinforced concrete structures. (Method of test for determination of chloride content in cement is given in IS 12423:1988.)*

Notes 2. Granulated slag conforming to IS 12089:1987 † has been found suitable for the manufacture of Portland slag cement.

3. Physical Requirements

3.1 Fineness — Specific surface, not less than 225 m²/kg.

3.2 Soundness — Expansion of unaerated sample

(i) not more than 10 mm by 'Le Chateliers' method

(ii) not more than 0.8 percent by autoclave method

3.3 Setting Time —

a) Initial setting time Not less than 30 minutes

b) Final setting time Not more than 600 minutes

3.4 Compressive Strength

a) 72 ± 1 h Not less than 16 MPa

b) 168 ± 2 h Not less than 22 MPa

c) 672 ± 4 h Not less than 33 MPa

4. Delivery — Packed in specified bags of 50 kgs or 25 kgs net or in bulk with tolerances specified in the standard.

* Method for colorimetric analysis of hydraulic cement.

† Granulated slag for manufacture of Portland slag Cement.

Note — For methods of tests, refer to relevant parts of IS 4031 Methods of physical tests for hydraulic cement and IS 4032:1985 Chemical analysis of hydraulic cement (*first revision*)

For detailed information, refer to IS 455:1989. Specification for portland slag cement (fourth revision).

SUMMARY OF
IS 1489 (PART1) : 1991 PORTLAND POZZOLANA CEMENT
PART 1 FLY ASH BASED
(Third Revision)

1. Scope — Covers the manufacture, physical and chemical requirements of Portland pozzolana cement using only fly ash pozzolana.

2. Raw Materials

2.1 Pozzolana

2.1.1 Fly ash used in the manufacture of Portland - pozzolana cement shall conform to IS 3812 : 1981*.

2.1.2 Fineness and average compressive strength in lime reactivity of fly ash shall not be less than 320 m²/kg and 4.0 MPa respectively.

2.1.3 Average compressive strength in lime reactivity of fly ash shall not be less than 4.0 MPa.

2.1.4 Fly ash content shall be between 15 to 35 percent by mass of portland pozzolana cement.

2.2 Portland Cement Clinker/Portland Cement shall conform to IS 269:1989†.

3. Chemical Requirements — See Table 1.

* Flyash for use as pozzolana and admixture (*first revision*)

† Ordinary portland cement, 33 Grade (*fourth revision*).

4. Physical Requirements

4.1 Fineness — Specific surface shall be not less than 300 m²/kg.

4.2 Soundness — Expansion of unaerated sample—

- i) Not more than 10 mm by 'Le Chateliers' method.
- ii) Not more than 0.8 percent by Autoclave method.

4.3 Setting Time —

Initial setting time	30 min, <i>Min</i>
Final setting	600 min, <i>Max</i>

4.4 Compressive Strength —

- a) At 72 ± 1h 16 MPa, *Min*
- b) At 168 ± 2h 22 MPa, *Min*
- c) At 672 ± 4h 33 MPa, *Min*

5. Delivery — Packed in specified bags of 50 kg or 25 kg net or in bulk with tolerances specified in the standard.

TABLE 1 CHEMICAL REQUIREMENTS OF PORTLAND POZZOLANA CEMENT

SI No. (1)	Characteristic (2)	Requirement (3)
i)	Loss on ignition, percent by mass, Max	5.0
ii)	Magnesia (MgO), percent by mass, Max	6.0
iii)	Sulphuric anhydride (SO ₃), percent by mass, Max	3.0
iv)	Insoluble material, percent by mass, Max	$x + \frac{4.0(100 - x)}{100}$ <p>where <i>x</i> is the declared percentage of flyash in the given Portland pozzolana cement.</p>

Note — For methods of tests, refer to IS 1727:1967 Methods of test for pozzolanic material (*first revision*), relevant part of IS 4031 Method of physical tests for hydraulic cement and IS 4032:1985 Methods of chemical analysis of hydrolic cement (*first revision*)

For detailed information, refer to IS 1489 (Part 1) 1991 Specification for portland pozzolana cement Part 1 :1991 Fly ash based (third revision).

SUMMARY OF
IS 1489 (PART 2) :1991 PORTLAND POZZOLANA CEMENT
PART 2 CALCINED CLAY BASED
(Third Revision)

1. Scope — Manufacture, Physical and Chemical requirements of Portland- pozzolana cement manufactured by using calcined clay pozzolana or a mixture of calcined clay and fly ash pozzolana.

2. Raw Materials

2.1 Pozzolana

2.1.1 Pozzolana used shall be either calcined clay pozzolana conforming to IS 1344: 1981*, or a mixture of calcined clay pozzolana conforming to IS 1344: 1981 and fly ash conforming to **IS 3812 : 1981†**.

2.1.2 Fineness and average compressive strength in lime reactivity of pozzolana shall not be less than 320 m²/kg and 4.0 MPa respectively.

2.1.3 Average compressive strength in lime reactivity of pozzolana shall not be less than 4.0 MPa.

2.2 Portland cement clinker-shall confirm to IS 269:1989‡

* Calcined clay pozzolana (*second revision*).

† Fly ash for use as pozzolana and admixture (*first revision*).

‡ Ordinary portland cement 33 Grade (*fourth revision*).

3. Chemical Requirement — See TABLE 1.

4 Physical requirements

4.1 Fineness

Specific surface of Portland pozzolana cement shall be not less than 300 m²/kg.

4.2 Soundness — Expansion of unaerated sample.

- (i) Not more than 10 mm by 'Le Chatelier' Method.
- (ii) Not more than 0.8 percent by Autoclave method.

4.3 Setting time—

Initial setting time	30 min, Min.
Final setting time	600 min, Min.

4.4 Compressive strength

a) At 72 ± 1h	16 MPa, Min
b) At 168 ± 2h	22 MPa, Min
c) At 672 ± 4h	33 MPa, Min

5 Delivery Packed in specified bags of 50 kgs or 25, kgs net or in bulk with tolerances specified in the standard.

TABLE 1 CHEMICAL REQUIREMENTS OF PORTLAND- POZZOLANA CEMENT

SI No.	Characteristic	Requirement
(1)	(2)	(3)
i)	Loss on ignition, percent by mass, Max	5.0
ii)	Magnesia (MGO), percent by mass, Max	6.0
iii)	Sulphuric anhydrid (SO ₃), percent by mass, Max	3.0
iv)	Insoluble material, percent by mass, Max	$x + \frac{4.0(100 - x)}{100}$ <p>where x is the declared percentage of pozzolana in the given Portland pozzolana cement</p>

Note — For methods of tests, refer to relevant parts of IS 1727:1967 Methods of test of pozzolanic material (*first revision*), IS 4031— Method of physical tests of hydraulic cement and IS 4032: 1985 Methods of Chemical analysis of hydraulic cement (*first revision*)

For detailed information, refer to IS 1489(Part 2):1991 Specification for Portland pozzolana cement Part 2 calcined clay based (third revision).

SUMMARY OF
IS 3466 : 1988 MASONRY CEMENT
(Second Revision)

1. Scope — Requirements for masonry cement to be used for all general purposes where mortars for masonry are required. Masonry cement is, however, not intended for use in structural concrete, for flooring and foundation work or for reinforced and prestressed concrete works.

2. Physical Requirements — See TABLE 1.

3. Delivery — Packed in specified bags of 50 kg or 25 kg net or in bulk with tolerance as given in the standard.

TABLE 1 PHYSICAL REQUIREMENTS

<i>Sl No.</i>	<i>Characteristic</i>	<i>Requirements</i>
i)	Fineness— Residue on 45-micron IS Sieve, Max percent (by wet sieving)	15
ii)	Setting Time (by Vicat Apparatus)— a) Initial, Min b) Final, Max	90 min 24 h
iii)	Soundness: a) Le- Chatelier Max b) Autoclave expansion, Max	10 mm 1 percent
iv)	Compressive Strength—Average compressive strength of not less than 3 mortar cubes of 50 mm size, composed of 1 part masonry cement and 3 parts standard sand by volume, Min 7 days 28 days	2.5 MPa 5 MPa
v)	Air Content—Air content of mortar composed of 1 part masonry cement and 3 parts standard sand, by volume	6 percent
vi)	Water Retention— Flow after suction of mortar composed of 1 part cement and 3 parts standard sand by volume, Min	60 percent of original flow

Note — For methods of tests, refer to relevant parts of IS 4031. Methods of physical tests for hydraulic cement.

For detailed information, refer to IS 3466:1988 Specification for Masonry Cement (second revision).

SUMMARY OF
IS 6452 : 1989 HIGH ALUMINA CEMENT FOR STRUCTURAL USE
(First Revision)

1. Scope — Manufacture of high alumina cement (HAC) and specific requirements for its use as a structural building material in the colder regions of our country (continuously 18°C and below). Its use as a refractory cement is not covered.

NOTE — HAC mainly a refractory cement, but in some cold regions it may find use as a structural material due to high early strength development. Following restrictions shall be followed for its use in concrete—

- a) Shall not be used in locations where ambient temperature exceeds 18°C.
- b) Accelerators like calcium chloride shall not be used.
- c) Steam curing or elevated temperature of curing shall be avoided.
- d) Shall not be mixed with other types of cement.

2. Requirements

2.1. Total Alumina Content (Al_2O_3) — Not less than 32 percent

2.2 Fineness — Specific surface not less than 225 m²/kg

2.3 Soundness — Expansion not more than 5 mm (quantity of mixing water shall be 22 percent of cement by mass).

2.4 Setting Time — Initial not less than 30 minutes and final not more than 10 hours.

2.5 Compressive Strength of Cement Mortar Cubes 1:3 (1 cement: 3 Standard Sand) by Weight:

- a) At 24 hours } not less than 30 MPa
 ± 30 minutes }
- b) At 72 ± 1 hours not less than 35 MPa

3. Delivery — Packed in specified bags of 50 kg or 25 kg net or in bulk with tolerances as given in the standard.

Note — For methods of tests, refer to relevant parts of IS 4031 : Methods of physical tests for hydraulic cement and IS 4032 :1985 Method of chemical analysis of hydraulic cement (*first revision*)

For detailed information, refer to IS 6452:1989 Specification for High alumina cement for structural use (first revision).

SUMMARY OF
IS 6909 : 1990 SUPERSULPHATED CEMENT
(First Revision)

1. Scope—Requirements for composition, manufacture and testing of supersulphated cement (SSC).

2. Application —Supersulphated cement has been successfully used in a variety of aggressive conditions, for example, for marine works, mass concrete jobs to resist the attack by aggressive water, reinforced concrete pipes in ground water, concrete construction in sulphate bearing soils, and in chemical works under conditions involving exposure to high concentrations of sulphates or weak solutions of mineral acids. It has been used for the underside of bridges over railways and for concrete sewers carrying industrial effluents. Its use under tropical conditions has also been re-commended, provided the prevailing temperature is below 40°C. Although its use as a general purpose cement can be made with adequate precautions, it is not recommended for producing steam-cured products. Production of this cement will also result in greater utilization of blastfurnace slag, an industrial by- product of steel in the country.

3. Chemical Requirements —

Insoluble residue	4 percent, <i>Max</i>
Magnesium oxide	10 percent, <i>Max</i>

Sulphuric anhydride	6 percent, <i>Min</i>
Sulphide sulphur	1.5 percent, <i>Max</i>

4. Physical Requirements

4.1 Fineness — It shall have a fineness (specific surface) of not less than 400 m²/kg.

4.2 Soundness — Expansion not more than 5 mm by Le Chatelier method

4.3 Setting Time — Initial setting time: Not less than 30 minutes, final setting time: not more than 10 hour.

4.4 Compressive Strength —

a)	72	1 hours	not less than 15 MPa
b)	168	2 hours	not less than 22 MPa
c)	672	4 hours	not less than 30 MPa

±

5 Delivery — packed in specified bags of 50 kg or 25 kg net or in bulk with tolerances specified in the standard..

Note — For methods of tests, refer to relevant parts of IS 4031 Methods of physical tests for hydraulic cement, and IS 4032:1985 Method of chemical analysis of hydraulic cement (*first revision*)

For detailed information, refer to IS 6909:1990 Specification for supersulphated cement (first revision).

SUMMARY OF
IS 8041 : 1990 RAPID HARDENING PORTLAND CEMENT
(Second Revision)

1. Scope

Not more than 10 mm (*'Le Chatelier' method*).

1.1 Manufacture and chemical and physical requirements of rapid hardening Portland cement.

Not more than 0.8 percent (*autoclave*).

Note —The term 'rapid hardening' should not be confused with 'quick-setting'.

2. Chemical Requirement — Shall be as laid down in IS 269:1989*.

3.3 Setting Time: Initial setting 30 minutes, final setting 10 h.

3.4 Compressive Strength of Mortar Cubes

a) 24 hours \pm 30 minutes } Not less than 16 MPa

b) 72 \pm 1 hours } Not less than 27 MPa

3. Physical Requirements

3.1 Fineness — Specific surface shall not be less than 325 m²/kg.

4 Delivery — Packed in specified bags of 50 kg or 25 kg net or in bulk with tolerances specified in the standard.

3.2 Soundness — *Unaerated Cement*

*Ordinary Portland cement, 33 Grade.

Note — For methods of tests, refer to relevant parts of IS 4031 Methods of physical tests for hydraulic cement, and IS 4032:1985 Method of chemical analysis of hydraulic cement. (*first revision*)

For detailed information, refer to IS 8041: 1990 Specification for rapid hardening portland cement (second revision).

SUMMARY OF
IS 8042 : 1989 WHITE PORTLAND CEMENT
(Second Revision)

1 Scope**1.1 Manufacture and chemical and physical requirements of white Portland cement.**

Note—White Portland cement is generally used for architectural and decorative purposes and is generally meant for non-structural use. It is made from raw materials containing very little iron oxide and magnesium oxide.

2. Chemical Requirements — See Table 1.**3. Physical Requirements** — Physical requirements of white portland cement shall be as laid down in IS 269: 1989* except that compressive strength of mortar

prepared from white portland cement shall not be less than 90 percent of those specified for 33 grade ordinary Portland cement.

4. Degree of Whiteness — The reflectance of neat cement ring prepared and tested in accordance with the test specified shall not be less than 70 percent.

5. Delivery— Packed in specified bags of 50 kg, 10 kg, 5 kg, 2 kg or 1 kg net or in bulk subject to tolerances specified in the standard.

* Ordinary portland cement 33 Grade (*fourth revision*)

TABLE 1 CHEMICAL REQUIREMENTS FOR WHITE PORTLAND CEMENT

<i>Sl No.</i> (1)	<i>Characteristic</i> (2)	<i>Requirements</i> (3)
i)	Ratio of percentages of lime to percentage of silica, alumina and iron oxide	Not greater than 1.02 and not less than 0.66
ii)	Iron oxide, percent by mass	Not more than 1.0 percent
iii)	Insoluble residue, percent by mass	Not more than 2.0 percent
iv)	Magenesisa, percent by mass	Not more than 6 percent
v)	Total sulphur content calculated as sulphuric anhydride (SO ₃), percent by mass	Not more than 3.5 percent

Note —For methods of tests, refer to relevant parts of IS 4031 Methods of physical tests for hydraulic cement and IS 4032:1985 Methods of chemical analysis of hydraulic cement. (*first revision*)

For detailed information, refer to IS 8042:1989 Specification for white Portland cement (second revision).

SUMMARY OF
IS 8043 : 1991 HYDROPHOBIC PORTLAND CEMENT
(Second Revision)

1 Scope — Manufacture and chemical and physical requirements of hydrophobic Portland cement.

Note—Hydrophobic cement deteriorates very little during prolonged storage under unfavourable conditions. This cement is obtained by intergrinding 33 grade ordinary Portland cement clinker with certain hydrophobic agents which will impart to the cement a water repelling property. The hydrophobic properties are due to the formation of a water repellant film around each particle of cement. This film is broken during the mixing of the concrete, and normal hydration takes place. Hydrophobic cement shall not be confused with water proofing cements.

2. Chemical Requirements—The chemical requirements hydrophobic cement shall be as laid in IS 269:1989*.

3. Physical Requirements

3.1 Fineness — Specific surface shall not be less than 350 m²/kg.

3.2 Soundness and Setting Time — Shall be as laid down IS 269:1989.

3.3 Compressive Strength

- a) 72 ± 1 hours Not less than 15.69 MPa
- b) 168 ± 2 hours Not less than 21.57 MPa
- c) 672 ± 4 hours Not less than 30.40 MPa

4. Delivery — Packed in specified bags of 50 kg or 25 kg net subject to tolerances specified in the standard.

*Ordinary portland cement 33 Grade (*fourth revision*).

For detailed information, refer to IS 8043:1991 Specification for hydrophobic Portland cement (second revision).

SUMMARY OF
IS 8112 : 1989 43 GRADE ORDINARY PORTLAND CEMENT
(First Revision)

1. Scope — Manufacture, chemical and physical requirements of 43 grade ordinary Portland cement.

Note—This specification covers the requirements of ordinary Portland Cement for uses such as manufacture of prestressed concrete railway sleepers and precast products.

2. Chemical Requirements — See Table 1.

3. Physical Requirement

3.1 Fineness — Specific surface not less than 225 m²/kg

3.2 Soundness — Un-aerated cement not more than 10 mm by ‘Le Chatelier’ method and not more than 0.8 percent by autoclave method.

3.3 Setting Time —

- a) Initial setting time in minutes — not less than 30.
- b) Final setting time in minutes — not more than 600.

3.4 Compressive strength —

- a) 72 ± 1 hour not less than 23 MPa
- b) 168 ± 2 hour not less than 33 MPa
- c) 672 ± 4 hour not less than 43 MPa

4. Delivery — Packed in specified bags of 50 kg, 25 kg, 10 kg, 5 kg, 2 kg or 1 kg net or in bulk with tolerances specified in the standard.

TABLE 1 CHEMICAL REQUIREMENTS FOR HIGH STRENGTH PORTLAND CEMENT

<i>Sl No.</i> (1)	<i>Characteristic</i> (2)	<i>Requirement</i> (3)
i)	Ratio of percentage of lime to percentages of silica, alumina and iron oxide, when calculated by the formula $\frac{CaO - 0.7SO_3}{2.8SiO_2 + 1.2Al_2O_3 + 0.65Fe_2O_3}$	Not greater than 1.02 and not less than 0.66
ii)	Ratio of percentage of alumina to that of iron oxide	Not less than 0.66
iii)	Insoluble residue, percent by mass	Not more than 3.0
iv)	Magnesia, percent by mass	Not more than 6.0
v)	Total sulphur content calculated as sulphuric anhydride (SO ₃), percent by mass greater than 5 respectively	Not more than 2.5 and 3.0 when tricalcium aluminate percent by mass is 5 or less and
vi)	Total loss on ignition	Not more than 5 percent

Note 1 — For specific chemical and physical requirements of cement used for railway sleepers, refer to the standard.

Note 2 — For methods of tests, refer to relevant parts of IS 4031 Methods of physical tests for hydraulic cement and IS 4032:1985 Methods of chemical analysis of hydraulic cement. *(first revision)*

For detailed information, refer to IS 8112:1989 Specification for 43 Grade ordinary portland cement (first revision).

SUMMARY OF

IS 12269 : 1987 53 GRADE ORDINARY PORTLAND CEMENT

1. Scope — Manufacture, chemical and physical requirements of 53 Grade ordinary Portland cement.

Note—For certain specialized works, such as prestressed concrete and certain items of precast concrete, the concrete industry quite often needs a special type of ordinary Portland cement having the compressive strength much higher than the minimum compressive strength limits specified in *IS 269:1989** and *IS 8112:1991⁺*.

2. Chemical Requirement — See Table 1.

3. Physical Requirements

3.1 Fineness — Specific surface shall not be less than 225 m²/kg.

* Ordinary portland cement 33 grade (*fourth revision*).

⁺ 43 Grade ordinary portland cement (*first revision*).

3.2 Soundness — unaerated cement not more than 10 mm by 'Le Chatelier' method and 0.8 percent by autoclave method

3.3 Setting Time —

- a) Initial setting time in minutes – not less than 30, and
- b) Final setting time in minutes – not more than 600.

3.4 Compressive Strength —

- a) 72 ± 1 h, not less than 27 MPa
- b) 168 ± 2 h, not less than 37 MPa
- c) 672 ± 4 h, not less than 53 MPa

4. Delivery — Packed in specified bags of 50 kg, 25 kg, 10 kg, 5 kg, 2 kg or 1 kg or in bulk with tolerances specified in this standard.

TABLE 1 CHEMICAL REQUIREMENTS FOR 53 GRADE ORDINARY PORTLAND CEMENT

Sl No. (1)	Characteristic (2)	Requirement (3)
i)	Ratio of percentage of lime to percentages of silica alumina and iron oxide	Not greater than 1.02 and not less than 0.80
ii)	Ratio of percentage of alumina to that of iron oxide	Not less than 0.66
iii)	Insoluble residue, percent by mass	(a) In case no flyash, silica fume, rice husk ash and metakoline in added - Not more than 3.0 (b) In case of addition of fly ash and/or silica fume and/or rice husk ash and/or metakaoline - Not more than 5.0 Not more than 6.0
iv)	Magnesia, percent by mass	
v)	Total sulphur content calculated as sulphuric anhydride (SO ₃), percent by mass	Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5, respectively
vi)	Total loss on ignition	Not more than 4 percent

Note 1 — For specific chemical and physical requirements of cement used for railway sleepers, refer to the standard.

Note 2 — For methods of tests, refer to relevant parts of IS 4031 Methods of physical tests for hydraulic cement and IS 4032:1985 Methods of chemical analysis of hydraulic cement. (*first revision*)

For detailed information, refer to IS 12269:1987 Specification for 53 Grade ordinary portland cement.

SUMMARY OF

IS 12330 : 1988 SULPHATE RESISTING PORTLAND CEMENT

1. Scope — The manufacture, chemical and physical requirements and testing of sulphate resisting Portland cement.

Note — Sulphate resisting Portland cement is a type of Portland cement in which the amount of tricalcium aluminate is restricted to an acceptably low value. This cement should not be mistaken for supersulphated cement, which is produced by intergrinding or intimately blending a mixture of granulated blast furnace slag, calcium sulphate and a small amount of Portland cement or Portland cement clinker or any other sources of lime.

Sulphate resisting Portland cement can be used for structural concrete wherever ordinary Portland cement or Portland pozzolana cement or Portland slag cement are useable under normal conditions. Use of supersulphated cement is, however generally restricted where the prevailing temperature is below 40°C. The latter is not recommended for producing steam-cured products.

2. Chemical Requirements — See Table 1.

3. Physical Requirement

3.1 Fineness — Specific surface not less than 225 m²/kg

3.2 Soundness — Un-aerated cement-expansion not more than 10 mm by 'Le Chatelier' method and not more than 0.8 percent by autoclave method.

3.3 Setting Time —

- a) Initial setting time in minutes, not less than 30 and
- b) Final setting time in minutes not more than 600

3.4 Compressive Strength —

- a) $72 \pm 1h$, not less than 10 MPa
- b) $168 \pm 2h$, not less than 16 MPa
- c) $672 \pm 4h$, not less than 33 MPa

4. Delivery — Packed in specified bags of 50 kg net or in bulk with tolerances specified in the standard.

TABLE 1 CHEMICAL REQUIREMENTS FOR SULPHATE RESISTING PORTLAND CEMENT

Sl No. (1)	Characteristic (2)	Requirement (3)
i)	Ratio of percentage of lime to percentages of silica, alumina and iron oxide when calculated by the formula $\frac{CaO - 0.7SO_3}{2.8SiO_2 + 1.2Al_2O_3 + 0.65Fe_2O_3}$	Not greater than 1.02 and not less than 0.66
ii)	Insoluble residue, percent by mass	Not more than 4
iii)	Magnesia, percent by mass	Not more than 6
iv)	Total sulphur content calculated as sulphuric anhydride (SO ₃) percent by mass	Not more than 2.5
v)	Tricalcium aluminate (C ₃ A), percent by mass	Not more than 5
vi)	Tetracalcium aluminoferrite phase twice the tricalcium aluminate (C ₄ AF+2C ₃ A), percent by mass	Not more than 25
vii)	Total loss on ignition, percent by mass	Not more than 5

Note — For methods of tests, refer to relevant parts of IS 4031 Methods of physical tests for hydraulic cement and IS 4032 : 1985 Method of chemical analysis of hydraulic cement. (first revision).

For detailed information, refer to IS 12330:1988 Specification for sulphate resisting Portland cement.

SUMMARY OF
IS 2185 (PART 1) : 1979 CONCRETE MASONRY UNITS
PART 1 HOLLOW AND SOLID CONCRETE BLOCKS
(Second Revision)

1. Scope — Requirements for the following concrete masonry building units which are used in construction of loadbearing and partition walls:

- a) Hollow (open and closed cavity) load bearing concrete blocks.
- b) Hollow (open and closed cavity) non-load bearing concrete blocks, and
- c) Solid load-bearing concrete blocks.

Note—Concrete masonry units are used for both load-bearing and non-load bearing walls, for partitions and panel walls, as backing for other types of facing materials, for piers, pilasters and columns, for retaining walls, garden walls, chimneys and fire places, as fillers in concrete joist floor construction and as shuttering for beams, columns and lintels.

2. Terminology

2.1 Hollow (Open or Closed Cavity) Block—A block having one or more large holes or cavities which either pass through the block (open cavity) or do not effectively pass through the block (closed cavity) and having the solid material between 50 and 75 percent of the total volume of the block calculated from the overall dimensions.

2.2 Solid Block — A block which has solid material not less than 75 percent of the total volume of the block calculated from the overall dimensions.

3. Dimension

3.1 Normal Dimension—

Length	400, 500 or 600 mm
Height	200 or 100 mm
Width	200, 250, or 300 mm

Note 1 — Actual dimensions shall be 10 mm short of nominal dimensions or 6mm short in special cases where finer jointing is specified.

Note 2 — Block shall also be manufactured in half lengths of 200, 250 or 300 mm.

3.2 Tolerances — Not more than ± 5 mm in length and ± 3 mm in height and width of unit.

3.3 Face shells and webs shall increase in thickness from the bottom to the top of unit; the thickness shall be not less than the value given in Table 1, as appropriate.

4. Classification — see Table 2

4.1 Hollow (Open and Closed Cavity) Concrete Blocks —

- | | | |
|--|---|---------------|
| <ol style="list-style-type: none"> a) Grade A b) Grade B c) Grade C | } | (see Table 2) |
|--|---|---------------|

4.2 Solid Concrete Blocks — Grade D (See Table 2).

5. Physical Requirement

5.1 General — All units shall be sound and free of cracks or other defects.

5.2 Blocks Density and Compressive Strength — Shall be as given in Table 2.

5.3 Water Absorption — Average value of three units shall be not more than 10 percent by mass.

5.4 Drying Shrinkage — Average value of three units shall not exceed 0.1 percent.

5.5 Moisture Movement — Average value of three units shall not exceed 0.09 percent.

TABLE 1 MINIMUM FACE SHELL AND WEB THICKNESSES

All dimensions in millimetres.

<i>Nominal Block Width</i>	<i>Face Shell Thickness, Min</i>	<i>Thickness of Web, Min</i>	<i>Total Web Thickness Per Courses in Any 200 mm Length of Walling, Min</i>
(1)	(2)	(3)	(4)
100 or less	25	25	25
Over 100 to 150	25	25	30
Over 150 to 200	30	25	30
Over 200	35	30	38

TABLE 2 BLOCK DENSITY AND COMPRESSIVE STRENGTH

<i>Type</i>	<i>Grade</i>	<i>Density of Block kg/m³</i>	<i>Minimum Average Compressive Strength of Units at 28 Days N/mm²</i>	<i>Minimum Strength of Individual Units at 28 days N/mm²</i>
(1)	(2)	(3)	(4)	(5)
Hollow (open and closed cavity) load bearing unit	A (3.5)	Not less than 1500	3.5	2.8
	A (4.5)		4.5	3.6
	A (5.5)		5.5	4.4
	A (7.0)	Less than 1 500 but not less than 1 000	7.0	5.6
	B (2.0)		2.0	1.6
	B (3.0)		3.0	2.4
Hollow (open and closed cavity) non-load bearing units Solid load bearing units	B (5.0)	Less than 1 500 but not less than 1000	5.0	4.0
	C (1.5)		1.5	1.2
	D (5.0)	Not less than 1 800	5.0	4.0
	D (4.0)		4.0	3.2

Note 1 — For requirements regarding materials, surface texture, texture and finish, refer to the standard.

Note 2 — For methods of tests, refer to Appendices A to F of the standard.

For detailed information, refer to IS 2185 (Part 1):1979 Specification for concrete masonry units : Part 1 Hollow and solid concrete blocks (second revision).

SUMMARY OF
IS 2185 (PART 2) : 1983 CONCRETE MASONRY UNITS
PART 2 HOLLOW AND SOLID LIGHTWEIGHT
CONCRETE BLOCKS
(First Revision)

1. Scope — Covers the following lightweight concrete masonry building units which are used in the construction of load-bearing and non-load bearing walls:

- a) Hollow (open and closed cavity) load bearing concrete blocks,
- b) Hollow (open and closed cavity) non-load bearing concrete blocks,
- c) Solid load-bearing concrete blocks, and
- d) Solid non-load bearing concrete blocks

2. Dimensions and Tolerances

2.1 Nominal Dimensions

Length	400, 500 or 600 mm
Height	100 or 200 mm
Width	50, 75, 100, 150, 200, 250 or 300 mm

Note 1 — Actual dimensions shall be 10 mm short of the nominal dimensions (or 6 mm short in special cases where finer jointing is specified).

Note 2 — In addition, block shall be manufactured in half lengths of 200, 250 or 300 mm to correspond to the full lengths.

2.2 Tolerance — Not more than ± 5 mm in length and ± 3 mm in height and width of unit.

2.3 Hollow concrete blocks shall be made either with two cores or three cores. Stretchers in the 200, 250 and 300 mm width shall generally have concave ends, each end flange being grooved or plain. All 100 and 150 mm wide units shall generally be made with plain ends.

2.4 Face shells and webs shall increase in thickness from the bottom to the top of the unit. Depending upon the core moulds used, the face shells and webs shall be flared and tapered or straight tapered, the former providing a wider surface for mortar. The minimum thickness of the face shell and web shall be not less than 20 mm. However, for the top face shell of the closed cavity units, the minimum thickness may be less than 20 mm, but not less than 15 mm.

3. Classification

3.1 Load bearing lightweight concrete masonry units hollow (open and closed cavity) or solid shall conform to the following two grades—

- a) *Grade A*—These are used below and above ground level in damp-proof course, in exterior walls that may or may not be treated with a suitable weather-protective coating and for interior walls.
- b) *Grade B* — These are used above ground level in damp-proof course, in exterior walls that are treated with a suitable weather-protective coating and for internal walls.

3.2 Non-load bearing lightweight concrete masonry units, hollow (open and closed cavity) or solid shall be used in interior walls, partitions, panels and for exterior panel walls in steel or reinforced concrete frame construction when protected from weather by rendering or by some other efficient treatment.

4. Physical Requirements

4.1 General — All units shall be sound and free from cracks or other defects.

4.2 Block Density — Shall not exceed 1 600 kg/m³

4.3 Compressive Strength — See Table 1.

4.4 Water Absorption — See Table 1.

4.5 Drying Shrinkage—Load Bearing —

Grade 'A'	0.08 percent, <i>Max</i>
Grade 'B'	0.09 percent, <i>Max</i>
Non - Load Bearing	0.09 percent, <i>Max</i>

4.6 Moisture Movement—Average value of three units shall be less than the drying shrinkage specified in 4.5 by at least 0.01.

TABLE 1 PHYSICAL REQUIREMENTS

<i>Type and Grade Absorption</i>	<i>Minimum Compressive</i>		<i>Maximum average water</i>	
	<i>Strength</i>		<i>with oven-dry mass of concrete</i>	
	<i>Average of 8 units, Min</i>	<i>Individual units, Min</i>	<i>Less than 1360</i>	<i>Less than 1600</i>
(1)	(2)	(3)	(4)	(5)
Hollow, load bearing	N/mm ²	N/mm ²	Kg/m ³	Kg/m ³
Grade A	7.0	5.5	-	290
Grade B	5.0	4.0	320	-
Hollow, Non-load bearing	4.0	3.5	-	-
Solid, load bearing				
Grade A	12.5	10.8	-	290
Grade B	8.5	7.0	320	-

Note 1 — For requirements regarding materials, manufacture, surface texture and finish refer to the standard.

Note 2 — For methods of tests, refer to Appendices A to F of the standard.

For detailed information, refer to IS 2185 (Part 2) 1983 Specification for concrete masonry units : Part 2 Hollow and solid lightweight concrete blocks (first revision).

SUMMARY OF
IS 2185 (PART 3) : 1984 CONCRETE MASONRY UNITS
PART 3 AUTOCLAVED CELLULAR (AERATED)
CONCRETE BLOCKS
(First Revision)

1. Scope— Covers the requirements of autoclaved cellular (aerated) concrete blocks having density up to 1 000 kg/ m³.

Note — Autoclaved means team curing of concrete products, sandlime bricks, asbestos cement products, hydrous calcium silicate insulation products, or cement in an autoclave at maximum ambient temperatures generally between 170 and 215°C.

2. Dimensions and Tolerances

2.1 Nominal Dimensions

Length	400, 500 or 600 mm
Height	200, 250 or 300 mm
Width	100, 150, 200 or 250 mm

Note 1— Actual dimensions shall be 10mm short of the nominal dimensions (or 6 mm short in special cases where finer jointing is specified).

Note 2 — In addition, block shall be manufactured in half lengths of 200, 250 or 300 mm to correspond to the full lengths.

2.2 Tolerance — Not more than ± 5 mm in length and ± 3 mm in height and width of the unit.

3. Classification— Classified into two grades (See Table 1).

4. Physical Requirements

4.1 General — All units shall be sound and free of cracks and other defects .

4.2 For block density, compressive strength and thermal conductivity (See Table 1).

4.3 Drying Shrinkage — Shall not be more than 0.05 percent for Grade 1 blocks and 0.10 percent for Grade 2 blocks.

TABLE 1 PHYSICAL PROPERTIES OF AUTOCLAVED CELLULAR CONCRETE BLOCKS

Sl No.	Density in Ovendry Condition	Compressive Strength, Min		Thermal Conductivity Air Dry Condition
		Grade 1 (3)	Grade 2 (4)	
(1)	(2)			(5)
	kg/m ³	N/mm ²	N/mm ²	W/m.k
i)	451 to 550	2.0	1.5	0.21
ii)	551 to 650	4.0	3.0	0.24
iii)	652 to 750	5.0	4.0	0.30
iv)	751 to 850	6.0	5.0	0.37
v)	851 to 1 000	7.0	6.0	0.42

Note 1 — For requirements regarding materials surface texture and finish refer to the standard.

Note 2 — For methods of test, refer to the standard.

For detailed information, refer to IS 2185 (Part 3) 1984 Specification for concrete masonry units: Part 3 Autoclaved cellular (aerated) concrete blocks (first revision).

SUMMARY OF
IS 4996 : 1984 REINFORCED CONCRETE FENCE POSTS
(First Revision)

1. Scope — Requirements for reinforced concrete fence posts for general purposes. Recommendations for the provisions of wire holes and their spacing, as well as the erection of post-and-wire fence have also been included. Reinforced lightweight concrete fence posts and prestressed concrete fence posts are not covered.

2. Classification

- a) *Line Posts*— Line posts are intermediate posts forming the majority in a post-and-wire system and are intended to carry the fencing wire between the strainer posts.
- b) *Strainer Posts*— Posts notched on three sides and used with struts or braces as strainers at the corners or ends, or at intermediate positions in a line of fence.
- c) *Strut or Brace*— Member used in inclined position for supporting the strainer post.

3. Shape and Dimension

3.1 Shall be square, rectangular, circular or any polygonal in section. May be of uniform section or tapering on two sides or tapering on all four sides. The

cross-sectional dimensions and the reinforcement shall be adequate to conform to strength requirements given in 4.

Note— Some of the common sizes and shapes for reinforced concrete fence posts with other details such as reinforcement, fencing wire spacing from ground level, spacing of line post and strainer post and suitability of particular size of fence post for use are given in Appendix B of the standard for general guidance. These may be used provided the strength requirements are fulfilled.

3.2 Tolerances— ± 15 mm on overall length, ± 3 mm on cross-sectional dimensions and 0.5 percent on straightness of fence post.

4. Strength Test

5.1 Impact Test— When tested, specimen shall show no visible permanent cracking.

5.2 Static-Load Test—The static load required to produce first visible crack in post shall be as given below—

Line post	700 N
Strainer post	2 500 N
Strut or angle post	450 N

Note 1 — For typical details and dimensions of line post, strainer post and brace for fencing intended for various uses, for recommendations for manufacture of reinforced concrete under field conditions and for recommendations for erection of fence posts, refer to the standard.

Note 2— For method of tests, refer to Appendix C of the standard.

For detailed information, refer to IS 4996:1984 Specification for reinforced concrete fence posts (first revision).

SUMMARY OF

IS 5751 : 1984 PRECAST CONCRETE COPING BLOCKS

(First Revision)

1. Scope—Requirements for precast concrete coping blocks, giving details of materials for manufacture, workmanship, functional requirements and essential dimensions to meet them.

Note—The blocks serve as defence against entry of moisture into hollow concrete block walls. Functional requirements are:

- a) should prevent downward penetration of water
- b) should direct water clear of walls below
- c) should resist lateral displacement, either by its mass or by mechanical means such as clip type coping or by use of cramps and dowels.
- d) should allow for thermal and moisture movements.
- e) should be durable.

2. Dimension and Tolerances

2.1 Dimension of Cross Section— The form of cross section shall be as agreed to mutually. Overall width shall be determined by referring to thickness of wall to which coping is to be applied.

Note—For minimum dimensions of the cross section for clip type and for flat bottomed coping, see Fig. 1 and 2 of the standard.

2.2 Length— 1 m or as agreed.

2.3 Tolerances— ± 3 mm for cross-sectional profile and ± 6 mm for length.

3. Shape— Coping blocks shall slope to the rear so as to reduce wash of water and accumulated dirt over face of wall. The slope shall be as steep as possible for rapid shedding of water.

Note— For example of concrete copings such as splayed and saddleback coping, see Fig. 3 of the standard.

4. Mass— Not less than 35 kg/m for flat bottomed coping without cramps.

5. Fixing and Jointing— Ends of coping blocks shall be jointed by means of dowels, cramps or joggled mortar joints. Flashing of non-corrodible material is adopted at joints in coping blocks to prevent leakage.

6. Fittings— Stopped ends, hipped stopped ends, stooled ends and right-angled returns, shall be available to match the coping blocks.

For detailed information, refer to IS 5751:1984 Specification for precast concrete coping blocks (first revision).

SUMMARY OF
IS 5758 : 1984 PRECAST CONCRETE KERBS
(First Revision)

1. Scope— Requirements of precast concrete units for kerbs, channels, edgings, quadrants and gutter aprons in a range of sections, for use in carriageways and footways.

2. Designation— Dimensions of horizontal face shall be given first and the dimensions of vertical face be second.

3. Dimensions

3.1 Straight Kerbs

a) Rectangular Kerbs	150 × 300 125 × 250 100 × 250 mm
b) Splayed kerbs	150 × 300 125 × 250 mm
c) Half-batter kerbs	150 × 300 125 × 250 mm
d) Half-section kerbs	150 × 125 mm

3.2 Straight Channels

a) Rectangular kerbs	300 × 150 250 × 125 250 × 100 mm
b) Channels	250 × 125 mm

3.3 Edgings — 50 × 250, 50 × 200, 50 × 150 mm.

3.4 Quadrant — Depths 125, 200 or 250 mm and width 300 or 450 mm with faces to match the sections of straight kerbs.

3.5 Gutter Aprons — Width shall range from 150 to 2 500 or 3 000 mm but usual width shall range from 300 to 900 mm. Usual range of height 125 to 200 mm. The thickness of precast kerb shall be 75 to 150 mm while minimum thickness of channel shall be 125 or 100 mm.

3.6 Lengths — Uniform length of 1 m for straight kerb, straight channels, edgings and 1 m maximum normally for gutters.

Note— For standard section of concrete kerbs, channel, standard sections of concrete edgings, standard concrete quadrants and typical sections of kerb and gutter, see Fig 1 to 5 of the standard.

4. Tolerances— ±3 mm on length and height; + 1.5 and – 3 mm on width.

5. Moulding — When made under hydraulic pressure the pressure employed shall not be less than 7 MN/m².

6. Tests

6.1 Transverse Strength — When tested 28 days after they are manufactured, the unit shall support without injury, at least for one minute, the loads given in the Table.

Type of Product	Dimensions (mm)	Load to be Supported (N)
a) Rectangular kerbs	150 × 300 125 × 250 100 × 250	22 750 13 600 9 100
b) Splayed kerbs	150 × 300 125 × 250	22 750 13 600
c) Half-batter kerbs	150 × 300 125 × 250	22 750 13 600
d) Half-section kerbs	150 × 125	8 200
e) Channels	250 × 125	13 600
f) Edgings	50 × 250 50 × 200 50 × 150	3 180 2 720 2 040

6.1.1 If tests are carried out after a longer period, the load to be supported shall be increased by the ageing factor given below—

Age of sample (months)	3	6	12
Ageing factor	1.1	1.15	1.20

6.2 Water Absorption — Shall not exceed 3 percent in the first 10 minutes and 8 percent after 24 hours.

Note — For methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to IS 5758:1984 Specification for precast concrete kerbs (first revision).

SUMMARY OF IS 5820 : 1970 PRECAST CONCRETE CABLE COVERS

1. Scope— Requirements for reinforced and unreinforced precast concrete for covering cables.

2. Classification — See Table 1.

2.1 *Arch type covers are also sometimes used.*

3. Dimensions – See Table 2.

3.1 Tolerance — On length and width ± 3 mm, and on thickness ± 2 mm.

4. Tests

4.1 Impact Strength for Reinforced Covers— Not more than one transverse crack.

4.2 Transverse Strength for Unreinforced Covers— Average breaking load shall not be lower than the value specified in Table 2.

TABLE 1 CLASSIFICATION

<i>Class</i>	<i>Description</i>	<i>Conditions Where Normally Used</i>
EHV	Reinforced, with peak	22 kV and 33 kV underground power cables
HVP	Unreinforced, with peak	1.1 kV to below 22 kV underground power cables
HV	Unreinforced, flat	For power cables 1.1. kV and below
LV	Unreinforced, flat	

TABLE 2 DIMENSIONS

<i>Class</i>	<i>Type No.</i>	<i>Shape</i>	<i>Dimensions</i>				<i>Average breaking Load for unreinforced Covers, Min (kg)</i>
			<i>L</i>	<i>W</i>	<i>T</i>	<i>T'</i>	
EHV	1	With peak	450	230	50	75	450
	2	Do	600	230	50	75	750
HVP	1	Do	300	180	40	65	300
	2	Do	450	180	40	65	350
HV	1	Flat	300	180	40	-	300
	2	Do	450	180	40	-	350
LV	1	Do	250	150	40	-	200
	2	Do	300	180	40	-	200
	3	Do	450	180	40	-	200

Note 1 — *L, W* = Length, Width.

T = Total thickness in case of flat type and thickness of flat portion excluding peak in case of cover with peak.

T' = Total thickness including peak in case of cover with peak.

Note 2 — For typical concrete cable cover, flat type and with peak, see Fig. 1 and 2 of the standard.

Note 1— For manufacturing details with regard to the aspects such as mixing, moulding, protection from frost and reinforcement details, refer to 5 of the standard.

Note 2— For methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to IS 5820:1970 Specification for precast concrete cable covers.

SUMMARY OF

IS 6072 : 1971 AUTOCLAVED REINFORCED CELLULAR CONCRETE WALL SLABS

1. Scope — Requirements for autoclaved reinforced cellular concrete wall slabs, having density above 450 and up to 1 000 kg/m³.

2. Terminology — The cellular concrete consists of an inorganic binder (such as lime and cement) in combination with finely ground material containing silicic acid (such as sand), gas generating material (such as aluminium powder), water, and harmless additives (optional); and steam cured under high pressure in autoclaves.

3. Classification — Shall be classified on basis of oven-dry density (without reinforcement) and compressive strength —

<i>Class</i>	<i>Gross Density(kg/m³)</i>
A	Over 850 and up to 1 000
B	Over 750 and up to 850
C	Over 650 and up to 750
D	Over 550 and up to 650
E	Over 450 and up to 550

4. Designation — By indicating compressive strength in kgf/cm², horizontal load bearing capacity, that is, design load (in kgf/cm²), length (in m), breadth (in mm) and thickness (in mm).

5. Sizes

5.1 Preferred Dimensions — Length 1 to 6 m; width 600 mm; thickness 150 to 250 mm with increments of 25 mm.

5.2 Tolerances — For 500 mm and below, ± 2 mm over 500 mm, ± 5 mm.

Note — For form tolerances for wall slabs, refer to Table 1 of the standard.

6. Finish — Tongue at one side and groove on the other side. Alternatively groove on both sides for filling with cement mortar. Longitudinal edges shall be chamfered.

7. Physical Properties

7.1 Density — Range as specified in 3.

7.2 Dry Shrinkage — Not more than 0.09 percent.

7.3 Residual water content at the time of delivery shall be declared by the manufacturer.

7.4 Fire Resistance — Not less than 2 hours.

7.5 Compressive Strength and Thermal Conductivity—

<i>Class</i>	<i>Compressive Strength, Min (kgf/cm²)</i>	<i>Thermal Conductivity Max (kcal/m/h/°C)</i>
A	70	0.36
B	60	0.32
C	50	0.26
D	35	0.21
E	20	0.18

Note 1 — For methods of tests, refer to IS 3809 1979 Specification for fire resistance test for structures (*first revision*) and relevant part of IS 6441 Methods of test for autoclaved cellular concrete products .

Note 2 — For details of manufacture with regard to aspects such as reinforcement, formation of cells of cellular concrete (method of autoclavation) and finish, refer to 6 of the standard.

Note 3 — For structural requirements, refer to 8 of the standard.

For detailed information, refer to IS 6072:1971 Specification for autoclaved reinforced cellular concrete wall slabs.

SUMMARY OF

IS 6073 : 1971 AUTOCLAVED REINFORCED CELLULAR CONCRETE FLOOR AND ROOF SLABS

1. Scope — Requirements for autoclaved reinforced cellular concrete floor and roof having density above 450 and up to 1 000 kg/m³

2. Terminology — The cellular concrete consists of an inorganic binder (such as lime and cement) in combination with finely ground material containing silicon dioxide (such as sand), gas generating material (such as aluminium powder), water and additives (optional); and steam cured under high pressure in autoclaves.

3. Classification — Shall be classified on basis of oven-dry density (without reinforcement) and compressive strength—

<i>Class</i>	<i>Gross Density (kg/m³)</i>
A	Over 850 and up to 1 000
B	Over 750 and up to 850
C	Over 650 and up to 750
D	Over 550 and up to 650
E	Over 450 and up to 550

4. Designation — By indicating compressive strength (kgf/cm²), load bearing capacity, that is, design load (kgf/cm²), length (m), breadth (mm) and thickness (mm).

5. Sizes

5.1 Preferred Dimensions— Length 1 to 6 m; width 600 mm; thickness 75 to 250 mm with increments of 25 mm.

5.2 Tolerances — For 500 mm and below, ± 2 mm over 500 mm, ± 5 mm.

Note — For form tolerances for wall slabs, refer to Table 1 of the standard.

6. Finish — Tongue at one side and groove on the other side. Alternatively groove on both sides for filling with cement mortar. Longitudinal edges shall be chamfered.

7. Physical Properties

7.1 Density — Range as specified in 3.

7.2 Dry Shrinkage — Not more than 0.09 percent.

7.3 Residual water content at the time of delivery shall be declared by the manufacturer.

7.4 Fire Resistance — Not less than 2 hours.

7.5 Compressive Strength and Thermal Conductivity—

<i>Class</i>	<i>Compressive Strength, Min (kgf/cm²)</i>	<i>Thermal Conductivity Max (kcal/m/h/°C)</i>
A	70	0.36
B	60	0.32
C	50	0.26
D	35	0.21
E	20	0.18

Note 1 — For methods of tests, refer to IS 3809 : 1979 Specification for fire resistance test for structures (*first revision*), and relevant parts of IS 6441 Part 1 to 9 Methods of test for autoclaved cellular concrete products.

Note 2 — For details of manufacture with regard to aspects such as reinforcement, formation of cells of cellular concrete (method of autoclavation) and finish, refer to 6 of the standard.

Note 3 — For structural requirements, refer to 8 of the standard.

For detailed information, refer to IS 6073:1971 Specification for autoclaved reinforced cellular concrete floor and roof slabs.

SUMMARY OF
IS 6523 : 1983 PRECAST REINFORCED CONCRETE DOOR
AND WINDOW FRAMES
(First Revision)

1. Scope — Requirements for precast reinforced concrete door and window frames. Use of such frames is recommended to be restricted to a maximum opening width of 2.25 m.

2. Shape and Dimensions — Cross section 60 × 100 mm or 70 × 75 mm for single shutter door and 60 × 120 mm for double shutter door. Overall sizes (width and height) of frames shall conform to IS 4021:1995 *

Note 1 — Suitable adjustments in cross-sectional shape may be made by agreement between the purchaser and the supplier to provide suitable groove for wall plaster, etc, provided the overall dimensional requirements given above are not affected.

Note 2 — For overall dimensions of the frame, the width of the frame shall be the total length of the horizontal piece measured out-to-out; the height of the frame shall be the total height measured from the lowest end of the vertical piece (in case of three member frame or the outer edge of the lower horizontal member in case of four member frame) to the outer edge of the toe horizontal piece.

*Specification for timber door, window and ventilator frames (second revision).

3. Requirements

3.1 Materials

3.1.1 Cement — Ordinary Portland cement or Portland slag cement or Portland pozzolana cement or rapid hardening Portland cement or high strength ordinary Portland cement.

3.1.2 Aggregates — Well graded mixture of coarse and fine aggregates. Maximum size of coarse aggregate shall be 10mm.

3.1.3 Concrete — Not weaker than M 20 (see IS 456 : 2000) *

3.1.4 Reinforcement shall be clean and free from loose mill scale, loose rust, mud, oil grease or any other coating which may reduce the bond between the concrete and the steel. A slight film or rust may not be regarded as harmful but the steel shall not be visibly pitted by rust.

* Code of practice for plain and reinforced concrete (fourth revision)

Note — For requirements in regard to manufacture (construction and finish, positioning of reinforcement, casting, curing, etc), arrangements for fixing of hinges to frames, arrangements for door and window fixtures and erection along with illustrations refer to the standard.

For detailed information, refer to IS 6523:1983 Specification for precast reinforced concrete door and window frames (first revision).

SUMMARY OF

IS 9893 : 1981 PRECAST CONCRETE BLOCKS FOR LINTELS AND SILLS

1. Scope — Requirements of precast concrete lintels and sills.

2. Shape and Dimensions

2.1 Lintels

2.1.1 Reinforced concrete lintels — May be precast in one piece or in two pieces as a split lintel

Note — The latter is lighter in mass, easier to handle and the air space between the pieces affords insulation which is desirable especially if furring is not provided.

2.1.2 Lintel-cum-sun shade — For use over door, window and ventilator openings of exterior walls in buildings may also be precast.

2.1.3 U-shaped lintels — U-Shaped lintels are precast by stringing together U-shaped concrete masonry units as forms, and then placing reinforcement and pouring concrete to fill the forms.

2.1.4 Lintel bearing — Reinforced concrete lintels for doors and windows shall be bonded into the masonry on either side of the opening. It is advisable to provide a bearing length approximately equal to the depth of the lintel.

2.1.5 Throatings — A 16mm wide throatings shall be provided to the soffit to external lintels.

2.1.6 Inserts for lintels — Provision shall be made for fixing screws to windows, door frames, curtain and blind fittings, etc, by means of timber or pre-formed inserts incorporated in the lintels during course of manufacture or by the forming of holes for inserts.

For details refer to Figs. 1 to 4 of the standard.

2.2 Sills

2.2.1 General — General types of sills in common use-the slip sill and the lug sill. Both types are sloped on the top face to drain water away quickly. If projections are provided, they should project at least 40mm beyond wall face and be provided with a groove along the lower outer edge to provide a drip. Lengths up to 1m may be cast in one piece.

2.2.1.1 Slip sills — Slip sills are inserted after the wall proper has been built and therefore require no protection during construction.

2.2.1.2 Lug sills — Lug sills are those with the ends projecting into the masonry wall. There are no vertical joints at the juncture of the sills and the jambs which is one of the advantages of the lug sill over the slip sill.

2.2.2 Dowell holes for sills — Concrete sills to take metal windows shall be provided with holes 20mm diameter and 32 mm deep at prescribed distances from each end.

2.2.3 Projection of sills — The projection of sills, when provided, shall be not less than 40mm from the finished wall face.

2.3 Tolerances — For lintels, a tolerance of $+12_{-0}$ mm shall be allowed on cross-sectional dimensions and ± 6 mm on the length. In case of sills, a tolerance of $+0_{-6}$ mm shall be allowed on the cross-sectional dimensions and ± 3 mm on the length.

For details refer to Figs. 5 to 7 of the standard.

3. Strength Requirement

3.1 Ultimate breaking load obtained as prescribed in **7.1.1** of the standard shall not be less than the ultimate load which the lintel is designed to carry.

Note 1 — For details of material, refer to **3** of the standard.

Note 2 — For details of manufacture, or aspects such as construction, finish, mould, reinforcement, occurring etc, refer to **5** of the standard.

For detailed information, refer to IS 9893:1981 Specification for precast concrete lintels and sills.

SUMMARY OF

IS 10388 : 1982 CORRUGATED COIR, WOODWOOL, CEMENT ROOFING SHEETS

1. Scope — Requirements regarding materials, dimensions and physical properties for corrugated roofing sheets made from coir, woodwool and cement.

Note — Optimum utilization of national resources demand that use of indigenous building material should be promoted. Coir, woodwool and few other vegetable fibres which are available in large quantity in this country, have been found suitable for the manufacture of sheets for roofing purposes. The sheets may be either plain or corrugated and manufactured by mixing and pressing coir wood-wool and cement in suitable proportions.

2. Materials

2.1 Cement—This shall conform to either IS 269:1989* or IS 8041 : 1990† or IS 8112 : 1989‡

2.2 Woodwool — These shall be obtained from any species of soft timber in fibre form having following dimensions—

Length of fibre	=	200 to 500 mm
Width	=	0.5 to 2.5 mm
Thickness	=	0.2 to 0.35 mm

2.3 Coir — These shall be baby fibres, free from pith and shall be capable of absorbing cement.

3. Dimensions and Tolerances—See Table 1.

4. Physical Requirements— See Table 2.

* 33 Grade ordinary Portland cement (*fourth revision*).

† Rapid hardening Portland cement (*second revision*).

‡ 43 Grade ordinary Portland cement (*first revision*).

**TABLE 1 DIMENSIONS AND TOLERANCES FOR CORRUGATED COIR,
WOODWOOL, CEMENT ROOFING SHEETS**
(All dimensions in millimeters)

<i>Length</i>	<i>Width</i>	<i>Thickness</i>	<i>Depth of Corrugation</i>	<i>Pitch of Corrugation</i>
(1)	(2)	(3)	(4)	(5)
1 500 1 750 2 000	1 000	6.5	48	146
Tolerances	± 10	+ free – 0.5	+3 –6	+6 –2

**TABLE 2 PHYSICAL REQUIREMENTS OF WOODWOOL, COIR CEMENT
CORRUGATED ROOFING SHEETS**

<i>Sl.No</i>	<i>Characteristics</i>	<i>Requirements</i>
(1)	(2)	(3)
i)	Transverse strength	1.5×10^{-3} N/m width, <i>Min</i>
ii)	Water absorption	30 percent, <i>Max</i>
iii)	Impermeability	Shall not show any formation of drops of water except traces of moisture on the lower surface
iv)	Acid resistance	Amount of acetic acid to be used 1 150 g/m ² , <i>Max</i>

Note —The age of specimens for testing shall be at least 4 weeks.

Note — For methods of tests , refer to Appendices A to D of the standard.

For detailed information, refer to IS 10388:1982 Specification for corrugated coir, woodwool, cement roofing sheets.

SUMMARY OF

IS 12440 : 1988 PRECAST CONCRETE STONE MASONRY BLOCKS

1. Scope — Requirements of precast concrete stone masonry blocks, used in the construction of load bearing and non-load bearing walls.

2. Terminology

2.1 Concrete Stone Masonry Block — A precast cement concrete solid block having stone spalls in it (25-30 percent of block volume) and cement concrete with dense stone aggregate and sand. It is 100 percent solid.

2.2 Stone Face Exposed Block — A concrete stone masonry block where the stone spalls are exposed at one of its face. This face, when forms the exposed wall face, the wall gets the texture of stone surface exposed.

3. Dimensions and Tolerances

3.1 Nominal dimensions —

Length	300 mm
Height	150 mm and
Width	100, 150 and 200 mm

In addition block shall be manufactured in one third half, two-thirds and three quarters of its full length.

Note — The term 'nominal' means that the dimension includes the thickness of the mortar joint. Actual dimensions shall be 10mm short of the nominal dimensions.

3.2 For 200, 150 and 100 mm nominal thick walls, the blocks shall be of $300 \times 200 \times 150$ mm, $300 \times 150 \times 150$ mm and $300 \times 100 \times 150$ mm nominal size respectively.

3.3 For accommodating vertical reinforcement required in earthquake resistant construction special block of half-width and with semi-circular recess in it (*see* Fig.1 of the standard) shall be used. These dimensions are suitable for 200 mm thick wall. Similar blocks shall be made for walls of thickness greater than 200 mm.

3.4 Tolerances — The maximum variation in the length of the units shall not be more than ± 5 mm and maximum variation in height and width of units not more than ± 3 mm. The faces of blocks shall be flat and rectangular, opposite faces shall be parallel, and all arises shall be square. The bedding surfaces shall be at right angles to the faces of the blocks.

4. Classification — *See* Table 1.

5. Physical Requirement

5.1 Water Absorption — The water absorption being the average of three blocks, shall not be more than 6 percent by mass.

5.2 Compressive Strength — *See* Table 1

TABLE 1 COMPRESSIVE STRENGTH OF CONCRETE STONE MASONRY BLOCKS

(Based on 28 days Strength)

Class Designation	Minimum Average* Compressive Strength of Blocks N/mm ²	Minimum strength of Individual Blocks N/mm ²
5	5.0	3.5
6	6.0	4.2
7	7.0	5.0
9	9.0	6.3
10	10.0	7.5

*For 100 mm wide blocks (for 100 mm thick walls) the minimum strength may be 3.5 N/mm².

Note 1 — For details of materials refer to 5 of the standard.

Note 2 — For details of manufacture in regard to mould, mix, placing, compaction, curing and drying refer to 6 of the standard.

Note 3 — For methods of tests, refer to Appendices A to C of the standard.

For detailed information refer to IS 12440:1988. Specification for precast concrete stone masonry blocks.

SUMMARY OF
IS 12592 : 2002 PRECAST CONCRETE MANHOLE
COVER AND FRAME
(First Revision)

1. Scope

Requirements for precast steel reinforced cement concrete manhole covers and frames intended for use in sewerage and water drainage.

2. Grades and Types

2.1 Manhole cover shall be of the following four grades and types:

<i>Grades</i>	<i>Grade Designation</i>	<i>Type/Shape of Cover Frame</i>
Light Duty	LD-2.5	Rectangular, square and circular
Medium Duty	MD-10	Rectangular and circular
Heavy Duty	HD-20	rectangular, square, circular and lamphole (scraper manhole)
Extra Duty	EHD-35	rectangular, square and circular (scraper manhole)

2.2 Recommended locations for placement of different grades and types / shapes of manholes covers and frames are given in 3.2.1 to 3.2.4 of the standard.

3. Shapes and Dimensions

3.1 Shape— The shapes of precast concrete manhole covers shall be of shape as mentioned in 2.

3.2 Dimensions and Tolerance – The dimensions and tolerances on dimension of frames shall be as shown in Table 1 of the standard.

4. Physical Requirements

4.1 General — All covers and frames shall be sound and free from cracks and other defects which interferes with the proper placing of the unit or impair the strength or performance of the units.

4.2 Dimensions – The dimensions of the cover and frame shall be as specified in 3.2

4.3 Load Test — Breaking load of individual units shall be not less than the value specified in the table given below :

Load Test Load and Diameter of Block			
<i>Grade of Cover</i>	<i>Type</i>	<i>Load in kN</i>	<i>Diameter of Block mm</i>
LD-2.5	Rectangular, square and circular	25	300
MD-10	Rectangular and circular	100	300
HD-20	Circular, lamphole, square and rectangular (scraper manhole)	200	300
EHD-35	Circular, square and rectangular (scraper manhole)	350	300

5. The permanent set shall not exceed the requirement given in Annex C of the Standard.

Note 1 — For details of material refer to 4 of the standard.

Note 2 — For details of manufacture in regard to mixing, placing, compaction, curing and finishing, refer to 7 of the standard.

Note 3 — For methods of tests refer to Annex B and C of the standard.

For detailed information, refer to IS 12592 :2002 Specification for precast concrete manhole covers and frames.

SUMMARY OF

IS 13356 : 1992 PRECAST FERROCEMENT WATER TANKS UP TO 10 000 LITRES CAPACITY

1. Scope — Requirements of precast ferrocement water tanks of capacity 270 to 10 000 litres.

Note — The capacity of tank means the net capacity which is the volume of the actual usable water confined between the levels of the centres of the overflow and outlet sockets. Gross capacity of a tank shall be taken as the total storage capacity including the dead storage and free board.

2. Shape and Dimension — Ferrocement water tanks are generally made in square, rectangular and circular shapes. For relatively large circular tanks of diameter exceeding 2.0 m, a shallow spherical dome may be provided for the base or alternatively, suitable fillets may be provided at the junction of bottom slab and vertical wall.

Dimensions of ferrocement water tanks shall be calculated depending upon their capacities. For cylindrical tanks, height to diameter ratio of 1.0 is generally recommended. For rectangular tanks, length to breadth ratio should generally be kept 1.5 whereas the height to length and breadth ratio should generally be 0.5 to 1.5. If the length of any side exceeds 1.5 m, it is desirable to provide stiffeners in the side walls at spacing not exceeding 1.5 m.

3. Tolerances

- | | | |
|----|---|--------|
| a) | Length, breadth, height and diameter up to 1 m; and | ±5 mm |
| | Length, breadth, height and diameter above 1 m | ±10 mm |
| b) | Thickness | ±2 mm |

4. Design

4.1 The minimum compressive strength of cement mortar cubes having area of face equal to 50 cm² shall be 25 N/mm². The recommended mix proportion is 1 part of cement to 1.5 to 2.5 parts of sand by mass. Water cement ratio should be 0.35 to 0.45.

4.2 The tensile stress in reinforcement under services condition shall not exceed 200 N/mm².

4.3 The minimum cross-sectional area of main reinforcement in any one of the two principal directions shall not be less than 1.0 percent of the gross cross-sectional area of the element.

4.4 Laps in wire mesh, where provided, shall be not less than 100 mm.

4.5 The skeletal steel shall be spaced at not more than 300 mm centre to centre in both directions. Laps in bars where, provided, shall be not less than 150 mm. The skeletal steel may not be necessary in case of mechanized or semi-mechanized casting processes.

4.6 The minimum wall thickness shall be 12 mm for tanks up to 2 000 litres capacity in case of mechanized or semi-mechanized casting and 15 mm for tanks up to 1 000 litres capacity when hand cast. For larger capacity tanks the wall thickness may be 20 mm to 40 mm depending on capacity.

4.7 The minimum thickness of the lid/cover slab shall in no case be less than 15 mm.

4.8 In case the bottom slab thickness exceeds 30 mm, the slab may be cast in ferrocement only. However, an intermediate plain concrete layer using graded coarse aggregate of nominal maximum size 6.3 mm may be introduced between the wire mesh layers to achieve the design thickness without excessive use of cement. In case of composite slab, the minimum thickness of top as well as bottom layer of ferrocement shall not be less than 8 mm.

4.9 The minimum clear cover to reinforcement shall be 4 mm.

5. Tests

5.1 Strength of Mortar — For cubes of size 70.6 mm shall be not less than 25 N/mm².

5.2 Water Tightness Test — When filled with water, the

external faces of the tanks shall show no sign of leakage and sweating and remain apparently dry over the period of observation of seven days after allowing a seven day period for absorption of water after filling. This test shall be done before painting the interior of the tanks.

Note 1 — For details of material, refer to 4 of the standard.

Note 2 — For details of construction in regard to casting, curing, transportation, finish and painting refer to 6 of the standard.

For detailed information, refer to IS 13356:1992 Specification for precast ferrocement water tanks up to 10 000 litres capacity.

SUMMARY OF

IS 13990 : 1994 PRECAST REINFORCED CONCRETE PLANKS AND JOISTS FOR ROOFING AND FLOORING

1. Scope — Requirements for precast reinforced concrete planks and joist used for construction of roofs and floors. The planks length upto 1.5 m long only are covered.

2. Shape, Dimensions and Tolerances

2.1 Precast Reinforced Concrete Planks

2.1.1 Shape — Shape of the planks shall be rectangular with haunches as shown in. Top surface shall be chequered finish.

2.1.2 Dimensions

2.1.2.1 Width — The width of the planks shall be 300 mm.

2.1.2.2 Length — The length of the planks shall be limited to a maximum of 11.5 m. However, it is preferable to use lengths in multiple of 300 mm only, keeping in view the requirements of modular co-ordination.

2.1.2.3 Thickness — The plank shall be made partly 30 mm and partly 60 mm thick. A 100 mm wide tapered concrete filling shall be provided for strengthening the haunch portion for shear during handling and erection.

Length of the tapered concrete filling at both ends shall be kept 300 mm for all lengths of planks and the length of central 60 mm thick portion shall be decreased for lengths of planks smaller than 1.5 m.

2.2 Partially Precast Joists — The width of precast joists shall be kept equal to required width of web of T-beam (see IS 13994 : 1994)* and the depth shall be kept equal to the required overall depth of T-beam less the thickness of flange, that is, the maximum thickness of RC planks (60 mm).

2.3 Tolerances — Casting tolerances on various dimensions of plank shall be as given below —

<i>Dimension</i>	<i>Tolerance</i>
Length	± 5 mm
Width	± 3 mm
Thickness	± 2 mm
Bow (deviation from intended line or plane).	± 2 mm
Twist (distance of any corner from the plane containing other three corners).	1 mm

2.3.1 Squareness — The long edge of planks shall be taken as the base line. The shorter side shall not vary in its length from perpendicular distance between long edges by more than 3 mm.

2.3.2 Flatness — The maximum deviation from a 1.5 m straight edge placed in any position on a nominal plane surface shall not exceed 2 mm.

3. Design

3.1 The planks — The planks shall be designed as simply supported for self weight including in situ concrete over haunches, and as a continuous slab for a load comprising live load, self weight and dead load of floor finish and/or water proofing treatment. The design shall be in accordance with the limit state method of IS 456 : 2000.*

3.2 Reinforcement-as per IS 456 : 2000 — Reinforcement for planks for roofs and floors of residential buildings for spacing of joists at 1.5 m, shall comprise 3 bars of 6 mm of mild steel grade I conforming to IS 432 (Part 1) : 1982⁺ as main reinforcement and 6 mm dia bars, of mild steel grade I conforming to IS 432 (Part

* Code of practice for design and construction of floor and roof with precast reinforced concrete planks and joists.

* Code of practice for plain and reinforced concrete (fourth revision)

⁺ Mild steel and medium tensile steel bars and hard drawn steel wire for concrete bars for concrete reinforcement, Part I mild steel and medium tensile bars (third revision).

I) : 1982, at 200 mm c/c as transverse reinforcement. In the absence of detailed design same reinforcement may be used for spacing of joist smaller than 1.5 m.

Reinforcement for RCC joist shall be provided as per design (see IS 13994 : 1994).

4. Test — Dimensional test and deflection recovery test shall be routine test whereas failure load test shall be a type test. Type test is intended to prove the suitability and performance of a new design and size of a component. Failure load test be applied at the time of design of a component of a particular size or at the time of any change in the design/size.

Note 1— For details of materials refer to 3 of the standard.

Note 2— For method of test refer to Annex A of the standard.

For detailed information, refer to IS 13990:1994 Specification for precast reinforced concrete planks and joists for roofing and flooring

SUMMARY OF

IS 14143 : 1994 PREFABRICATED BRICK PANEL AND PARTIALLY PRECAST CONCRETE JOIST FOR FLOORING AND ROOFING

1. Scope—Requirements for prefabricated brick panel and partially precast joist for flooring and roofing.

2. Dimensions and Tolerances

2.1 Prefabricated Brick Pane

2.1.1 Length—Length of panel shall not exceed 1.1 m for bricks having strength less than 40 N/mm². For bricks having strength more than 40 N/mm² conforming to IS 2180 : 1988* the length of panel shall not exceed 1.2 m. From economic point of view, the minimum recommended length of panel is 0.9 m.

2.1.2 Width— Width of the panel shall be 53 cm for panels made of conventional size (230 mm × 110 mm × 75mm) bricks and 45 cm for panels made of modular size (190 mm x 90 mm x 90 mm) bricks.

2.1.3 Thickness—Thickness of the panel shall be equal to thickness of a brick, that is, 75 mm for conventional size bricks and 90 mm for modular size bricks.

2.2 Partially Precast Joist

2.2.1 Shape—Partially precast joist shall be rectangular in shape with steel stirrups kept projecting out which shall be tied with reinforcement along the joist to achieve monolithicity with concrete (*see* Fig. 2).

2.2.2 Width— Shall be sufficient to support two successive spans of brick panels with sufficient bearing, leaving an adequate gap between them. The minimum recommended width is 13 cm.

2.2.3 Depth—For clear span of joist up to 4.2 m depth shall be 100 mm for both conventional and modular size bricks, Accordingly overall depth of joist with in-situ concrete of 35 mm shall be 210 mm for conventional bricks and 225 mm for modular bricks.

2.3 Thickness of Joints

2.3.1 Longitudinal Joints—Thickness of longitudinal joints shall be 40 mm to accommodate one 6 mm reinforcing bar with adequate cover (*see* Fig. 1).

2.3.2 Transverse Joints— Thickness of transverse joints shall vary from a minimum of 15 mm to a maximum of 30 mm. However in a single panel unit, this shall be kept uniform for all transverse joints.

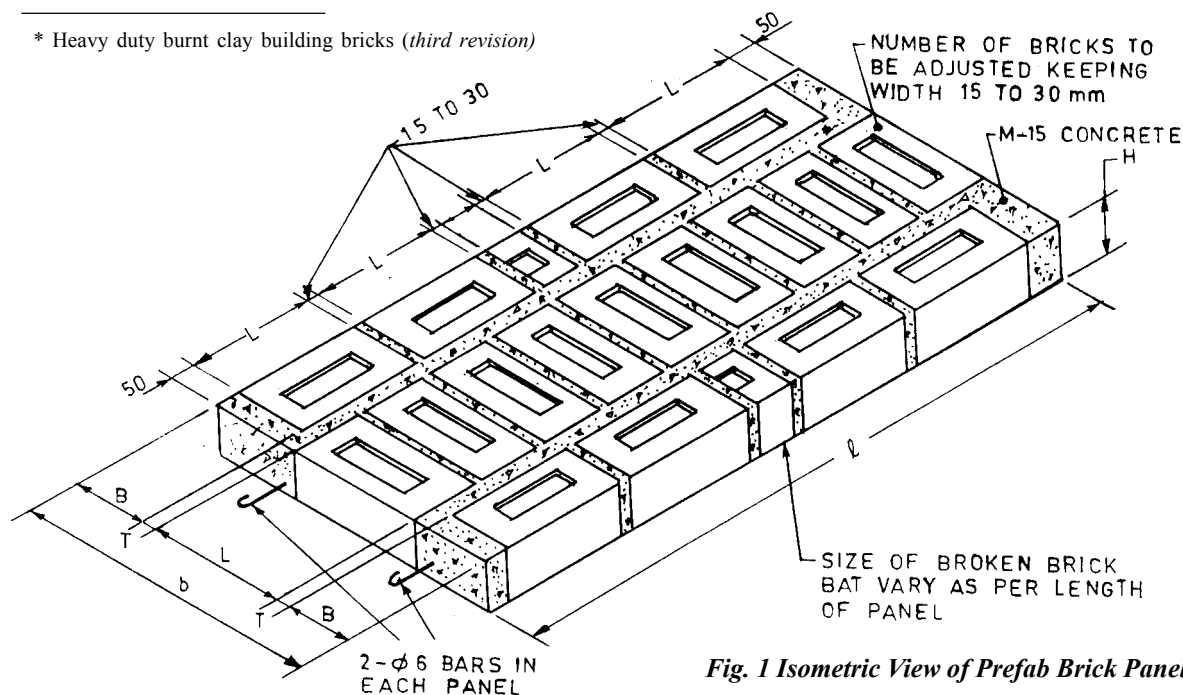


Fig. 1 Isometric View of Prefab Brick Panel

2.4 Tolerances — Tolerances on various dimensions of the panel shall be as given below —

Dimension	Tolerance
Length of panel	± 10 mm
Width of panel	± 5 mm
Thickness of panel	± 4 mm

3 Reinforcement

3.1 Reinforcement required for brick panel shall consist of 2 bars of required diameter embedded in the longitudinal joints.

3.1.1 Reinforcement with two mild steel Grade 1 bars of 6 mm conforming to IS 432 (Part 1) : 1982* may be used in residential building.

* Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement, Part 1 Mild steel and medium tensile steel bars (third revision)

3.1.2 Reinforcement for RC joist shall be provided as per design (see IS 14142 : 1994).**

3.2 Cover to Reinforcement — A minimum clear cover of 15 mm shall be provided to reinforcement in the panel while for the joist the minimum clear cover shall be 25 mm.

4. Test — Dimensional test and deflection recovery test shall be routine tests whereas failure load test shall be type test. Type test is intended to prove the suitability and performance of a new design and size of a component. Failure load test is applied at the time of any change in the design/size.

** Code of practice for design and construction of roofs and floors with prefabricated brick panel.

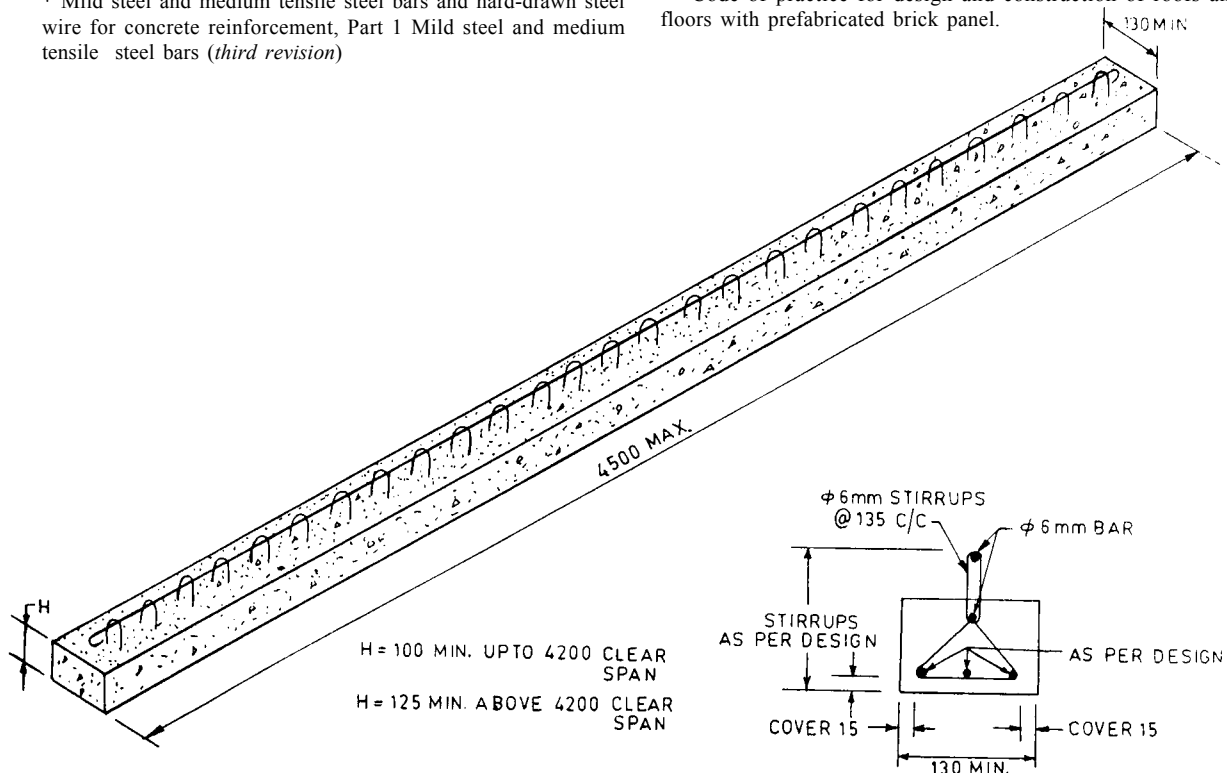


Fig. 2 Typical Partially Precast Joist

Note 1 — For details of material refer to 3 of the standard.

Note 2 — For details of manufacture with regard to mould, casting and curing refer to 6 of the standard.

Note 3 — For methods of tests, refer to Annex B of the standard.

For detailed information, refer to IS 14143:1994 Specification for prefabricated brick panel and partially precast concrete joist for flooring and roofing.

SUMMARY OF

IS 14201 : 1994 PRECAST REINFORCED CONCRETE CHANNEL UNITS FOR CONSTRUCTION OF FLOORS AND ROOFS

1. Scope— Requirements for precast reinforced concrete channel units having a length of up to 4.5 m used for construction of floors and roofs.

2. Shape, Dimension and Tolerance

2.1 Shape

2.1.1 The precast units shall be channel (inverted trough) shapes, having outer sides corrugated and grooved at ends to provide shear key action transfer of moments between adjacent units. (Fig 1 and 2).

2.1.2 Inner sides of the channel shall be kept sloping, as shown in Fig. 2 to simplify easy demoulding. The slope may be kept between 1/8 to 1/16.

2.2 Dimensions

2.2.1 Length— The maximum length of the unit shall be restricted to 4.5 m from stiffness considerations.

2.2.2 Width— The nominal width of channel unit shall be 300 mm or 600 mm.

2.2.3 Depth— The depth of the channel unit shall be kept either 130 mm or 200 mm.

2.2.4 Thickness of flange— The minimum thickness of flange shall be 30 mm for 300 mm wide channel units and 35 mm for 600 mm wide channels.

2.2.5 Thickness of web (legs of channel unit)— The minimum thickness of the channel leg shall be not less than 25 mm.

2.3 Tolerances on Dimensions

2.3.1

<i>Dimension</i>	<i>Tolerance</i>
Length	± 5 mm
Width	± 3 mm
Bow (deviation from intended line or plane)	± 3 mm
Twist (distance of any corner from the plane containing other three corners)	± 3 mm

2.3.1 Squareness— When considering the squareness of the corner, the longer of the two sides being checked shall be taken as the base line. The shorter length shall not vary in length from the perpendicular by more than 3 mm.

2.3.2 Flatness— The maximum deviation from a 1.5 m straight edge placed in any position on a nominal plane surface shall not exceed 2 mm.

3. Design

3.1 The channel units shall be designed in accordance with IS 14215:1994.*

3.2 Reinforcement

* Code of practice for design and construction of floors and roofs with precast reinforced concrete channel units.

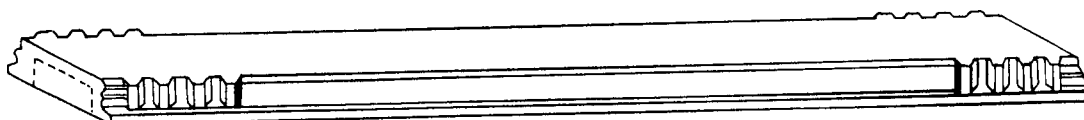


Fig. 1 Channel Unit

3.2.1 Main reinforcement of the channel units shall comprise two bars of required diameter as per the design placed at the bottom of two legs of channel unit. Two bars of mild steel Grade 1 conforming to IS 432 (Part 1): 1982,* 6 mm shall be provided at top corners to support the stirrups (see Fig 2). Stirrups of 3 mm at the rate of 300 mm c/c along the length of the channel unit (see Fig 2) shall be provided.

* Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement, Part 1 Mild steel and medium tensile steel bars (third revision).

3.2.2 *Cover to reinforcement* — The minimum cover to reinforcement shall be 15 mm.

4. Tests— Tests for dimensional conformity, deflection recovery and failure load shall be conducted.

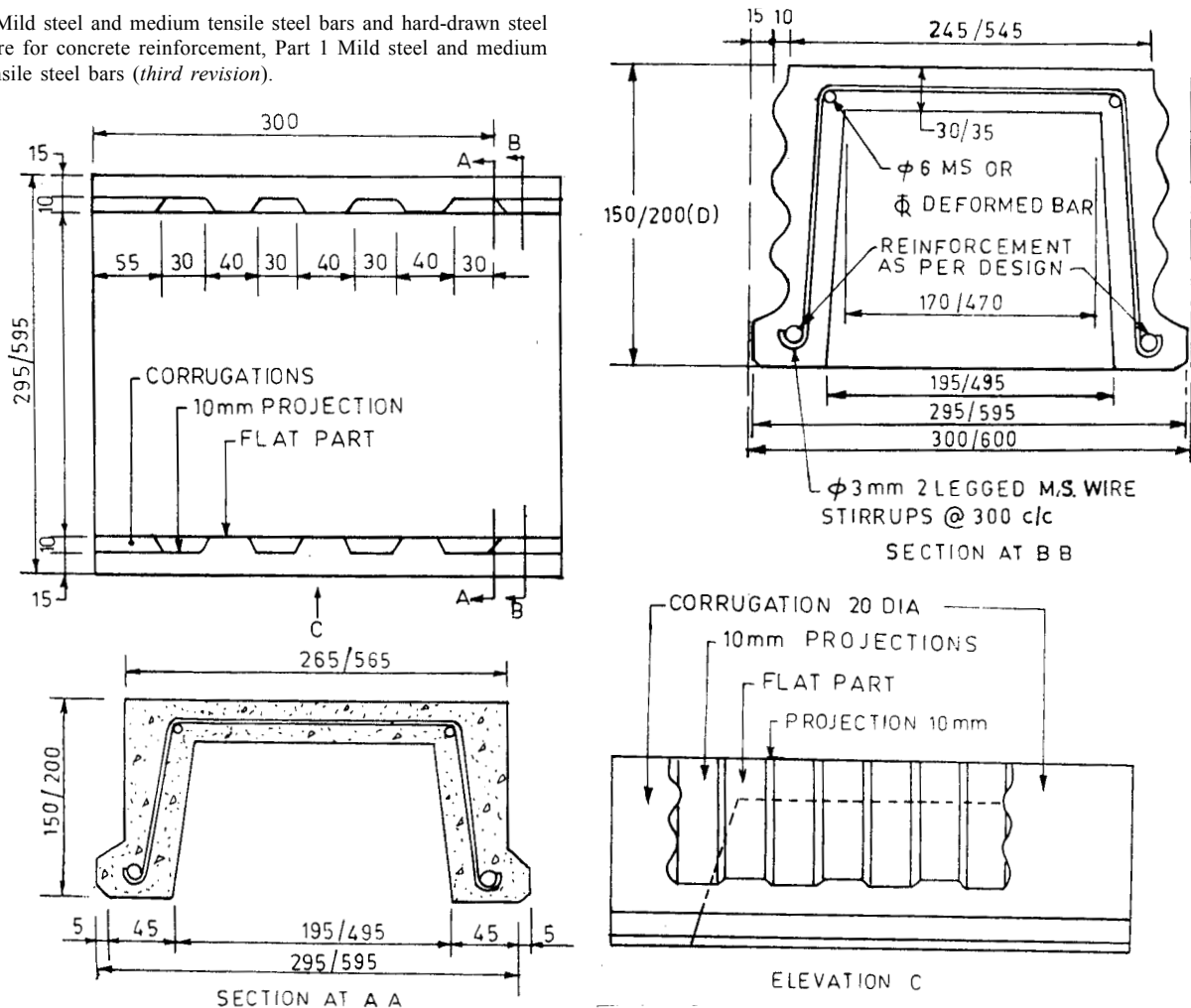


Fig. 2 Typical Details of Channel Unit

Note 1— For details of materials refer to 3 of the standard.

Note 2— For details of manufacture refer to 6 of the standard.

Note 3— For method of test refer to Annex A of the standard.

For detailed information, refer to IS14201:1994 Specification for precast reinforced concrete channel units for construction of floors and roofs.

SUMMARY OF IS 14241 : 1995 PRECAST REINFORCED CONCRETE L-PANEL FOR ROOFING

1. Scope—Requirements for prefabricated reinforced concrete L-panels used for making roofs for buildings. This standard also covers the requirements for prefabricated reinforced concrete channel units which are to be used along with L-panels in the roof construction.

2. Shape and Dimensions

2.1 Shape—The precast L-panel units shall have a cross-section of “L” shape with end bearing of same depth and width as the rib of L-section at the two ends of length. The end bearing length of rib parallel to the width of L-panel shall be kept lesser than the overall width of L-panel to provide an overlapping of 80-150 mm depending upon climatic conditions (see Fig. 1).

2.1.1 Channel Units—Units having a cross-section of channel shape shall also be produced in required numbers, to be used at the eaves in a verandah or for achieving aesthetic effect (see Fig. 1).

2.2 Dimensions

2.2.1 Length—The maximum span of L-panels shall be restricted to 4 m. Lower lengths may be preferred, wherever possible, for easy handling. A minimum bearing on the gable walls shall be kept 60 mm on either side of the L-panels.

2.2.2 Width—A guidance may be taken for choosing the width from Table 2 of the standard.

2.2.3 Thickness of flange—A thickness of flange of 30 to 40 mm depending upon the size of units and climatic conditions should be adopted, keeping it 30 mm for overall width up to and including 700 mm and 40 mm for widths up to 900 mm.

2.2.4 Depth and width of rib—The dimensions of rib shall be determined in accordance with the design procedure laid down in IS 14242 : 1995.* In any case, the depth and width of rib shall be not less than those given in Table 2 of the standard.

* Design and construction of roofs using precast reinforced concrete L-panels-code of practice.

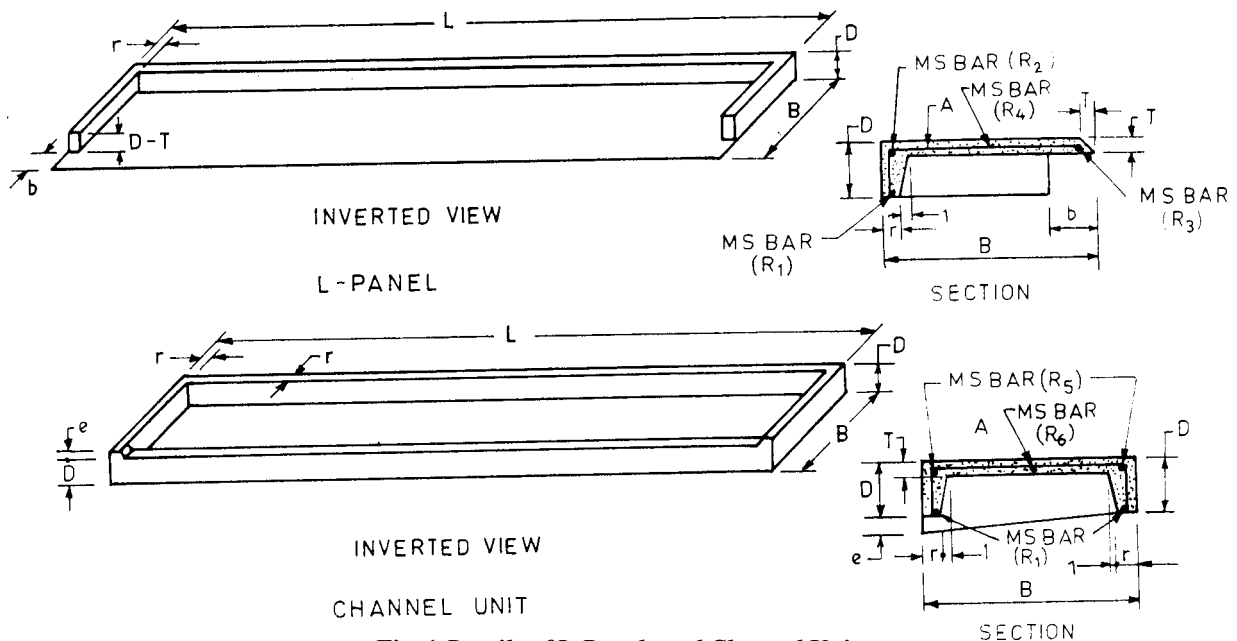


Fig. 1 Details of L-Panels and Channel Units

3. Reinforcement

3.1 Main reinforcement required shall consist of one bar of required diameter provided at bottom of the rib of L-panel having an adequate cover. The required diameter shall be designed in accordance with IS 14242 : 1995. Alternatively, the required diameter may be taken from Table 2 which applies for reinforcement conforming to mild steel Grade I of IS 432 (Part 1) : 1982* and high strength deformed bars as per IS 1786 : 1978.** The detailing shall be followed in accordance with Fig. 1.

3.2 Reinforcement for temperature and handling shall be provided in the flange as per Table 2 of the standard

3.3 At the eaves over verandah where channel units are provided, the same tensile reinforcement as for L-panel shall be provided in both the ribs (the total reinforcement thus being double that of L-panel) while the overall dimensions shall be kept the same.

4. Tests—Dimension test, deflection, recovery test shall be routine tests while failure load test shall be type test.

* Mild steel and medium tensile steel bars hard-drawn steel wire for concrete reinforcement : Part 1 Mild steel bars (*third revision*).

** High strength deformed steel bars and wires for concrete reinforcement (*third revision*).

Note 1— For details of material refer to **3** of the standard.

Note 2— For details of manufacture with regard to mould, casting and curing refer to **6** of the standard.

Note 3— For methods of tests, refer to Annex A of the standard.

For detailed information, refer to IS 14241:1995 Specification for precast reinforced concrete L-panel for roofing.

SUMMARY OF
IS 459 : 1992 CORRUGATED AND SEMI-CORRUGATED ASBESTOS
CEMENT SHEETS
(Third Revision)

1. Scope— Covers corrugated and semi-corrugated asbestos cement sheets, designed to provide structural weather exposed surfaces of roofs and building walls of industrial, residential, agricultural commercial and institutional types of buildings and for decorative and other purposes.

2. Dimensions and Tolerances — See Table 1.

3. Physical and Mechanical Characteristics

3.1 The load bearing capacity of corrugated and semi-corrugated sheets shall be not less than 5 N/mm width of specimen.

3.2 Impermeability test (optional) — The specimens shall not show during 24 hours of test any formation of drops of water except traces of moisture on the lower surface.

3.3 Frost cracking test (optional) — Shall not show any cracking, surface alteration or delamination.

3.4 Density (Optional test) — Shall not be less than 1.4g/cm³.

4. Finish — Shall have rectangular shape; corrugation true and regular; edges straight and clean and square.

TABLE 1 DIMENSIONS AND TOLERANCES OF CORRUGATED AND SEMI-CORRUGATED SHEETS

Sl. No.	Types of Sheets	All dimensions in millimetres											
		Depth of Corrugation	Pitch of Corrugation	Overall Width	Effective Width	Nominal Thickness	Length of Sheet						
(1)	(2)	D	Tolerances	P	Tolerances	B	Tolerances	C	Tolerances	T	Tolerances	A	Tolerances
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)(11)	(12)	(13)	(14)	(14)
i) Corrugated		48	+3 -5	146	+6 -2	1050	+10 -5	1010	+10 -5	6	+free -0.5	1500 1750 2000 2250 2500 2750 3000	+5 -10
ii) Semi-corrugated	45		+3 -5	338	+6 -2	1100	+10 -5	1014	+10 -5	6	+free -0.5	1500 1750 2000 2250 2500 2750 3000	+5 -10

1. Tolerance given in this table for pitch of corrugation relates to measurement over six pitches for corrugated sheets and three pitches for semi corrugated sheets.

2. Nominal lengths other than those specified in col 13 may also be manufactured by mutual agreement between

Note — Corrugated sheets of overall width 1086 mm and effective width 1016 mm with tolerances and other parameters same as in this table 1 may also be manufactured by mutual agreement between the manufacturer as the purchaser (see Fig 1A of the standard)

Note 1 — For method of measurement of different dimensions of sheets, refer to 5 of the standard.

Note 2 — For methods of tests, refer to IS 5913: 2003 Methods of tests for asbestos cement products (second revision).

For detailed informatoin refer to IS 459:1992 Specification for corrugated and semi-corrugated asbestos cement sheets (third revision).

SUMMARY OF
IS 1592 : 2003 ASBESTOS CEMENT PRESSURE PIPES
(Fourth Revision)

1. Scope—Requirements relating to plain ended asbestos cement pipes and joints intended for use under pressure; it defines certain conditions of manufacture, classification, characteristics and acceptance tests applicable to these products.

Note — Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings are covered by IS 1626. Asbestos cement pipes and fittings for sewerage and drainage are covered by IS 6908 'Specification for asbestos cement pipes and fittings for sewerage and drainage (first revision).

2. Pipes

2.1 Classification

2.1.1 Pipes of Nominal Diameter Up to 1 000 mm — Pipes of nominal diameter up to 1 000 are classified according to the works hydraulic test pressure give in Table 1.

TABLE 1 CLASSIFICATION

<i>Sl.No</i>	<i>Classes</i>	<i>Works Hydraulic Test Pressure, TP (MPa)</i>
(1)	(2)	(3)
i)	10	1.0
ii)	15	1.5
iii)	20	2.0
iv)	25	2.5

NOTES

1. Pipes of class 12, 18, 24, 30, 35 and 36 corresponding to works hydraulic test pressure of 1.2, 1.8, 2.4, 3.0, 3.5 and 3.6 MPa respectively may also be manufactured. In such cases, detailed dimensions shall be arrived at between the manufacturer and the purchaser.

2. For pipes of nominal diameter from 600 mm to 1 000 mm, the procedure given in 3.2.2 may also be used.

The relationship between the bursting pressure (*BP*) and the works hydraulic test pressure (*TP*), and the relationship between the bursting pressure (*BP*) and the hydraulic working pressure (*WP*) shall not be less than the values indicated in Table 2.

TABLE 2 PRESSURE RELATIONSHIP

<i>Sl.No</i>	<i>Nominal Diameters</i>	$\frac{BP}{TP}$	$\frac{BP}{WP}$
(1)	(2)	(3)	(4)
i)	From 50 to 100	2	4
ii)	From 125 to 200	1.75	3.5
iii)	From 250 to 1 000	1.5	3

Note — Pipes of nominal diameter above 1 000 mm and up to 2 500 mm may also be manufactured with the data on the above parameters to be as mutually agreed to between the manufacturer and the purchaser.

2.1.2 Pipes of Nominal Diameter Exceeding 1 000 mm — Pipes of nominal diameter exceeding 1 000 mm are not classified in the same way as defined in 2.1.1 They are designed to suit the specific requirements of any particular pipeline.

2.2 General Appearance and Finish

The material surface shall be regular and smooth. The pipes may be coated internally and/or externally with a suitable coating, if required by the purchaser's representative.

2.3 Characteristics

2.3.1 Geometrical Characteristics

2.3.1.1 Nominal diameter

The nominal diameter of the pipes corresponds to the internal diameter expressed in millimetres, tolerances excluded. The series of nominal diameters is given in Table 3.

TABLE 3 NOMINAL DIAMETER

All dimensions in millimetres

50	400
60	450
80	500
100	600
125	700
150	750
200	800
250	850
300	900
350	1 000

Note — The pipes of nominal diameter above 1 000 mm may also be manufactured, if required with mutual agreement between the manufacturer and the user.

2.3.1.2 Thickness of wall and external diameter

The thickness of wall and external diameters of asbestos cement pressure pipes shall be as per Table 4.

2.3.1.3 Length

The nominal length of the pipes refers to the length measured between the extremities for pipes with plain ends. It shall not be less than 3 m for pipes with a nominal diameter equal to or less than 200 mm; and not less than 4 m for pipes with a nominal diameter exceeding 200 mm.

In special cases shorter pipes may be specified. The nominal length should preferably be a multiple of 0.5 m

2.3.1.4 Tolerances

(a) External diameter of finished ends

Tolerances on the external diameter at 100 mm from ends shall be follows.

Nominal Diameter mm	Tolerances mm
50 to 300	± 0.6
350 to 500	± 0.8
600 to 700	± 1.0
750 to 1000	± 1.5

Note — Such tolerances for sizes above 1 000 mm would be as agreed to between the manufacturer and the user.

(b) Nominal thickness of the wall

On jointing surfaces at the pipe ends, the lower deviations of the tolerances are as follows :

Nominal Thickness (mm)	Tolerance (mm)
Up to and including 10	– 1.0
Over 10 up to and including 20	– 1.5
Over 20 up to and including 30	– 2.0
Over 30 up to and including 60	– 3.0
Over 60 up to and including 90	– 3.5
Over 90	– 4.0

Notes

1 Plus tolerance shall be free

2 For pipes of 50 and 60 mm diameter, the above tolerances are allowable provided that the variation of the internal diameter resulting from the their application does not exceed – 5 mm.

3 The thickness at any point along the barrel of the pipe should be not less than that obtained by application of the tolerances given above.

4 The average thickness of the samples from the lot shall not be less than the nominal thickness and not more than 10 percent of the pipes samples should have negative tolerance

(c) Nominal length

The tolerances on nominal length shall be as follows

For all length $^{+50}_{-20}$ mm

2.3.2 Physical Characteristics

Shall show no fissure, leakage or sweating.

2.3.3 Mechanical Characteristics

2.3.3.1 Bursting

Shall have a minimum unit bursting strength of 22 N/mm² except that for diameters exceeding 1 200 mm this strength may be reduced by not more than 20 percent by agreement between the manufacturer and the purchaser provided that the safety factors specified in the relevant for large diameter pipes are maintained.

2.3.3.2 Crushing

When tested in accordance with 3.5 (a) (3) of the standard the pipes shall have a minimum unit transverse crushing strength of 44 N/mm² except that for diameters exceeding 1 200 mm this strength may be reduced by not more than 20 percent by agreement between the manufacturer and the purchaser provided that the safety factors specified in the relevant Indian Standard for large diameter pipes are maintained.

2.3.3.3 Bending

When tested as prescribed in 3.5 (a)(4) of the standard (test limited to pipes with a nominal diameter less than or equal to 150 mm), the pipes shall have a minimum unit bending strength of 24.5 N/mm².

3. JOINTS

3.1 Type – Two types of joints are normally provided with asbestos cement pressure pipes and they are (a) asbestos cement coupling with rubber sealing rings, and (b) cast iron detachable joints with rubber sealing rings and bolts and nuts.

3.2 Characteristics**3.2.1 Geometrical Characteristics**

3.2.1.1 Dimensions – The dimensions of the asbestos cement coupling shall be as given in Annex B of the standard. The shape of all parts including the rubber rings, shall be determined by the manufacturer of the pipes

The joints, when mounted and put under pressure, shall ensure the permanent tightness of the pipeline against both leakage and infiltration.

3.2.2 Sealing Characteristics – The assembled joints, when tested at the factory, shall be capable of withstanding the specified hydraulic test pressure of the pipes on which they are to be used, even when the pipes are set at the maximum angular deviation recommended by the manufacturer. -

TABLE 4 CLASSIFICATION AND DIMENSIONS OF ASBESTOS CEMENT PRESSURE PIPES

All dimensions are in millimetres

Sl.	Nom	Class 10		Class 15		Class 20		Class 25	
No.	Dia	Thickness	External Diameter	Thickness	External Diameter	Thickness	External Diameter	Thickness	External Diameter
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1)	50	9.5	69.0	9.5	69.0	11.0	71.5	13.5	76.5
2)	60	9.5	79.0	9.5	79.0	11.0	81.5	13.5	86.5
3)	80	9.5	99.5	9.5	99.5	11.0	101.5	13.5	106.5
4)	100	9.5	120.0	10.0	121.0	13.5	126.5	16.5	132.5
5)	125	9.5	145.0	11.0	147.0	14.0	152.5	17.5	159.5
6)	150	9.5	171.0	13.0	176.5	16.5	183.0	21.0	191.0
7)	200	-	-	16.5	233.5	22.0	242.5	27.5	253.5
8)	250	-	-	17.0	284.5	23.0	294.5	28.5	305.5
9)	300	-	-	20.0	340.5	27.0	352.5	34.5	366.5
10)	350	-	-	21.0	392.0	27.5	405.0	35.0	419.0
11)	400	-	-	24.0	448.0	32.0	463.0	39.5	478.0
12)	450	-	-	26.5	498.0	35.5	515.0	44.0	532.0
13)	500	-	-	29.0	554.5	39.0	572.5	48.5	591.5
14)	600	-	-	35.0	665.5	46.0	686.5	58.0	710.5
15)	700	-	-	38.0	769.0	51.5	795.0	65.5	823.0
16)	750	-	-	40.5	824.0	55.0	853.0	70.0	882.0
17)	800	-	-	43.5	880.0	59.0	910.0	75.0	941.0
18)	850	-	-	46.0	935.0	62.5	967.0	79.5	1000.0
19)	900	-	-	48.5	990.0	66.0	1024.0	84.0	1059.0
20)	1000	-	-	54.0	1101.0	73.5	1138.0	93.5	1177.0

Notes

1 External diameters at finished ends of the pipes specified in the table are already in practical use and are specified the purpose of interchangeability. Due to inherent characteristics of the manufacturing process and common moulds for all classes, external diameter may not be equal to internal diameter plus twice the thickness in all cases.

2. For nominal diameters 700 to 1 000 mm for Classes 15 to 25, the barrel thickness shall not be less than the thickness mentioned above. The same may be verified from bursting test pieces.

3. For pipes of nominal diameter above 1 000 mm data/details shall be as agreed to between the manufacturer and the purchaser.

Note — For methods of tests, refer to standard and IS 5913:2003 Methods of tests for asbestos cement products (second revision).

For detailed information, refer to IS 1592 : 2003 Specification for asbestos cement pressure pipes (fourth revision).

SUMMARY OF

IS 1626 (PART 1) : 1994 ASBESTOS CEMENT BUILDING

PIPES AND PIPE FITTINGS, GUTTERS, AND GUTTER FITTINGS

AND ROOF FITTINGS PART 1 PIPES AND PIPE FITTINGS

(Second Revision)

1. Scope— Requirements of socketed asbestos cement building and sanitary pipes and pipe fittings of diameter 50 to 150 mm for use as rain water pipes, soil, waste and ventilating pipes.

1.1 *The followings pipes and pipe fittings are covered—*

- a) Single socketed pipe,
- b) Loose socket,
- c) Plain bend,
- d) Swan neck,
- e) Sanitary bend,
- f) Single and double equal junctions,
- g) Single and double unequal junctions,
- h) Single and double equal inverted junctions with spigot branch,
- j) Hexagonal rain water head,
- k) Shoe,
- m) Cone cap cowl,
- n) Slotted vent cowl, and
- p) W.C. connectors,

2. Workmanship— The interior surface of the pipes and pipe fittings should be regular.

3. Dimensional Requirements

3.1 Nominal Diameter and Thickness— The nominal diameter of the pipes and pipe fittings corresponds to the internal diameter (bore), tolerances not being taken into account.

3.2 Length

3.2.1 Nominal Length— The nominal lengths of pipes correspond to the useful lengths of the socketed pipes exclusive of internal depth of socket, not taking tolerance into account, and shall be 500, 1000, 1500, 1830, 2000, 2440 and 3000 mm.

3.2.2 Overall Length— The overall length is the sum of nominal length and length of socket.

3.3 Tolerances

3.3.1 Internal diameter of plain ends and sockets: The ratio of the actual diameter (maximum or minimum bore of pipes, pipe fittings or sockets measured over a given section) and the nominal diameter (bore of pipes, pipe fittings or sockets) should lie between 0.95 and 1.05 for all diameters of pipes and pipe fittings.

3.3.2 The nominal length— The tolerances on nominal length of pipes and pipe fittings shall be ± 10 mm and ± 5 mm respectively.

3.3.3 The overall length— The tolerances on the overall lengths of pipes shall be ± 10 mm.

3.3.4 The depth of socket— The tolerances on the depth of the sockets of pipe fittings shall be ± 5 mm.

4. Physical Requirements

4.1 The deviation in straightness of pipes shall not exceed the following—

<i>Nominal Diameter</i>	<i>Deviation</i>
mm	mm
50 to 60	5.5l
80 to 150	4.5l

where *l* is the nominal length of the pipe in metres

4.2 Hydraulic Pressure Test— To be carried out on all pipes and fittings except on cone cap cowl, slotted vent cowl and pipe fittings provided with access doors.

4.2.1 Pipes and fittings shall show no fissure or visible sweating on outside surface when subjected to internal hydraulic pressure of 0.1 MN/m^2 maintained for 30 seconds.

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4.2.2 Hydraulic bursting test — (optional for pipes only) the pipe shall indicate a minimum bursting stress of 5 MN/m²

4.2.3 Longitudinal bursting test — The unit longitudinal bending stress shall not be less than 12.5 MN/m².

4.2.4 Transverse crushing test — The unit transverse crushing stress of pipes at failure shall not be less than 14 MN/m².

4.2.5 Water absorption test — The mean water absorption of specimen shall not be more than 28 percent of the dry mass of the material.

Note— For methods of tests, refer to IS 5913:1989 Method of tests for asbestos cement products (*first revision*)

For detailed information refer to IS 1626 (Part 1):1984 Specification for asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roof fittings: Part 1 Pipes and pipe fittings (second revision).

SUMMARY OF

**IS 1626 (PART 2) : 1994 ASBESTOS CEMENT BUILDING
PIPES AND PIPE FITTINGS, GUTTERS AND GUTTER FITTINGS
AND ROOF FITTINGS
PART 2 GUTTERS AND GUTTER FITTINGS
(Second Revision)**

1. Scope — Requirements of asbestos cement gutters and gutter fittings used in buildings.

Note— For detailed dimensions for various items of gutters and their fittings, refer to Tables 2 to 4 and appropriate figures of the standard.

2. Workmanship — The interior surface of the gutters and their fittings shall be regular and uniform.

3.1 Tolerances

On length ± 10 mm

On profile ± 10 mm

On thickness ± 1.5 mm

3. Dimensional Requirements

- a) *Valley gutters* — Normal size (in mm), shall be, $915 \times 205 \times 230$, $610 \times 150 \times 230$, $455 \times 125 \times 150$ and $405 \times 125 \times 255$ with thickness 12.5 mm, and length 1 830 mm.
- b) *Boundary wall gutters* — Nominal size (in mm), shall be $510 \times 150 \times 255$, $455 \times 150 \times 305$, $305 \times 150 \times 230$ and $280 \times 125 \times 180$ with thickness 12.5 mm and length 1 830 mm.
- c) Half round gutters Nominal size shall be 305, 230 and 150 mm with thickness 9.5 mm.

4. Physical Requirements

4.1 When tested for impermeability, the specimen shall not show during 24 h of test any formation of drops of water, except traces of moisture on the lower surface.

Note — For methods of tests, refer to IS 5913:1989 Methods of tests for asbestos cement products (*first revision*).

For detailed information, refer to IS 1626 (Part 2) : 1994 Specification for asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roof fittings: Part 2 Gutters and gutter fittings (Second Revision).

SUMMARY OF
IS 1626 : 1984 ASBESTOS CEMENT BUILDING
PIPES AND PIPE FITTINGS, GUTTERS AND GUTTER FITTINGS
AND ROOF FITTINGS
PART 3 ROOF FITTINGS
(Second Revision)

1. Scope— Requirements of asbestos cement roofing fittings, to be used in conjunction with corrugated and semi-corrugated asbestos cement sheets conforming to IS 459:1992*

1.1 The following roofing fittings are covered in this standard.

- a) *Ridges*—
 - 1) Serrated adjustable ridges,
 - 2) Plain wing adjustable ridges,
 - 3) One piece plain angular ridges,
 - 4) Unserrated adjustable ridges for hips,
 - 5) Close fitting adjustable ridges, and
 - 6) Northlight adjustable ridges.
- b) Eaves filler pieces
- c) Ridge finials,
- d) Apron pieces
- e) Barge boards for corner pieces, curved barge boards,
- f) Rooflights,
- g) North light curves or ventilator curves,
- h) Cowl type ventilator curves,
- j) Expansion joints for semi-corrugated sheets and fittings like ridges and northlight curve.
- k) Louvres, S type,
- m) Radial exhaust, and
- n) Curved sheets.

2. Shapes, Dimensions and Tolerances

2.1 Shapes— The shapes of various fittings shall be as detailed in Table 1 read with appropriate figures as given in the standard.

2.2 Dimensions— Shall be declared by the manufacture

2.3 Tolerances

2.3.1 *Length* ± 10 mm

2.3.2 *Thickness* + free -1.0 mm

3. Physical Requirement

3.1 All the finished products shall be inspected for freedom from visual defects.

3.2 The surface of fittings intended to be exposed to the weather shall be generally of smooth finish and the finish should permit any minor variation of the surface appearance due to the method of manufacture, which does not impair the performance of the fittings.

3.2.1 The fittings shall be clean with straight and regular edges.

3.3 When tested for impermeability, the specimen shall not show during 24 hours of test any formation of drops of water, except traces of moisture on the lower surface.

* Corrugated and semi-corrugated asbestos cement sheets (*third revision*)

Note — For methods of tests, refer to IS 5913:1989 Methods of tests for asbestos cement products (*first revision*).

For detailed information, refer to IS 1626(Part 3):1994 Specification for asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roof fittings: Part 3 Roof fittings (second revision).

SUMMARY OF
IS 2096 : 1992 ASBESTOS CEMENT FLAT SHEETS
(First Revision)

1. Scope—Requirements regarding, composition, dimension and tests of asbestos cement flat sheets (semi-compressed and fully compressed). These sheets are different from autoclaved silica asbestos cement flat sheets which are covered in IS 13000:1990.*

2. Classification— See Table 1.

3. Dimensional and tolerances

3.1 Thickness— shall be 3, 4, 5, 6, 8, 10, 12 and 15 mm.

3.2 Length and Width — See Table 2.

3.3 Tolerances

3.3.1 On thickness —

(a) From 3 mm to 5 mm ± 0.5 mm

(b) From 6 mm and above ± 0.1 mm

where 'e' is nominal thickness of sheet.

3.3.2 On length and width — Shall not vary from the nominal dimensions for length and width by more than ± 5 mm.

3.3.3 Straightness of edges — Shall be not more than 2 mm/m for the relevant dimension (length or width)

3.3.4 Squareness of edges — Shall be not more than 3 mm/m.

4. Tests

4.1 Bending Strength Test and Density — Bending stress and density shall not be less than the values specified in Table 1.

4.2 For measurement of thickness, straightness and squareness of edges, refer to **8** of the standard.

* Silica asbestos cement flat sheets

TABLE 1 CLASSIFICATION				
Class of Sheet	Description of Sheet	Minimum Bending strength in N/mm ²		Minimum Density g/cc
		Loading Parallel to the Fibre of Sheet	Loading at Right Angles to the Fibre of Sheet	
(1)	(2)	(3)	(4)	(5)
1	Semi-compressed	13	16	1.2
2	Fully compressed	20	28	1.6

TABLE 2 NOMINAL DIMENSIONS OF ASBESTOS CEMENT SHEETS

Length	Width	
	1200	1220
600	x	x
610	x	x
1200	x	x
1200	x	x
1800	x	x
1830	x	x
2400	x	x
2440	x	x
3000	x	x
3050	x	x

Note— For methods of tests, refer to IS 5913:1989 Methods of test for asbestos cement products (first revision).

For detailed information, refer to IS 2096:1991. Specification for asbestos cement sheets (first revision).

SUMMARY OF
IS 2098 : 1997 ASBESTOS CEMENT BUILDING BOARDS
(First Revision)

1. Scope — Requirements regarding composition, dimensions, and test of asbestos cement building boards. Asbestos cement flat sheets and silica asbestos cement flat sheets which are different, are not covered in this standard.

2. Classification — See Table 1.

3. Tolerances

3.1 Length and Width ± 0.5 mm

3.2 Thickness

a) From 3 mm to 5 mm ± 0.5 mm

b) From 6 mm and above $\pm 0.1 e$ mm (± 10 percent) where 'e' is nominal thickness of board.

4. Tests

4.1 Load Bearing Capacity— Average of two specimens not less than 20 kg for Class A boards and 15 kg for Class B and Class C boards.

Further, the breaking load of either of the specimens shall not be less than 15 kg for Class A boards and 10 kg for Class B and Class C boards.

4.2 Water Absorption Test— The amount of water absorbed by the specimen shall not exceed 40 percent of its dry weight.

TABLE 1 DIMENSIONS OF ASBESTOS CEMENT BUILDING BOARDS

<i>Class of Board</i>	<i>Length</i>	<i>Width</i>	<i>Thickness</i>
	mm	mm	mm
(1)	(2)	(3)	(4)
A	2440 (2400) 1830 (1800) 1220 (1200)	1220 (1200)	6
B	2440 (2400) 1830 (1800) 1220 (1200)	1220 (1200)	5
C	2440 (2400) 1830 (1800) 1220 (1200)	1220 (1200)	4

Note — Values which are not in brackets are preferred sizes .

Note — For methods of tests, refer to IS 5913:1989 Methods of tests for asbestos cement products *(first revision)*.

For detailed information, refer to IS 2098:1997 Specification for asbestos cement building boards (first revision).

SUMMARY OF
IS 6908 : 1991 ASBESTOS CEMENT PIPES AND FITTINGS FOR
SEWERAGE AND DRAINAGE
(First revision)

1. Scope — Requirements for asbestos-cement pipes and fittings suitable for use with gravity flow at atmospheric pressure, intended for sewerage and drainage application.

2. General Appearance and Finish— The pipes shall be seamless, compact and homogeneous. Their internal surface shall be regular and smooth. the internal face between the branch and the parent pipe of junctions shall have a flush and fair finish.

3. Classification— Classified according to crushing strength as given in Table 1.

4. Fittings

4.1 General appearance and finish shall comply with the requirements of 2.

4.2 Classification and Types

4.2.1 Shall be of equivalent strength to that of the adjacent pipes.

4.2.2 The nominal diameter of fittings shall correspond to nominal diameters of pipes.

4.2.3 Thickness of the barrel of the fittings shall be at least equal to that for corresponding pipe.

4.2.4 The basic types of fittings are— bends, angle junctions, equal or unequal tees, double sockets, sleeves and saddles.

5. Tolerances

5.1 *Pipes* — See Table 2.

5.2 Fittings — Tolerances on the nominal thickness of the fittings shall be as follows:

Upper deviation	: Free
Lower deviation	:—1.5 mm

6. Tests

6.1 Hydraulic Pressure Test— The pipe and joints when tested to a pressure of 0.25 MPa shall not show any fissure, leakage, or sweating on their outside surface.

6.2 Transverse Crushing Test—

- a) *Pipes*— Minimum 33 N/mm.
- b) *Fittings* — No minimum transverse crushing load is required

6.3 Longitudinal Bending Strength (Optional) Shall not fracture below the following bending loads

100 mm	2.8 kN
125 mm	4.2 kN
150 mm	6.0 kN

6.4 Acid Resistance Test (Optional) — The amount of acetic acid neutralised shall not exceed 0.100 g/cm

7. Joints

- a) Asbestos cement couplings with rubber sealing rings.
- b) Cast iron detachable joints with rubber sealing rings and bolts and nuts.

7.1 The assembled joint shall be capable of withstanding an internal hydrostatic pressure of 0.25 MPa

TABLE 1 CLASSIFICATION OF PIPES

Nominal Diameter mm (1)	Minimum Ultimate Crushing Load		
	Class 1 (2)	Class 2 (3)	Class 3 (4)
100	15.0	15.0	15.0
125	15.0	15.0	15.0
150	15.0	15.0	17.5
200	15.0	17.5	25.0
250	15.0	22.5	30.0
300	17.5	27.5	35.0
350	21.5	31.5	41.5
400	23.5	36.5	48.5
450	26.5	40.0	53.5
500	30.0	45.0	60.0
600	36.5	53.5	71.5
700	41.5	63.5	83.5
750	45.0	67.5	90.0
800	48.5	71.5	96.5
850	51.0	76.5	102.5
900	53.5	81.5	108.5
1000	60.0	90.0	120.0

Note— No crushing load at rupture shall be less than 15 kN/m.

TABLE 2 PERMISSIBLE DEVIATIONS ON SIZES

Thickness (1) mm	Permissible Deviations		
	On Thickness Excluding Machined Ends (2) mm	On External Diameter at Finished Ends (3) mm	On Nominal Length (4) mm
Up to and including 10	-1.5		+50
Over 10, up to and including 20	-2.0	±1.0 for 100 to 700 mm nominal diameter and	- 20 for 100 to 300mm nominal diameter and
Over 20, up to and including 30	-2.5		
Over 30, up to and including 60	-3.0	± 1.5 for 750 to 1000 mm nominal diameter	+ 50 - 40 for nominal diameter greater than 300 mm
Over 60, up to and including 90	-3.5		
Over 90	-4.0		

Note— Nominal length of the pipes shall be 3 m for nominal diameters upto 200 mm and 4 m for greater diameters.

Note— For methods of tests, refer to IS 5913:1989 Methods of tests for asbestos cement products (first revision).

For detailed information, refer to IS 6908:1991 Specification for asbestos cement pipes and fittings for sewerage and drainage (first revision).

SUMMARY OF

IS 8870 : 1978 ASBESTOS CEMENT CABLE CONDUITS AND TROUGHS

1. Scope— Covers asbestos cement cable conduits of 50 to 150 mm diameter together with plastic couplings and asbestos cement conical couplings and asbestos cement collars with rubber rings. These are intended to accommodate paper insulated telecommunication and power cables.

Also covers asbestos cement cable trough of 100×100 mm to 300×300 mm size together with bends and union clips for use at ground level and above ground level for carrying cables.

2. Dimensions and Tolerances

2.1 Conduits and Bends — See Table 1.

2.2 The nominal sizes of asbestos cement troughs shall be 100×100, 150×100, 180×150, 300×200 and 300×300 mm. Nominal length and wall thickness shall be 1.75 m and 12 mm respectively.

2.2.1 Tolerances on depth and width shall be ± 3 mm and on length it shall be ± 6 mm.

2.3 For detailed dimensions for asbestos cement conduits, troughs and their fittings, refer to Table 3 to 7 of the standard.

3. Finish — Homogenous with inner and outer surfaces clean, true, smooth and free from any imperfections that render them unsuitable for their purpose. Ends shall be finished square to the axis.

4. Tests

4.1 Conduits shall be tested for straightness, regularity of thickness and diameter, flexural strength, crushing strength, water absorption, impact resistance and flattening resistance.

4.2 Troughs shall be tested for straightness, regularity of thickness, flexural strength and water absorption.

Note— For detailed test requirements refer to 6 of the standard.

TABLE 1 DIMENSIONS AND PERMISSIBLE VARIATIONS OF ASBESTOS CEMENT CONDUITS AND BEND

Nominal Diameter (1)	Internal Diameter (2)	Nominal Length		Wall Thickness (5)	Permissible Variation	
		Conduits (3)	Bends (4)		Thickness (6)	Length (7)
mm	mm	m	m	mm	mm	mm
50	50	2,3,4	2	9.0	± 1.5	+50 -20
80	80	2,3,4	2	9.5	± 1.5	+50 -20
100	100	2,3,4	2	9.5	± 1.5	+50 -20
125	125	2,3,4	2	10.0	± 1.5	+50 -20
150	150	2,3,4	2	10.0	± 1.5	+50 -20

Note — Bends shall be in 90° and 135° angles.

Note— For methods of tests, refer to IS 5913:1989 Methods of tests for asbestos cement products (first revision).

For detailed information, refer to IS 8870 : 1978 Specification for asbestos cement cable conduits and troughs.

SUMMARY OF

IS 9627 : 1980 ASBESTOS CEMENT PRESSURE PIPES (LIGHT DUTY)

1. Scope—Requirements for manufacture, classification dimensions, tests and acceptance criteria for asbestos cement pressure pipes (light duty) of class 5 and class 10.

2. Physical Properties

2.1 Hydraulic bursting Stress— Not less than 10 N/mm for class 5 pipes and 12.5 N/mm for class 10 pipes.

2.2 Transverse Crushing Strength — In case of pipes larger than 150 mm, the unit transverse crushing stress shall not be less than 30 N/mm.

2.3 Longitudinal Bending Stress — In case of pipes smaller than 150 mm, the unit longitudinal bending stress shall not be less than 20 N/mm.

3. Classification

3.1 Classified with respect to hydraulic pressure as given below :

Class	Hydraulic Test Pressure N/mm ²
5	0.5
10	1.0

3.2 The classification given above is based on the hydraulic test pressure and the hydraulic working pressure shall normally be not more than 50 per cent of the pressure defining the class.

3.2.1 The relationship between the bursting pressure (BP) and the hydraulic test pressure (TP) and the relationship between bursting pressure (BP) and the normal hydraulic working pressure (WP) shall not be less than the values indicated below

Nominal	BP TP	BP WP
Diameter, mm		
50 to 100	2	4
125 to 200	1.5	3.0

4. Dimensions and Tolerances

4.1 Nominal diameters and other dimension of pipes— Shall be given in Table 1.

4.2 Tolerances—

a) Diameter— ± 0.6 mm

b) Thickness—

Nominal Thickness mm	Tolerances mm
Up to and including 10	-1.5
Over 10 up to and including 15	-2.0

c) *Length* — 3, 4 and 5 m with tolerance of
+50 mm
-20 mm

d) *Deviation in straightness*—

50 mm Dia	-5.5 l mm
80 mm to 200 Dia	-4.5 l mm

where *l* is the length of the pipe in metres

5. Tests

5.1 Hydraulic Pressure Tightness Test— The pipe shall not indicate any loss or visible sweating on the outside surface of the pipe, when the hydraulic test pressure as given in 3 is maintained for 30 seconds. The test time may be reduced to 10 seconds without changing the class provided that the internal pressure is increased by 10 percent.

6. Joints

- Asbestos cement couplings with rubber sealing rings; and
- Cast iron detachable joints with rubber sealing rings and bolts and nuts.

6.1 Cast iron detachable joints shall conform to IS 8794:1988*.

6.2 Rubber rings used in jointing shall comply with the requirements of IS 5382:1985.[†] If the pipes are to be used for conveying drinking water, the rings shall not affect the quality of water.

[†] Rubber sealing rings for gas mains, water mains and sewers (first revision).

* Cast iron detachable joints for use with asbestos cement pressure pipes (first revision).

TABLE 1 DIMENSIONS OF ASBESTOS CEMENT PRESSURE PIPES

Sl.	No.	Nominal Diameter	Class 5		Class 10	
			Thickness	External Diameter	Thickness	External Diameter
(1)	(2)		(3)	(4)	(5)	(6)
	mm		mm	mm	mm	mm
i)	50		9.5	69.0	9.5	69.0
ii)	80		9.5	99.0	9.5	99.0
iii)	100		9.5	119.0	11.0	122.0
iv)	125		9.5	144.0	11.0	147.0
v)	150		9.5	169.0	11.5	173.0
vi)	200		9.5	219.0	15.0	230.0

Note — For methods of tests, refer to IS 5913:1989 Methods of test for asbestos cement products (*first revision*).

For detailed information, refer to IS 9627:1980 Specification for asbestos cement pressure pipes (light duty).

SUMMARY OF IS 13000 : 1990 SILICA ASBESTOS - CEMENT FLAT SHEETS

1. Scope – Requirement for materials, classification, dimensions and tests for silica-asbestos-cement flat sheets.

2. Classification – Shall be classified according to bending stress and density as given below :

<i>Class of sheets</i>	<i>Bending Stress Loading parallel to fibres</i>	<i>N/mm².Min Loading at right angles</i>	<i>Density g/cm³. Min</i>
1	13	16	1.2
2	20	28	1.6

3. General Appearance and Finish — Shall be free from visible defects that impair its appearance or serviceability. The surface of the sheets shall be of uniform texture and shall have at least one smooth surface. They shall be flat, rectangular and shall have neatly trimmed straight and regular edges and shall be square at the corners.

4. Dimensions and Tolerances

4.1 Thickness shall be 3,4,5,6,8,10,12 and 15 mm

4.2 *Nominal lengths and widths of silica- asbestos—*
Cement flat sheets shall be as follows—

<i>Length</i> mm	<i>Width</i>	
	1200 mm	1220 mm
600	×	—
610	—	×
1 200	×	—
1 220	—	×
1 800	×	—
1 830	—	×
2 400	×	—
2 440	—	×
3 000	×	—
3 050	—	×

Note— For methods of tests, refer to IS 5913:1989 Methods of test for asbestos cement products (*first revision*).

For detailed information refer to IS 13000:1990 Specification for silica-asbestos-cement flat sheets.

4.3 Tolerances

a) Thickness

From 3 mm to 5 mm — ± 0.5 mm

From 6 mm and above — $\pm 0.1 e$ mm

where *e* is nominal thickness of sheet.

b) *Length and Width*— Shall not vary from the nominal dimensions for length and width by more than ± 5 mm.

c) *Straightness of Edges*— Shall be not more than 2mm/m for the relevant dimension (length or width)

d) *Squareness of Edges*—The tolerance on squareness of the edges shall be not more than 3 mm/m.

5. Tests— Shall be done for thickness, straightness of edges, squareness of edges, bending stress and density.

SUMMARY OF

IS 13008 : 1990 SHALLOW CORRUGATED ASBESTOS CEMENT SHEETS

1. Scope — Covers the requirements for materials, dimensions and tests for shallow corrugated asbestos cement sheets.

2. Dimensions and Tolerances — See Table 1

3. Physical and Mechanical Properties

3.1 Load bearing capacity — Shall be not less than 1.8mm width of the specimen.

3.2 Impermeability — Shall not show during 24 hours of test any formation of drops of water except traces of moisture on the lower surface.

4. Finish — Shall have a rectangular shape, smooth surface on the weathering side, a good appearance and shall be true and regular. The edges of the sheets shall be straight and clean.

TABLE 1 DIMENSIONS AND TOLERANCES OF SHALLOW CORRUGATED SHEETS

		All dimensions in millimetres.	
<i>Sl No.</i>	<i>Characteristics</i>	<i>Nominal Dimension</i>	<i>Tolerances</i>
i)	Depth of corrugation	20	±2.0
ii)	Pitch of corrugation	75	±1.5
			±10
iii)	Overall width	1 015	- 5
			+Free
iv)	Nominal thickness	4.2	- 0.2
v)	Length of sheet	1 500	±10
		1 750	
		2 000	
		2 250	

Note— For methods of tests, refer to IS 5913:1989 Methods of tests for asbestos cement products (*first revision*).

For detailed information, refer to IS 13008:1990 Specification for shallow corrugated asbestos cement sheets.

SUMMARY OF
IS 458 : 2003 PRECAST CONCRETE PIPES (WITH AND
WITHOUT REINFORCEMENT) – SPECIFICATION
(Fourth Revision)

1. Scope — Requirements for reinforced and unreinforced precast cement concrete pipes, of both pressure and non- pressure varieties used for water mains, sewers, culverts and irrigation. The requirements for collars are also covered by this standard.

2. Classification — For the purpose of this standard, concrete pipes shall be classified as per clause 4.1 of the standard

3. Dimensions and Tolerances

3.1 Dimension

The internal diameter, barrel wall thickness, length, the minimum reinforcements and strength test requirements for different classes of pipes (*see 4.1* of the standard) shall be as specified in Tables 1 to 11 of the standard. Dimensions of collar for class NP1 and dimensions and reinforcement of collar for class NP2 shall be as per Tables 1 and 21 of the standard respectively.

3.2 Tolerances

The following tolerances shall be permitted :

<i>Sl. No.</i>	<i>Dimensions</i>	<i>Tolerances</i>
i) Overall length		: ± 1 percent of standard length
ii) Internal diameter of pipes:		
a) Up to and including 300 mm		: ± 3 mm
b) Over 300 mm and up to and including 600 mm		: ± 5 mm
c) Over 600 mm		: ± 10 mm
iii) Barrel wall thickness:		
a) Up to and including 30 mm		: +2 mm : -1 mm
b) Over 30 mm up to and including 50 mm		: +3 mm : -1.5 mm

c) Over 50 mm up to and including 65 mm	: +4 mm : -2 mm
d) Over 65 mm up to and including 80 mm	: +5 mm : -2.5 mm
e) Over 80 mm up to and including 95 mm	: +6 mm : -3 mm
f) Over 95 mm	: +7 mm : -3.5 mm

Note — In case of pipes with flexible rubber ring joints, the tolerance on thickness near the ends will have to be reduced. Near the rubber ring joints, the tolerance on thickness shall be as given in Tables 13 to 19 in case of pipes manufactured by spinning process and as given in Table 15 and Table 16 in case of pipes manufactured by vibrated casting process.

4. Workmanship and Finish

4.1 Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench, no opening between ends in contact shall exceed 3 mm in pipes up to 600 mm diameter (inclusive), and 6 mm in pipes larger than 600 mm diameter.

4.2 The outside and inside surfaces of the pipes shall be dense and hard and shall not be coated with cement wash or other preparation unless otherwise agreed to between the purchaser and the manufacturer or the supplier. The inside surface of the pipe shall be smooth. For better bond, inner surface of the collar may be finished rough.

5. Tests

5.1 Every pipe shall be tested, for hydrostatic pressure, three-edge bearing and absorption tests.

Note 1 — For requirements of materials, design, reinforcement, spigots and sockets refer to the standard.

Note 2 — For methods of tests refer to IS 3597 : 1998 Methods of test for concrete pipes (*second revision*).

For detailed information, refer to IS 458 : 2003 Specification for precast concrete pipes (with and without reinforcement) (fourth revision).

SUMMARY OF
IS 784 : 2001 PRESTRESSED CONCRETE PIPES
(INCLUDING SPECIALS)
(Second Revision)

1. Scope — Requirements of prestressed concrete cylinder and non- cylinder pipes (including specials) with nominal internal diameter in the range of 200 mm to 2 500 mm, in which permanent internal stresses are deliberately introduced by tensioned steel to the desired degree to counteract the stresses caused in the pipe under service.

2. Terminology

2.1 Prestressed Concrete Cylinder Pipe — A welded sheet steel cylinder with steel socket and spigot rings welded to its ends, lined with concrete suitably compacted and circumferentially pre stressed to withstand internal pressure and external design loads and subsequently coated with cement mortar or concrete

to protect the steel cylinder and prestressing wires.

2.2 Prestressed Concrete Non Cylinder Pipe— A suitably compacted concrete core longitudinally prestressed with pre-tensioned high tensile steel wire embedded in the concrete, circumferentially prestressed and coated with cement mortar/ concrete to protect the circumferential prestressing wire to withstand internal pressure and external design loads.

3. Dimensions and Tolerances

3.1 Nominal internal diameter of pipes and minimum core thickness shall be as given below—

<i>Nominal Internal Diameter of Pipe Thickness</i>	<i>Minimum Core Thickness</i>	<i>Nominal Internal Diameter of Pipe</i>	<i>Minimum Core</i>
mm	mm	mm	mm
200	35	1 300	75
250	35	1 400	75
300	35	1 500	80
350	35	1 600	85
400	35	1 700	90
450	35	1 800	95
500	35	1 900	100
600	40	2 000	105
700	40	2 100	110
800	45	2 200	115
900	55	2 300	120
1 000	60	2 400	125
1 100	65	2 500	130
1 200	70		

3.2 Length — Effective length shall be 2 to 6 m. However preferred effective length should be 2, 2.5, 4, 5 and 6 m. For pipes upto and including 300dia, the effective length shall not be more than 3 m.

3.3 Tolerance

3.3.1 Length — ± 1 percent of specified length.

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3.3.2 Internal diameter

- a) For Pipes of length less than 4 m.
 ± 5 mm for dia upto and including 350 mm
 ± 10 mm for dia above 350 mm
- b) For pipes of length 4 m and above

Internal Diameter	Tolerances	
	In areas within 600 mm of an end of the Pipe mm	Over rest of the pipe mm
a) Upto 900 mm	± 6	± 9
b) Over 900 mm and upto 1600 mm	± 9	± 12
c) Over 1600 mm	± 12	± 12

3.3.3 Core thickness — Shall not be less than the designed thickness by more than 5 percent.

4. Workmanship and finish

4.1 The maximum permissible deviation from the straight on internal surfaces of any pipe throughout its length, shall not exceed 5 mm for every metre length.

4.2 Pipes shall be free from local depressions or bulges greater than 5 mm extending over a length, in any direction, greater than twice the thickness of barrel.

5. Tests

5.1 Hydrostatic Factory Test.

5.2 Permeability Test — The permeability test when conducted in accordance with the method described in IS 3597 shall meet the requirement of final permeability. The final permeability shall not exceed 0.3 cm^3

Note — It is recommended that initial absorption shall not exceed 2.0 cm^3 and the difference in any time readings during initial absorption should not be more than 0.8 cm^3 .

drop of water level shall not exceed 2 cm^3 at the end of 2h and final permeability between fourth and fifth hour shall not exceed 0.3 cm^3

5.3 Three-Edge Bearing Test — Pipes designed for drainage, sewerage and culverts when subjected to three-edge bearing test shall meet the requirements given in Table 2 of the standard.

Note — For requirements regarding materials, design manufacture of special and joints refer to the standard.

Note — For methods of tests and test details, refer to the standard and IS 3597 : 1998 .Methods of test for concrete pipe (second revision).

For detailed information, refer to IS 1784 : 2001 Specification for Prestressed concrete pipes (including specials) (second revision).

SUMMARY

IS 1916 : 1989 STEEL CYLINDER PIPES WITH CONCRETE LINING
AND COATING

(First Revision)

1. Scope — Requirements for steel cylinder pipes with concrete lining and coating having nominal internal diameter from 200 mm to 3 000 mm for use in water mains, sewers, irrigation works and similar situations.

Note — Such pipes shall generally be provided with —

a) *Plain ends*

1) For butt welded joints with collar upto 700 mm dia, and

2) For simple butt welded jointing above 800 mm dia.

b) *Flanged ends*; and

c) *Spigot and socket ends* (conforming to relevant Indian Standard) for joints with rubber rings.

2. Classification

<i>Class</i>	<i>Test Pressure</i>
<i>Class 1</i>	0.5 MPa (or 50 m head)
<i>Class 2</i>	1.0 MPa (or 100 m head)
<i>Class 3</i>	1.5 MPa (or 150 m head)
<i>Class 4</i>	2.0 MPa (or 200 m head)
<i>Class 5</i>	2.5 MPa (or 250 m head)

Special class Above 2.5 MPa (or above 250 m head), the exact test pressure being specified by the purchaser.

3. Dimension

3.1 Diameter — The internal diameter of finished pipes shall be 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1 000, 1 100, 1 200, 1 300, 1 400, 1 500, 1 600, 1 700, 1 800, 1 900, 2 000, 2 100, 2 200, 2 300, 2 400, 2 500, 2 600, 2 700, 2 800, 2 900, and 3 000 mm

Tolerance on internal diameter shall be ± 3 mm for pipes of diameter 300 mm and under, and ± 6 mm or $\pm 1\frac{1}{2}$ percent of internal diameter, whichever is less, for pipes of diameter exceeding 300 mm.

3.2 Length — The recommended length is 6 m. The overall length of the pipe shall not vary by more than 1 percent of the agreed length.

4. Workmanship and finish — Pipes with lining and coating shall be straight and free from cracks. The ends of the pipes shall be square with their longitudinal axis.

The lining and coating of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation. The lining and coating shall be free from excessive distance and surface irregularities. Projections exceeding 3mm measured from the general surface of the lining shall be removed.

5. Steel Cylinder

5.1 Thickness of Plates for Steel Cylinder— Shall be as given below—

<i>Internal Diameter of Finished Pipe</i> mm	<i>Minimum Thickness of Plate</i> mm
200 to 450	3.0
500 to 900	5.0
1 000 to 1 100	6.0
1 200 to 1 500	8.0
1 600 to 1 800	10.0
1 900 to 2 200	12.0
2 300 to 2 600	14.0
2 700 to 3 000	16.0

5.2 Each Cylinder shall undergo hydrostatic test at the test pressure given in 2.

6. Lining and Coating

6.1 Lining and Coating thickness — Minimum thickness shall be as follows:

<i>Internal Diameter of Finished Pipe</i> mm	<i>Minimum Thickness of Lining</i> mm	<i>Minimum Thickness of Coating</i> mm
200 to 300	15	25
350 to 400	20	25
450 to 3 000	25	25

Note — For requirements of material, design and manufacture and methods of tests, refer to the standard.

For detailed information, refer to IS 1916 : 1989 Specification for steel cylinder pipes with concrete lining and coating (first revision).

SUMMARY OF

IS 4350 : 1967 CONCRETE POROUS PIPES FOR UNDER DRAINAGE

1. Scope — Requirement for porous pipes made of concrete for use in under drainage. The requirements cover pipes ranging from 80 to 900 mm nominal internal diameter with three types of joints.

2. Shape and Dimensions

2.1 Pipes may have butt ends, or rebated or ogee ends.

2.2 Dimensions for Concrete Porous Pipes— See Table 1.

2.3 Collar Dimensions— See Table 2.

2.4 Tolerances

Nominal Internal Diameter	Permissible Deviation from Nominal Internal Diameter
Upto and including 300 mm	+3 mm –1.5
Over 300 mm, upto 400 mm	+6 mm –3 mm
over 400 mm	+1.5 percent –0.75 percent

2.4.1 Deviation from straightness — Not to exceed 3 mm per metre run.

3. Tests

3.1 Load Test — Specimen shall support a minimum load of 2000 kg uniformly distributed per metre length of pipe without showing any signs of failure at least for 1 minute.

3.2 Infiltration Test

Nominal Internal Diameter	Rate of Infiltration per metre Length of the Pipe
mm	l/minute
80 to 100	60
150 to 250	120
300 to 900	300

Table 1. DIMENSIONS FOR CONCRETE POROUS PIPES

Nominal Internal Diameter	Effective Length	Minimum Wall Thickness	Joints
mm	m	mm	
(1)	(2)	(3)	(4)
80	2.0 or 2.5 or 3.0	25	Butt, rebated or ogee
100			
150			
250			
300			
350	2.5 or 3.0	30	Butt, rebated or ogee
400			
450			
500			
600			
700	2.5 or 3.0	40	Butt, rebated or ogee
800			
900			
	2.5 or 3.0	50	Butt, rebated or ogee

TABLE 2 COLLAR DIMENSIONS

<i>Nominal Internal Diameter</i>	<i>Collar Dimension</i>		<i>Minimum Length</i>
	Minimum Caulking Space	Minimum Thickness	
mm	mm	mm	mm
80	13	25	150
100			
150			
250			
300	16	30	150
350			
400			
450	19	35	200
500			
600	19	45	200
700			
800	19	45	200
900			

Note — For detailed requirements on manufacture, finish, methods of tests and typical sketches refer to the standard.

For detailed information, refer to IS 4350: 1967 Specification for concrete porous pipe for under drainage.

SUMMARY OF

IS 7319 : 1974 PERFORATED CONCRETE PIPES

1. Scope — Requirements for perforated non-reinforced concrete pipes for use in underdrainage work

Note— Reinforced cement concrete perforated concrete pipes may be supplied by mutual agreement between the purchaser and the supplier.

Note— These pipes are used for underdrainage work in infiltration galleries, reclaiming water logged areas and for similar other purposes

2. Classification

- a) *Circular perforation pipes*— 5 to 8 mm diameter perforations arranged in rows parallel to the axis of the pipe. Perforations shall be approximately 75 mm centre to centre, along rows. The rows shall be spaced over not more than 165° of the circumference.
- b) *Slotted perforation pipes*— Slots shall be circumferential in direction, not more than 5 mm nor less than 3 mm in width, and of the lengths shown in Table 1. There shall be two rows of slots, spaced 165°

3. Sizes and Dimensions — See Table-1

3.1 Tolerances — Table 2

4. Workmanship and Finish

4.1 Shall be free from fractures, cracks and blisters laminations and surface roughness.

4.2 Joints — Spigot and socket type.

4.3. Specials — shall have spigot and socket ends. Curves shall be at 90°, 45° and 22½°

5. Tests

5.1 Three edge bearing test or sand bearing test.

5.2 Absorption Test — Total absorption at the end of 24 h shall not exceed 8 percent of dry weight.

TABLE 1 SIZES AND DIMENSIONS

<i>Internal Diameter</i>	<i>Minimum Thickness</i> <i>Barrel,</i>	<i>Rows of Perforation</i>	<i>Perforations Per Row</i>	<i>Length of Slots</i>	<i>Spacing of Slots</i>	<i>Minimum Strength</i> <i>kg/m, Three Edge Bearing Method</i>
mm (1)	mm (2)	(3)	(4)	mm (5)	mm (6)	(7)
80	25	4	9	25	50	—
100	25	4	9	25	75	1 560
150	25	4	9	37.5	75	1 560
200	25	4	9	50	100	1 560
225	25	6	10	50	100	1 670
250	25	6	10	50	100	1 670
300	30	6	10	75	150	1 790
350	32	6	10	75	150	1 880
400	32	8	10	75	150	2 020
450	35	8	10	75	150	2 230

TABLE 2 TOLERANCES

a) Overall length	± 1 percent of standard length
b) Internal diameter of pipes or socket:	
1) 300 mm and under	+ 3 mm – 1.5 mm
2) 400 mm	+ 6 mm – 3 mm
3) over 400 mm	+ 1.5 percent – 0.75 percent
c) Barrel wall thickness :	
1) up to 25 mm	± 1.5 mm
2) Over 25 up to 35 mm	± 2.0 mm
3) Over 35 up to 50 mm	± 3.0 mm
4) Over 50 mm	$\pm (3 \text{ mm} + 1 \text{ mm for every } 15 \text{ mm or part thereof over } 50 \text{ mm, limited to a maximum of } 5 \text{ mm})$
d) Deviation from Straight :	The deviation from straight shall not exceed 3mm for every metre run.

Note — For methods of tests, refer to IS 456: 2000 Code of practice for plain and reinforced concrete (*fourth revision*) and IS 3597 : 1998 Methods of test for concrete pipes (*second revision*).

For detailed information, refer to IS 7319 : 1974 Specification for perforated concrete pipes.

SUMMARY OF

IS 7322 : 1985 SPECIALS FOR STEEL CYLINDER REINFORCED CONCRETE PIPES

1. Scope — Requirements and methods of tests for steel cylinder reinforced concrete specials for steel cylinder reinforced concrete pipes conforming to IS 1916 : 1989* having nominal internal diameter from 200 to 1800mm. Covers special having—

- a) Spigot and socket ends,
- b) Plain ends or slip- in type ends suitable for field welding, and
- c) Flanged ends for connection with valves and accessories.

2. Classification — Special shall have the same classification as for steel cylinder reinforced concrete pipes given in 2 of IS 1916:1989*.

3. Dimensions — Nominal internal diameters for bends, tees, scour tees and flanges shall be 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1 000, 1 100, 1 200, 1 300, 1 400, 1 500, 1 600, 1 700 and 1 800 mm.

3.1 Minimum thickness of plate for steel shell and nominal thickness of flange are given below—

<i>Nominal Internal diameter of Special Finished</i> mm	<i>Minimum Thickness of Steel Plate for Shell</i> mm
200 to 500	2.5
600 to 900	5.0
1 000 to 1 100	6.0
1 200 to 1 500	8.0
1 600 to 1 800	10.0

<i>Nominal Internal Diameter</i> mm	<i>Nominal Thickness of Flange</i> mm
200 to 300	15
350 to 450	18
500 to 600	20
700 to 1 100	25
1 200 to 1 800	32

* Steel cylinder pipe with concrete lining and coating (*first revision*).

Note — For detailed dimensions see Fig. 1 to 5 of the standard

3.2 Tolerances— The following shall be permitted—

<i>Dimensions</i>	<i>Tolerances</i>
Arm length	±40 mm
Arm length (specified)	±10 mm
Internal diameter	
300 mm and under	± 3 mm
over 300mm	± 6 mm or ±1½ mm (which ever is less)
Angular deviation	±1°

4. Workmanship and Finish — Specials shall be free from local dents or bulges greater than 3.0 mm in depth and extending over a length in any direction greater than twice the thickness of the barrel. They shall be free from cracks. When actually placed in site trench, no opening between ends in contact shall exceed 3 mm in specials up to 600 mm diameter and 6 mm in specials larger than 600 mm diameter.

5. Tests

5.1 Each fitting shall be tested for conformity to the requirements of this standard.

5.2 The unlined special shall be tested by dye penetration test.

5.3 Dye- Penetration Test — This test shall be done in accordance with IS 3658 : 1999†

† Code of practice for liquid penetrant flaw detection (*second revision*)

For detailed information, refer to IS 7322 : 1985 Specification for specials for steel cylinder reinforced Concrete pipes.

SUMMARY OF
IS 1834 : 1984 HOT APPLIED SEALING COMPOUNDS
FOR JOINTS IN CONCRETE
(First Revision)

1. Scope— Specifies hot applied sealing compounds intended for use in sealing joints in concrete roads, runways, bridges and other structures. The material covered by this standard is suitable only for longitudinal and transverse joints not more than 12 m apart.

2. Materials— Joint sealing compounds, composed of suitable mixtures of materials, shall form a resilient and adhesive barrier in concrete joints and shall be capable of resisting the infiltration of water and the ingress of solid particles. They shall not be unduly affected by temperature variation and shall resist any tendency to flow out of the joint or be picked up by vehicle tyres under hot weather conditions. They shall not become brittle or suffer loss of resiliency during cold weather conditions. On heating in suitably designed kettles they shall be capable of acquiring a pouring consistency enabling them to be run molten in a uniform manner into all types of horizontal joints without difficulty.

Note—Sealing compound shall be employed for filling contraction and construction joints as well as a sealing medium above expansion joint filler to a depth not exceeding 40 mm.

3. Grades

- a) Grade A (Ordinary), and
- b) Grade B (Fuel Resistant)

Grade A is suitable for concrete constructions other than those which are subjected to spillage of kerosine or other petroleum oils.

Grade B is suitable for use in construction where resistance to kerosine or other petroleum oils is required.

4. Physical Requirements — See Table 1.

TABLE 1 PHYSICAL REQUIREMENTS OF SEALING COMPOUNDS OF GRADES A AND B

<i>Sl No.</i>	<i>Characteristic</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Pour point, <i>Max</i>	180°C
ii)	Flow test, percentage, <i>Max</i>	5
iii)	Extensibility, <i>Min</i>	6 mm
iv)	Penetration, at 250c, 100g, 5s, 1/10	15 <i>Min</i> 50 <i>Max</i>
v)	Aviation fuel resistance — (for Grade B only)	
	a) Increase in penetration as measured in	
(iv)	After 7 days immersion in aviation fuel	15 <i>Max</i>
	b) Change in mass, after 7 days immersion in aviation fuel, percent,	1 <i>Max</i>

Note — For methods of tests refer to the standard

For detailed information, refer to IS 1834 : 1984 Specification for hot applied sealing compounds for joint in concrete (first revision).

SUMMARY OF

**IS 1838 (PART 1) : 1983 PREFORMED FILLERS FOR EXPANSION
JOINT IN CONCRETE PAVEMENT AND STRUCTURES
(NON- EXTRUDING AND RESILIENT TYPE)
PART 1 BITUMEN IMPREGNATED FIBRE
(First Revision)**

1. Scope — Specifies the requirements for bitumen impregnated fibre fillers for expansion joints. The fillers may be used for filling expansion joints in concrete roads, runways and buildings.

2. Dimensions and Tolerances

2.1 Dimensions — The length, width and thickness of the preformed strips shall be as agreed to between the purchaser and the manufacturer.

2.2 Tolerances

On length	± 5 mm
On width	± 3 mm
On thickness	± 5 mm

3. Physical requirements

**TABLE 1 PHYSICAL REQUIREMENTS OF BITUMEN
IMPREGNATED FIBRE FILLERS**

<i>Sl. No.</i>	<i>Characteristic</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Resistance to handling	Strips shall not be deformed or broken by twisting, bending or other types of ordinary handling when exposed to atmospheric condition.
ii)	Recovery	Shall recover at least 70 percent of its thickness before the test.
iii)	Compression	a) Load required to compress the specimen to 50 percent of its original thickness before the test shall be 7 Kg/cm ² (0.7 N/mm ²), <i>Min.</i> 53 kg/cm ² (5.3 N/mm ²), <i>Max.</i> b) Loss in bitumen 3 percent, <i>Max.</i>
iv)	Extrusion	Amount of extrusion of the free edge shall not exceed 6.5 mm.
v)	Water absorption	20 percent, <i>Max.</i>
vi)	Density	300 kg/m ³ , <i>Min.</i>
vii)	Bitumen content	35 percent, <i>Min.</i>
viii)	Weathering	a) Shall show no sign of disintegration or separation of fibres after the test. b) Shall satisfy the requirement of recovery, compression and extrusion after the test.
ix)	Penetration of recovered bitumen	Shall be between 25 to 100 at 25°C

Note — For methods of tests, refer to IS 10566 : 1983 Methods of test for preformed fillers for expansion joints in concrete paving and structural construction.

For detailed information, refer to IS 1838(Part 1) : 1983 Specification for preformed fillers for expansion Joint in concrete pavement and structures (non extruding and resilient type): Part 1 Bitumen impregnated fibre (first revision).

SUMMARY OF

**IS 1838 (PART 2) : 1984 PREFORMED FILLERS FOR EXPANSION
JOINT IN CONCRETE PAVEMENT AND STRUCTURES
(NON-EXTRUDING AND RESILIENT TYPE)
PART 2 CNSL ALDEHYDE RESIN AND COCONUT PITH**

1. Scope — Specifies the materials, manufacture, properties and tests for CNSL aldehyde resin and coconut pith based fillers for expansion joints in concrete roads, runways, bridges and other structures.

2. Properties

2.1 Preformed slabs or strips of expansion joint fillers shall not be deformed or broken by twisting, bending or other handling when exposed to atmospheric conditions. Pieces of the joint filler that have been damaged shall be rejected.

2.2 Recovery— The specimen shall recover at least 70 percent of its thickness before the test.

2.3 The load required to compress to 50 percent of its thickness before test, shall be 0.7 to 5.3 N/mm².

The material after compression shall not show a loss of more than 5 percent of its original mass.

2.4 Extrusion— When tested with three edges restrained and compressed to 50 percent of its thickness before test, the extrusion of the edges of the test specimen shall not exceed 6.5 mm

2.5 Weathering— When tested, test specimen shall show no disintegration.

3. Dimension — Shall conform to the order.

4. Tolerances — Tolerances of ± 2.5 mm on thickness, ± 5 mm on depth and ± 7.5 mm in length shall be permitted.

Note— For methods of tests, refer to IS 10566 : 1983 Methods of test for preformed fillers for expansion joints in concrete paving and structural construction.

For detailed information, refer to IS 1838(Part 2) : 1984 Specification for preformed fillers for expansion joint in concrete pavement and structure (Non extruding and resilient type) Part 2 CNSL aldehyde resin and coconut pith.

SUMMARY OF

IS 11433 (PART 1) : 1985 ONE-PART GUN-GRADE POLYSULPHIDE-BASED JOINT SEALANTS

PART 1 GENERAL REQUIREMENTS

1. Scope— General requirements of one-part gun-grade polysulphide-based sealants used in some sealing or glazing applications in buildings and structures.

2. Selection of Material— The sealant shall cure at ambient temperature and humidity when applied.

3. Curing Conditions— Standard cure condition shall be $40 \pm 2^\circ\text{C}$ temperature and 95 ± 5 percent relative humidity.

4. Test Requirements

4.1 Rheological Properties — The flow of the sealant shall be such that it shall not slump or sag in vertical or horizontal displacement or slip from the channel.

4.2 Recovery — The cure of the sealant shall be considered satisfactory if it exhibits recovery of not less than 75 percent, and if the tensile force required to extend the specimen is not less than 25 N or greater than 300 N.

After the test the sealant shall be cut open with a clean sharp knife; there shall be no substantial transfer of the sealant onto the knife blade.

4.3 Mass loss after heat ageing — The mass loss, which includes volatile content, shall not exceed 10 percent. The sealant shall exhibit no cracks bubbles or chalking.

4.4 Staining — There shall be no staining on the test

mortar.

4.5 Test for Cyclic Adhesion — Adhesion and cohesion shall be considered satisfactory if after three cycles the total area (length \times depth) of failure does not exceed 100 mm^2 per specimen.

4.6 Test for Adhesion in Peel

4.6.1 Adhesion to aluminium, stainless and cement mortar — For each of the test surfaces, that is aluminium, stainless steel and cement mortar, the average peel strength shall be no less than 25N and the material shall not fail in adhesion over more than 25 percent of the area of the test surface. For each test surface four strips shall be tested and the average peel strength recorded. If all strips meet the requirements the sealant shall be deemed to comply the test.

4.6.2 Adhesion to glass after sunlamp exposure through glass — For each of the test strips the average peel strength shall be not less than 25N and the material shall not fail in adhesion over more than 25 percent of the area of the test surface.

4.6.3 Adhesion after heat ageing — The sealant shall be considered satisfactory if the force required to extend the specimen is not less than that required to extend the specimen in 4.2 and not greater than 300N. Adhesion and cohesion shall be considered satisfactory if the total area of failure does not exceed 100 mm^2 per specimen.

Note — For Methods of test, refer to IS 11433 (Part 2) : 1986 One-part gun-grade polysulphide-based joint sealants, Part 2 Methods of test

For detailed information, refer to IS 11433 Part 1: 1985 Specifications for one-part gun-grade polysulphide-based joint sealants: Part 1 General requirements

SUMMARY OF
IS 12118 (PART 1) : 1987 TWO-PARTS POLYSULPHIDE BASED
SEALANTS
PART 1 GENERAL REQUIREMENTS

1. Scope — General requirements of two grades of two-part polysulphide based sealants for use in general building applications, namely, pouring grade and gun grade. Pouring grade sealants are intended for use in horizontal joints. Gun grade sealants are intended for use in vertical and inclined joints (that is, glazing applications).

2. Grades of Sealants

2.1 Pouring Grade — A sealant which flows sufficiently to give reasonably smooth level surface when applied in a horizontal upward facing joint at ambient temperature.

2.2 Gun Grade — A sealant which permits application in a suitable joint of any aspect or inclination without appreciable slumping at ambient temperature.

3. Selection of Material — The salient shall cure at ambient temperature.

4. Test Requirements

4.1 Rheological Properties

4.1.1 Pouring grade sealant — The sealant shall exhibit a smooth and level surface.

4.1.2 Gun-grade sealant — The sealant shall not slump in vertical displacement by more than 1.0 mm, when tested in a vertical position and shall not protrude in front of

the original profile in a horizontal position.

4.2 Plastic Deformation — The sealant shall have a plastic deformation not greater than 25 percent.

4.3 Adhesion and Tensile Modulus — Adhesion and tensile modulus shall be considered satisfactory, if the total area (length \times depth) of failure shall not exceed 100 mm² and the force required to produce the extension shall not be less than 25 N and not more than 270 N. In case of the test after cycles of extension, the total area of failure shall not exceed 100 mm².

4.4 Application of Life — The sealant shall have an application life of not less than 2h.

4.5 Adhesion in Peel — The average peel strength of four strips of backing material for each of the test surfaces shall be not less than 25N and the material shall not fail in adhesion over more than 25 percent of the test area.

4.6 Loss of Mass After Heat Ageing — The loss of mass shall not exceed 12 percent for pouring grade and 6 percent for gun grade.

4.7 Staining — The sealant shall produce no staining on the primed or unprimed surface of the test mortar.

Note — For Methods of test, refer to IS 12118(Part 2) :1987 Two-part polysulphide-based sealants, Part 2 Methods of test

For detailed information, refer to IS 12118:1987 Specification for two -part polysulphide-based sealants: Part1 General requirements.

SECTION 2
BUILDING LINES

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SUMMARY OF
IS 712 : 1984 BUILDING LIMES
(Third Revision)

1. Scope — Requirements for building limes used for construction purpose.

2. Classification —

Class A — Eminently hydraulic lime used for structural purposes.

Class B — Semi-hydraulic lime used for masonry mortars, lime concrete and plaster undercoat.

Class C — Fatlime used for finishing coat in plastering, whitewashing, composite mortars, etc, and with addition of pozzolanic materials for masonry mortar.

Class D — Magnesium/dolomitic lime used for finishing coat in plastering, white washing, etc.

Class E — *Kankar* lime used for masonry mortars.

Class F — Siliceous dolomitic lime used for undercoat and finishing coat of plaster.

Note 1 — Lime shall be available either in hydrated or quick form, except that of Classes A and E which shall be supplied in hydrated form.

Note 2 — Applications indicated are only suggestive.

3. Chemical Requirements—See Table 1

4. Physical Requirements —See Table 2

TABLE 1 CHEMICAL REQUIRMENTS

SL. No.	CHARACTERISTICS	CLASS									
		A	B		C	D		E	F		
		Hydrated,	Quick	Hydrated,	Quick	Hydrated,	Quick	Hydrated,	Quick	Hydrated,	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	Calcium and magnesium oxides percent, <i>Min</i> (on ignited basis)	60	70	70	85	85	85	85	50	70	70
ii)	Magnesium oxides, percent (on ignited basis) <i>Max</i>	6	6	6	6	6	—	—	6	—	—
iii)	Silica, alumina and ferric oxide, percent <i>Min</i> (on ignited basis)	20	10	10	—	—	6	6	—	6	6
iv)	Unhydrated magnesium oxide, percent, <i>Max</i> (on ignited basis)	—	—	—	—	—	8	8	—	8	8
v)	Insoluble residue in dilute acid and alkali percent <i>Max</i> (on ignited basis)	15	10	10	2	2	2	2	25	10	10
vi)	Carbondioxide, percent, <i>Max</i> (on oven dry basis)	5	5	5	5	5	5	5	5	5	5
vii)	Free moisture content percent, <i>Max</i>	2	—	2	—	2	—	2	2	—	2
viii)	Available lime as CaO, percent, <i>Min.</i> (drybasis)	—	—	—	75	75	—	—	—	—	—

TABLE 2 PHYSICAL REQUIREMENTS

SL. No.	Characteristics	Class									
		A	B	C	D	E	F				
		Hydrated,	QuickHydrated,	QuickHydrated,	QuickHydrated,	Hydrated,	QuickHydrated				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	Fineness—										
a)	Residue on 2.36 mm IS Sieve, percent, <i>Max.</i>	Nil	—	Nil	—	Nil	—	Nil	Nil	—	Nil
b)	Residue on 300 micron IS Sieve, percent, <i>Max.</i>	5	—	5	—	Nil	—	Nil	5	—	5
c)	Residue on 212 micron IS Sieve, percent, <i>Max.</i>	—	—	—	—	10	—	10	—	—	Nil
ii)	Residue on slaking—										
a)	Residue on 850 micron IS Sieve, percent, <i>Max.</i>	—	10	—	5	—	5	—	—	10	—
b)	Residue on 300 micron IS Sieve, percent, <i>Max.</i>	—	—	—	5	—	5	—	—	—	—
iii)	Setting time—										
a)	Initial set, Min, h	2	—	—	—	—	—	—	2	—	—
b)	Final set, max, h	48	—	—	—	—	—	—	48	—	—
iv)	Compressive strength, <i>Min</i> , N/mm ²										
a)	at 14 days	1.75	1.25	1.25	—	—	—	—	1.0	1.25	1.25
b)	at 28 days	2.8	1.75	1.75	—	—	—	—	1.75	1.75	1.75
v)	Transverse strength at 28 days, N/mm ² , <i>Min</i>	1.0	0.7	0.7	—	—	—	—	0.7	0.7	0.7
vi)	Workability bumps, <i>Max.</i>	—	—	—	12	10	12	10	—	—	—
vii)	Volume yield ml/g, <i>Min.</i>	—	—	—	1.7	—	1.4	—	—	—	—
viii)	Soundness, Le Chaterlier expansion, mm, <i>Max.</i>	5	—	5	—	—	—	—	10	—	10
ix)	Popping & pitting	Free from pop and pits	—	Free from pop and pits	—	Free from pop and pits	—	Free from pop and pits	—	—	Free from pop and pits

5. Packing — The hydrated lime shall be supplied, in suitable containers, such as jute bags lined with polythene or high density polythene woven bags lined with polythene or craft paper bags, preferably containing 50 kg of lime.

Note — If the hydrated lime can be used within 30 days, use of liner may be dispensed with.

The quicklime shall be supplied in containers like metal container or similar suitable containers preferably containing 50 kg of lime.

Note— For methods of tests, refer to IS 1514: 1990 Methods of sampling and test for quick lime and hydrated lime (*first revision*) and relevant parts of IS 6932: 1973 Methods of test for building limes.

For detailed information, refer to IS 712: 1984 Specification for building limes (third revision).

SUMMARY OF
IS 2686 : 1977 CINDER AS FINE AGGREGATES FOR
USE IN LIME CONCRETE
(First Revision)

1. Scope — Requirements for cinder for use as aggregates in lime concrete.

2. General — Cinder aggregates shall be well-burnt furnace residue obtained from furnaces using only coal as fuel. It shall be clean and free from clay, dirt, wood ash or other deleterious matter.

3. Classes —

- a) Class A – for general purposes
- b) Class B – for interior work not exposed to damp conditions, and
- c) Class C – for precast blocks.

4. Grading —

<i>IS Sieve Designation</i>	<i>Percentage Passing</i>
10–mm	100
4.75–mm	80
2.36–mm	60
1.18–mm	40
600–micron	30
300–micron	25
150–micron	16

5. Characteristics

5.1 Sulphate Content — Shall not exceed 1 percent when expressed as sulphur trioxide.

5.2 Loss on ignition — Shall not exceed 10 percent for class A, 20 percent for class B and 25 percent for Class C.

Note — For methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to IS 2686 : 1977 Specification for cinder as fine aggregates for use in lime concrete (first revision).

SUMMARY OF
IS 3068 : 1986 BROKEN BRICK (BURNT CLAY) COARSE
AGGREGATE FOR USE IN LIME CONCRETE
(Second Revision)

1. Scope — Requirements for coarse aggregate prepared from broken bricks (burnt clay) for use in lime concrete.

2. Quality — Shall be prepared from the well/overburnt bricks conforming to class designation 50 and above of IS 1077:1992.* It shall be free from underburnt clay particles, soluble salt and adherent coating of soil or silt. Brick aggregate should be handled least number of times before being used in concrete.

3. Physical Requirements

3.1 Grading for broken brick coarse aggregate -shall be as follows —

<i>IS Sieve Designation</i>	<i>Percent Passing (By Mass)</i>
75 mm	100
37.5 mm	95-100
19.0 mm	45- 75
4.75 mm	0- 5

3.2 Requirements of broken brick coarse aggregate-shall be as follows:

<i>Characteristic</i>	<i>Requirement</i>
Bulk density, kg/m ³	1 100 - 1 350
Aggregate impact value, percent, <i>Max</i>	50
water absorption, percent, <i>Max</i>	20
Water soluble matter, percent, <i>Max</i>	1

*Common burnt clay building bricks (*fifth revision*)

Note — For methods of tests, refer to Appendices A and B of the standard and IS 2386: 1963 Methods of tests for aggregates for concrete. IS 5640: 1970 Methods of test for determining aggregate impact value of soft coarse aggregates.

For detailed information, refer to IS 3068:1986 Specification for broken brick (burnt clay) coarse aggregate for use in lime concrete (second revision).

SUMMARY OF
IS 3115 : 1992 LIME BASED BLOCKS
(Second Revision)

1. Scope — Covers dimension, quality and strength requirement of lime based blocks (both hollow and solid) used for walls, internal partitions and filler walls.

2. General Requirements— All blocks shall be sound, free from cracks, broken edges, distortion and other defects. The bedding surface shall be at right angles to the face of blocks. The ends of the blocks which form the vertical joints may be plain, tongued and grooved or double grooved.

3. Types

Type A – Block with both faces keyed for plastering

Type B – Block with both faces smooth and suitable for use without plastering or rendering on either side, and.

Type C – Block with one face keyed and one face smooth.

4. Dimensions

4.1 Actual Sizes

Length	390 mm
Width	90, 190, 290 mm
Height	90, 190 mm

4.2 Tolerances—

Length ± 5 mm, *Max*

Width and Height ± 3 mm, *Max*

4.3 Hollow block shall be made with one or more cavities and wall thickness at any point shall not be less than 40 mm.

5. Physical Requirements

5.1 Block Density — Shall not be less than 1 000 kg/m³

5.2 Compressive Strength — Average strength of eight blocks shall be not less than 3.5 MPa. Also compressive strength of any individual block shall not fall below the minimum average value by more than 20 percent.

5.3 Drying Shrinkage— Shall not exceed 0.1 percent

5.4 Moisture Movement— Shall not exceed 0.05 percent.

Note — For methods of test, refer to IS 2185 (Part 1):1979 Concrete masonry units— Part 1 solid and hollow concrete blocks (*second revision*).

For detailed information, refer to IS 3115:1992 Specification for lime based blocks (second revision).

SUMMARY OF
IS 3182 : 1986 BROKEN BRICK (BURNT CLAY)
FINE AGGREGATE FOR USE IN LIME MORTAR
(Second Revision)

1. Scope — Requirements for broken brick (burnt clay) fine aggregate for use in lime mortar.

2. General Quality — Shall be prepared from broken/ solid bricks conforming to class designation 50 and above of IS 1077:1992*. It shall be free from underburnt clay particles, soluble salts and adherent coating of soil or silt.

3. Physical Requirements

<i>IS Sieve</i>	<i>Percent Passing (By Mass)</i>
4.75 mm	100
2.36 mm	90-100
1.18 mm	70-100
600 µm	40-100
300 µm	5-70
150 µm	0-15
75 µm	Nil

4. Requirement of Broken Brick Fine Aggregate

Specific gravity	2.4 - 2.7
Clay and silt, percent, <i>Max</i>	5
Materials finer than 75 µm	15
IS Sieve, percent <i>Max</i>	
Water soluble matter, percent, <i>Max</i>	1

* Common burnt clay building bricks (*fifth revision*).

Note — For methods of tests, refer to relevant parts of IS 2386: Method of test for aggregates for concrete, and IS 3068:1986 Broken brick (burnt clay) coarse aggregate for use in lime concret (*second revision*).

For detailed information, refer to IS 3182:1986 Specification for broken brick (burnt clay) fine aggregate for use in lime mortar (second revision).

SUMMARY OF
IS 4098 : 1983 LIME POZZOLANA MIXTURE
(First Revision)

1. Scope — Requirements of lime pozzolana mixture for use in construction works.

2. Types

<i>Type</i>	<i>Use</i>
LP7	For masonry mortars up to Grade MM 0.5, and for foundation concrete
LP20	For masonry mortars up to Grade MM 2 and for foundation concrete.
LP40	For masonry mortars up to Grade MM 5.

3. Chemical Requirements — See Table 1

TABLE 1 CHEMICAL REQUIREMENTS

<i>SlNo.</i>	<i>Characteristic</i>	<i>Requirements</i>
(1)	(2)	(3)
i)	Free moisture content, percent, <i>Max</i>	5
ii)	Free lime, percent, <i>Min</i>	22
iii)	Carbon dioxide, percent, <i>Max</i>	5
iv)	Sulphate content, percent, <i>Max</i>	3
v)	Magnesium oxide, percent, <i>Max</i>	8

4. Physical Requirements — See Table 2.

TABLE 2 PHYSICAL REQUIREMENTS.

<i>Sl No.</i>	<i>Characteristic</i>	<i>Requirment Type of Mixture</i>		
(1)	(2)	LP40 (3)	LP20 (4)	LP7 (5)
i)	Fineness, percent retained on 150- micron IS Sieve	15	15	—
ii)	Setting time, hours			
	a) Initial, <i>Min</i>	2	2	2
	b) Final, <i>Max</i>	24	36	48
iii)	Compressivestrength- average compressive strength of not less than 3 mortar cubes of size 50 mm composed of one part of lime pozzolana mixture and 3 partsof standard sand by weight, N/mm ²			
	a) At 7 days, <i>Min</i>	2	1	0.3
	b) At 28 days, <i>Min</i>	4	2	0.7
iv)	Water retention ,flow after suction of mortar composed of one part of lime-pozzolana and 3 parts of standard sand by weight, percent of original flow, <i>Min</i> .	65	65	65
v)	Soundness, autoclave expansion, percent <i>Max</i> .	1	1	1

5. Delivery—Shall be packed in bags (jute, multiply paper, HDPE or cloth) with a net mass of '50' kg. The permissible tolerance on the mass of mixture supplied

in bags shall be ± 2.5 percent per bag with an overall tolerance of ± 0.5 percent for wagon load upto 25 tonnes.

Note — For methods of tests, refer to IS 1514 : 1990 Methods of sampling and test for quick lime and hydrated lime (*first revision*). IS 1727 : 1967 Methods of test for pozzolanic materials (*first revision*), relevant parts of IS 4031: Methods of physical tests for hydraulic cement, and IS 6932 (Part 2): 1973 Methods of tests for building limes.

For detailed information, refer to IS 4098:1983 Specification for lime pozzolana mixture (first revision)

SUMMARY OF
IS 4139 : 1989 CALCIUM SILICATE BRICKS
(Second Revision)

1. Scope—Requirements regarding classification, general quality, dimensions, compressive strength and drying shrinkage of calcium silicate bricks used in building.

2. General Quality — Shall be sound, compact and uniform in shape. Shall be free from visible cracks, warpage, organic matter, large pebbles and nodules of free lime. Shall be solid and with or without frog. Shall have smooth rectangular faces with sharp and square corners and shall be uniform in colour.

3. Dimensions and Tolerances — The size shall be 190 mm × 90 mm × 90 mm and 190 mm × 90 mm × 40 mm. Tolerance on length shall be ± 3 mm and that on breadth and height ± 2 mm.

4. Classification

<i>Class Designation</i>	<i>Average Compressive Strength (N/mm²)</i>	
	<i>Not less than</i>	<i>less than</i>
7.5	7.5	10
10	10	15
15	15	20
20	20	—

5. Physical Characteristics

5.1 The minimum average compressive strength shall not be less than that specified in 4.

The compressive strength of any individual brick shall not fall below the minimum average compressive strength specified for the corresponding class of bricks by more than 20 percent.

5.2 Drying Shrinkage— See Table 1.

**TABLE 1 DRYING SHRINKAGE OF
CALCIUM SILICATE BRICKS.**

<i>Class Designation</i>	<i>Drying Shrinkage, Max (Percent of Wet Length)</i>
7.5	0.06
10	0.06
15	0.04
20	0.04

Note — For method of test, refer to Appendix A of the standard and IS 3495 :1992 Methods of test for burnt clay building bricks (first revision).

For detailed information, refer to IS 4139:1989 Specification for calcium silicate bricks (second revision).

SUMMARY OF
**IS 10360 : 1982 LIME-POZZOLANA CONCRETE
BLOCKS FOR PAVING**
(Second Revision)

1. Scope — Covers dimensions, quality and strength requirements of lime-pozzolana concrete blocks for use in paving.

2. General Requirements — Shall be sound, free from cracks, broken edges and other defects that would interfere with the proper placing of the unit.

3. Dimensions — 300 mm × 300 mm × 100 mm

Note 1 — In view of low abrasive resistance of lime pozzolana concrete, the blocks shall be provided with a thin wearing course of cement sand mortar of 10 mm cast integrally with the lime pozzolana concrete.

Note 2 — Of the total height of 100 mm, the bottom 90 mm shall consist of lime pozzolana concrete and top 10 mm of cement sand mortar.

4. Tolerances — Length-width + 5.0 mm height + 1.50 mm

5. Physical Requirements

5.1 Compressive Strength — 3.5 N/mm², Min

5.2 Drying Shrinkage — Not more than 0.1 percent

5.3 Moisture Movement — Shall not exceed 0.05 percent.

5.4 Abrasion Resistance — Of top wearing course surface (1:3 cement, sand mortar) shall have a maximum abrasion loss of 0.4 percent

5.5 Flexural Strength — Minimum average modulus of rupture shall be 0.5 N/mm².

Note — For method of tests, refer to IS 2185 (Part 1): 1997 Concrete masonry units Part 1 Hollow and solid concrete blocks IS 2690 (Part 2):1992 Burnt clay flat terracing tiles: Part 2 Handmade (*second revision*), and IS 9284:1979 Method of test for abrasion resistance of concrete,

For detailed information, refer to IS 10360:1982 Specification for lime pozzolana concrete blocks for paving.

SUMMARY OF

IS 10772 :1983 QUICK SETTING LIME POZZOLANA MIXTURE

1. Scope — Covers the requirements for lime pozzolana mixtures which tend to set fast, for use in construction works except reinforced concrete.

50 kg with a tolerance of ± 2.5 percent per bag.

2. Classification

Type 1

Type 2

Type 3

3. Chemical Requirements—See Table 1.

4. Physical Requirements — See Table 2.

5. Delivery — The mixture shall be packed in bags (jute, multiply paper, HDPE or cloth) with a net mass of

TABLE 1 CHEMICAL REQUIREMENTS

<i>Sl No</i>	<i>Characteristics</i>	<i>Requirements</i>
(1)	(2)	(3)
i)	Available lime, percent, <i>Min</i>	25
ii)	Carbon dioxide, percent, <i>Max</i>	2
iii)	Magnesium oxide, percent <i>Max</i>	6
iv)	Sulphate content as SO ₃ percent, <i>Max</i>	3
v)	Free moisture, percent, <i>Max</i>	2
vi)	Loss on ignition, percent, <i>Max</i>	20

TABLE 2 PHYSICAL REQUIREMENT

<i>Sl.No.</i>	<i>Characteristics</i>	<i>Requirements</i>		
		Type 1	Type 2	Type 3
(1)	(2)	(3)	(4)	(5)
i)	Fineness, residue by mass on 150-micron IS Sieve, percent <i>Max</i> .	5	5	5
ii)	Setting time, hours			
	a) Initial, <i>Min</i>	0.5	0.5	0.5
	b) Final, <i>max</i>	24	24	24
iii)	Compressive strength			
	a) Average of at least 3 mortar cubes at 7 days, N/mm ² , <i>Min</i>	2.5	1.0	0.4
	b) Average of at least 3 mortar cubes at 28 days N/mm ² , <i>Min</i> .	6.0	2.5	1.0
	c) Average of at least 3 mortar cubes at 90 days, N/mm ² , <i>Min</i>	8.0	4.0	1.5
iv)	Water retention, percent, <i>Min</i> .	70	70	70
v)	Soundness, expansion mm, <i>Max</i> .	10	10	10

Note— Types 1, 2 and 3 may be obtained with the pozzolana having lime reactivity values of 70 50 and 30 kgf/cm² respectively.

Note —For methods of tests, refer to various parts of IS 1514:1990 Methods of sampling and tests for quicklime and hydrated lime (*first revision*) IS 1727:1967 Method of test for pozzolanic material (*first revision*). Various parts of IS 4031 Methods of physical tests for hydraulic cement IS 4098:1983 Lime-pozzolana mixture (*first revision*), and Various parts of IS 6932 Methods of test for building limes.

For detailed information, refer to IS 10772 : 1983 Specification for quick setting lime pozzolana mixture.

SUMMARY OF
IS 12894 : 2002 PULVERIZED FUEL ASH-LIME BRICKS
(First Revision)

1. Scope — Requirements for classification, general quality, dimensions and physical requirements of fly ash-lime bricks used in buildings.

Note— Pulverized fuel ash lime bricks having wet compressive strength less than 30 N/mm² approximately 300 kg/cm² are covered in this standard and for higher strength *see* IS 2180 and IS 1077.

2. General Requirements

2.1 Visually the bricks shall be sound, compact and uniform in shape. The bricks shall be free from visible cracks, warpage and organic matter.

2.2 The bricks shall be solid and with or without frog 10 to 20 mm deep on one of its flat side. The shape and size of the frog shall conform to either Fig. 1A or Fig. 1B of the standard.

3. Classification

3.1 Pulverized fuel ash - lime bricks shall be classified on the basis of average wet compressive strength as given in Table 1.

Table 1 Classes of Pulverized Fuel Ash-Lime Bricks		
<i>Class Designation</i>	<i>Average Wet Compressive Strength not less than</i>	
	<i>N/mm²</i>	<i>Kgf/cm² (Approx)</i>
(1)	(2)	(3)
30	30.0	(300)
25	25.0	(250)
20	20.0	(200)
17.5	17.5	(175)
15	15.0	(150)
12.5	12.5	(125)
10	10.0	(100)
7.5	7.5	(75)
5	5.0	(50)
3.5	3.5	(35)

4. Dimensions and Tolerances

4.1 Dimensions

4.1.1 The standard modular sizes of pulverized fuel ash-lime bricks shall be as follows (*see* Fig. 1A and 1B):

<i>Length (L)</i>	<i>Width (W)</i>	<i>Height (H)</i>
mm	mm	mm
190	90	90
190	90	90

4.1.2 The following non-modular sizes of the bricks may also be used (*see* Fig. 1A and Fig. 1B)

<i>Length (L)</i>	<i>Width (W)</i>	<i>Height (H)</i>
mm	mm	mm
230	110	70
230	110	30

4.1.2.1 For obtaining proper bond arrangement and modular dimensions for the brickwork, with the non-modular sizes, the following sizes of the bricks may also be used:

<i>Length (L)</i>	<i>Width (W)</i>	<i>Height (H)</i>
mm	mm	mm
70	110	70 ^{1/3} length brick
230	50	70 ^{1/2} width brick

4.2 Tolerances

The dimensions of bricks when tested in accordance with **5.2.1** shall be within the following limits per 20 bricks:

(a) For Modular size

Length	3 720 to 3 880 mm (3 800 ± 80 mm)
Width	1 760 to 1 840 mm (1 800 ± 40 mm)
Height	1 760 to 1 840 mm (1 800 ± 40 mm)
	(For 90 mm high bricks)
	760 to 840 mm (800 ± 40 mm)
	(For 40 mm high bricks)

(b) For Non-modular Size

Length	4 520 to 4 680 mm (4 600 ± 80 mm)
Width	2 160 mm to 2 240 (2 200 ± 40 mm)
Height	1 360 mm to 1 440 (1 400 ± 40 mm)
	(For 70 mm high bricks)

560 to 640 mm (600 ± 40 mm)
(For 30 mm high bricks)

5. Physical Characteristics.

5.1 Compressive Strength— Shall be as per 3. The compressive strength of any individual brick shall not fall below the minimum average compressive strength of corresponding class of bricks by more than 20 percent.

5.2 Drying Strinkage— Shall not exceed 0.15 percent.

5.3 Efflorescence test— Shall have rating not more than ‘moderate’ upto class 12.5 and ‘slight’ for higher classes.

5.4 Water Absorption— Not more than 20 percent by mass upto class 12.5 and 15 percent by mass for higher classes when immersed in cold water for 24 hours.

Note — For methods of tests, refer to various part of IS 3495 :1992 Methods of tests of burnt clay building bricks (*third revision*) and IS 4139:1989. Calcium silicate bricks (*second revision*).

For detailed information, refer to IS 12894:2002 Specification for pulverized fuel ash-lime bricks (first revision).

SECTION 3

STONES

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SUMMARY OF
IS 1127 : 1970 DIMENSIONS AND WORKMANSHIP OF NATURAL
BUILDING STONES FOR MASONRY WORK
(First Revision)

1. Scope — Recommendations for the dimensions and workmanship of natural building stones used for various types of stone masonry.

2. Dimensions and Tolerances

2.1 Dimension — See Table 1. (based on thickness of mortar joints 3 mm for ashlar masonry, 6 mm for block in course and 10 mm for square rubble).

2.2 Tolerances

a) For stones required in ashlar masonry—

- 1) Length and breath ± 5 mm
 – 10 mm
- 2) Height ± 5 mm

b) For stones required for other than ashlar masonry—

- 1) Length and breath ± 5 mm
 – 10 mm
- 2) Height ± 5 mm

3. Workmanship — Stratified rocks shall be so quarried and dressed that the stones when set in building, are laid along the plane of stratification.

TABLE 1 DIMENSIONS OF NATURAL BUILDING STONES

TABLE 1 DIMENSIONS OF NATURAL BUILDING STONES				
Sl.No.	Type of Masonry	Length	Breath	Height
		mm	mm	mm
(1)	(2)	(3)	(4)	(5)
i)	Stones for ashlar	597	297	297
		697	347	347
		797	397	397
i)	Stones for block in course	394	194	194
		494	244	244
iii)	Stones for square rubble	90	90	90
		140	90,140	90,140
		190	90,140,190	90,140,190
		240	90,140,190	90,140,190
		290	90,140,190,240	90,140,190,240
		390	90,140,190,240,290	90,140,190,240,290
		440	90,140,190,240,290	90,140,190,240,290
		490	90,140,190,240,290	90,140,190,240,290
		590	90,140,190,240,290	90,140,190,240,290
iv)	Stones for random rubble.	May be of any size and shape but not less than 150 mm in any direction.		
v)	Stones for sills and lintels.	a) 890,990, 1090,1190, 1290	90, 190, 290, 390, 490	90, 140, 190
		b) 1390,1490, 1590,1690, 1790		
vi)	Stones for arches, domes and circular moulded work.	The dimensions depend on the particulars of the curve		
vii)	Coping stones.	190,290,390, 490,590,690, 790	200, 300, 400, 500, 600	100,150,200
viii)	Kerb stones.	390,490,590, 690,790		

Note — For details on dressing of stones, refer to the standard.

For detailed information, refer to IS1127:1970 Specification for dimensions and workmanship of natural building stones for masonry work (first revision).

SUMMARY OF
IS 1128 : 1974 LIMESTONE (SLAB AND TILES)
(First Revision)

1. Scope — Requirements for dimensions and physical properties of limestone slabs and tiles for use in flooring and face work.

2. General Requirements

2.1 Stone shall be without any soft veins, cracks or flaws and shall have a uniform texture.

2.2 The curvature in any direction shall not exceed 5 mm.

3. Dimensions — See Table 1.

4. Tolerances in Thickness

+5 mm upto 25 mm thickness and
 ±5 mm for thickness above 25 mm.

5. Physical Properties— See Table 2.

TABLE 1 STANDARD SIZES OF LIMESTONE SLABS AND TILES

<i>Length</i>	<i>Breadth</i>	<i>Thickness</i>
(1)	(2)	(3)
15 to 60 cm in stages of 5 cm	15 to 60 cm in stages of 5 cm	15 to 95 mm in stages of 10mm
60 to 100 cm in stages of 10 cm	30 to 100 cm in stages of 10 cm	- do -
100 to 150 cm in stages of 10 cm	30 to 100 cm in stages of 10 cm	25 to 95 mm in stages of 10 mm

TABLE 2 PHYSICAL PROPERTIES OF LIMESTONE SLABS.

<i>Sl.No.</i>	<i>Characteristics</i>	<i>Requirements</i>
(1)	(2)	(3)
i)	Water absorption	0.15 percent by weight
ii)	Transverse strength	70 kgf/cm ²
iii)	Durability	Shall not develop signs of spalling, disintegration or cracks.

Note — For methods of tests, refer to IS 1121(Part 2):1974 Methods of test for determination of strength properties of natural building stones. Part 2 Transverse strength (*first revision*), IS 1124:1974 Method of test for determination for water absorption, apparent specific gravity and porosity of natural building stones (*first revision*) and IS 1126:1974 Method of test for determination of durability of natural building stones (*first revision*)

For detailed information, refer to IS 1128:1974 Specification for limestone (slab and tiles) (first revision).

SUMMARY OF

IS 1130 : 1969 MARBLE (BLOCKS, SLABS AND TILES)

1. Scope — Requirements for sizes, physical properties, quality and workmanship of marble (block, slabs and tiles)

2. Classification

- (a) white, and
- (b) coloured

3. General Requirements — The marble, as far as possible, shall be free from foreign inclusions and prominent cracks.

4. Sizes

4.1 Blocks and slabs, shall be supplied in following sizes:

	<i>Length</i>	<i>Width</i>	<i>Thickness</i>
Blocks	30 to 250 cm	30 to 100 cm	30 to 100 mm
Slabs	70 to 250 cm	30 to 100 cm	20 to 150 mm

Note — All the sizes given are in stages of 10 cm or mm

4.2 Tiles shall be supplied in following sizes :

60 cm × 60 cm; 50 cm × 50 cm; 40 cm × 40 cm;
 30 cm × 30 cm; 20 cm × 20 cm; 10 cm × 10 cm;
 with thickness 18 to 24 mm in the same piece.

5. Tolerance — With thickness 18 to 24 mm in the same piece.

5.1 Blocks — + 2 percent for all dimensions.

5.2 Slabs — + 2 percent for length and width
 ± 3 percent for thickness

5.3 Tiles — + 4 percent for length and width and for thickness *see* 4.2.

6. Physical Properties *See* Table 1

TABLE 1 PHYSICAL PROPERTIES OF MARBLE

<i>Sl. No.</i>	<i>Characteristic</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Moisture absorption after 24 hours immersion in cold water.	Max 0.4% by weight
ii)	Hardness	Min 3
iii)	Specific gravity	Min 2.5

7. Workmanship — Edges of the slabs and tiles shall be true. Finishes may be one of the following:

- a) Sand and/or abrasive finish,
- b) Hone finish, or
- c) Polished finish.

Note — A short note on grouping of marble in the two categories mentioned above in 2 is given in Appendix A of the standard.

Note — For method of tests, refer to IS 1122:1974 Method of test for determination of true specific gravity of natural building stones (*first revision*), and IS 1124:1974 Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones (*first revision*).

For detailed information, refer to IS 1130:1969. Specifications for marble (blocks, slabs and tiles).

SUMMARY OF
IS 3316 : 1974 STRUCTURAL GRANITE
(First Revision)

1. Scope — Covers selection, grading and strength requirements of structural granite for the various constructional uses.

Note — Granite is a structural and ornamental stone because of its high compressive strength, durability and resistance to wear and abrasion. Fine grained variety takes and preserves high polish and is suitable for ornamental and monumental work. Available in different colours such as grey, mottled grey, red, pink, dark blue, white or green, depending on component minerals. Granite containing injurious minerals such as pyrites and marcasite shall be excluded.

2. General Requirements — Shall be free from flaws, injurious veins, cavities and similar imperfections.

3. Strength Requirements

3.1 Compressive Strength — Shall not be less than 1 000 kgf/cm².

3.2 Specific Gravity — Shall not be less than 2.6.

3.3 Water Absorption — Shall not be more than 0.5 percent.

4. Dimensions

4.1 Slabs — The slabs shall be rectangular or square and of specified dimensions. The tolerance in length and breadth shall be ± 2 mm and thickness ± 1 mm. The bottom face may be rough but the top surface shall be fine dressed and joint faces shall be dressed back square with the top surface for at least 50 mm, without hollowness or spalling off.

4.2 Blocks for Masonry — Dimensions shall be as specified. Tolerance + 5 mm for facing blocks. edges of blocks shall be dressed according to IS 1129 : 1972.*

* Recommendations for dressing of natural building stones *(first revision)*.

Note — For methods of tests, refer to IS 1121 Part 1 1974 Method test for determination of strength properties of natural building stones. Part 1 Compressive strength *(first revision)*, IS 1122:1974 Method of test for determination of true specific gravity of natural building stones *(first revision)* and IS 1124:1974 Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones *(first revision)*.

For detailed information, refer to IS 3316:1974 Specifications for structural granite (first revision).

SUMMARY OF
IS 3620 : 1979 LATERITE STONE BLOCK FOR MASONRY
(First Revision)

1. Scope — Requirements for dimensions, physical properties and workmanship of rectangular blocks made from laterite stone, used in the construction of walls and partitions.

2. General Requirements — Shall be exposed for three months before using but not to rains. Shall be without any soft veins, cracks, cavities, flaws and similar imperfections.

3. Dimensions —

<i>Length</i>	<i>Breadth</i>	<i>Thickness</i>
mm	mm	mm
390	190	190
490	190	190
590	290	290

3.1 Tolerance — ± 5 mm on all dimensions.

4. Physical Properties — See Table 1.

TABLE 1 PHYSICAL PROPERTIES

<i>Sl. No.</i>	<i>Characteristic</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Water absorption	Not more than 12 percent by mass
ii)	Specific gravity	Not less than 2.5
iii)	Compressive strength (for saturated dry samples)	Not Less than 3.5N/mm ²

5. Workmanship — Blocks shall be of uniform shape with straight edges at right angles and edges be rough and chisel dressed.

Note — For methods of tests, refer to IS 1121(Part 1) : 1974 Methods of test for determination of strength properties of natural building stones : Part 1 Compressive strength (*first revision*) and IS 1124:1974 Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones (*first revision*).

For detailed information, refer to IS 3620:1979 Specifications for laterite stone block for masonry (first revision).

SUMMARY OF
IS 3622 : 1977 SANDSTONE (SLABS AND TILES)
(First Revision)

1. Scope — Requirements for dimensions and physical properties of sandstone slabs and tiles for use in flooring, roofing and face work.

2. General Requirements

2.1 The stone shall be without any soft veins, cracks and flaws and shall have a uniform texture and colour.

2.2 The deviation of surface from straightness shall not exceed 5 mm for slabs and 1 mm for tiles.

3. Dimensions

3.1 Rough Cut — Sandstone slabs and tiles of rough cut edges shall be of sizes as specified below:

<i>Length</i>	<i>Breadth</i>	<i>Thickness</i>
15 to 360 cm in stages of 5 cm	15 to 90 cm in stages of 5 cm	15 to 100 mm in stages of 5 mm

Note — The sizes in between (of length and breadth) shall be reckoned as next lower size. This aspect will also cover tolerance in length and breadth.

3.1.1 Tolerances — The tolerance for thickness shall be ± 3 mm.

3.2 Machine Cut Slabs — Machine cut slabs with true and square edges shall be to the size mentioned in 3.1. The tolerance in length and breadth shall be ± 1 mm and of thickness shall be ± 3 mm

4. Physical Properties — See Table 1.

TABLE 1 PHYSICAL PROPERTIES OF SANDSTONE SLABS

<i>SL.No.</i>	<i>Characteristic</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Water absorption	Not more than 2.5 percent by mass
ii)	Transverse strength	Not less than 7 N/mm ² (70 kgf/cm ²)
iii)	Resistance to wear	Not greater than 2 mm on the average and 2.5 mm for any individual specimen
iv)	Durability	Shall not develop signs of spalling, disintegration or cracks.

Note — For methods of tests, refer to IS 1121(Part 2):1974 Methods of test for determination of strength properties of natural building stones: Part 2 Transverse strength (*first revision*), IS 1124:1974 Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones (*first revision*), IS 1126:1974 Method of test for determination for durability of natural building stones (*first revision*) and IS 1706:1972 Method of determination of resistance to wear by abrasion of natural building stones (*first revision*).

For detailed information, refer to IS 3622:1977 Specifications for sandstone (slabs and tiles) (first revision).

SUMMARY OF
IS 6250 : 1981 ROOFING SLATE TILES
(First Revision)

1. Scope — Requirements of dimensions, physical properties and workmanship of slate tiles used for sloped roof covering. Requirements in regard to method of laying and fixing of slate tiles for roofing covered in IS 5119 (Part 1):1968*.

2. General Requirements — Slate shall be free from veins, cracks, or other similar source of weakness. shall be of uniform colour and texture and shall not contain white patches and deleterious minerals. Slate shall be of reasonably straight cleavage and the grains shall be longitudinal.

*Code of practice for laying and fixing of sloped roof coverings, Part 1 Slating.

3. Dimensions and Tolerances

3.1 Standard size of slate tiles shall be as follows —

<i>Length</i>	<i>Breadth</i>	<i>Thickness</i>
mm	mm	mm
600	300	15 <i>Min</i>
500	250	15 <i>Min</i>

3.2 A tolerance of ± 5 mm shall be allowed on length and breadth.

4. Physical Properties— See Table 1.

TABLE 1 PHYSICAL PROPERTIES OF SLATE TILES

<i>SLNo..</i> (1)	<i>Characteristic</i> (2)	<i>Requirement</i> (3)
i)	Water absorption	a) Maximum average — 2 percent by mass. b) Variation should not exceed 20 percent between individual sample.
ii)	Modulus of rupture	60 N/mm ² (dry), <i>Min</i> 40 N/mm ² (wet), <i>Min</i>
iii)	Depth of softening	0.05 mm, <i>Max</i>
iv)	Permeability	No water shall ooze from the bottom.
v)	Sulphuric acid immersion (see Note)	Shall show no sign of delamination along the edge or swelling, softening flaking of the surface and shall not exhibit gaseous evolution during immersion.
vi)	Wetting and drying	Shall show no sign of delamination or splitting along the edge nor flaking of the surface.

Note — This requirement is related to the conditions of atmospheric pollution and the slate tiles be subjected to this requirement only if required by the purchaser.

5. Workmanship — Unless otherwise specified the slates shall be of uniform thickness and rectangular shape with reasonably full corners and the edges shall be true. The exposed surface shall be finished as specified and in accordance with an approved sample.

Note — For methods of tests, refer to Appendices A to E of the Standard and IS 4122:1967 Method of test for surface softening of natural building stones.

For detailed information, refer to IS 6250:1981 Specification for roofing slate tiles (first revision).

SUMMARY OF

IS 6579 : 1981 COARSE AGGREGATE FOR WATER BOUND
MACADAM

(First Revision)

1. Scope — Specifies the quality, physical properties and grading of coarse aggregates suitable for use in WBM construction.

2. Materials

2.1 The coarse aggregates used for WBM construction shall be any one of the followingx-

- a) Crushed or broken rock,
- b) Crushed or broken slag, and
- c) Broken brick aggregate.

2.1.1 Natural aggregates (like *kankar*, laterite, etc) other than mentioned in **2.1** may also be used.

3. Quality — The coarse aggregates from natural source shall be hard and durable. They shall be free from excessive flat, elongated, soft or disintergrated particles, dirt and other similar source of weakness. The coarse aggregates of slag shall be made from air-cooled blast furnace slag and shall not contain glassy material exceeding 20 percent and shall not weight less than 1

120 kg/m³. They shall be dense, of angular shape and shall be free from dirt and other similar sources of weakness. The broken brick aggregate shall be made out of well burnt bricks (see IS 1077 : 1992*) It shall be free from underburnt particles, dust and other foreign matter.

4. Size and Grading — See Table 1.

5. Physical Requirements

5.1 Abrasion (Los Angeles) Value — Shall not be more than 40 percent for wearing surface, 50 percent for base course and 60 percent for sub-base course.

5.2 Flakiness Index — shall not be more than 15 percent.

5.3 Impact Value — shall not be more than 30 for wearing surface, 40 for base course and 50 for sub-base course.

Note — Aggregates l-like brick, *kankar*, and laterite shall be tested for impact value under wet condition.

TABLE 1 SIZE AND GRADING OF COARSE AGGREGATES

Grading No. (1)	Sieve Designation (2)	Percent Passing the Sieve By Mass (3)
	<i>mm</i>	
1	106	100
	75	55 to 80
	63	25 to 60
	37.5	0 to 15
	19	0 to 5
2	75	100
	63	90 to 100
	53	50 to 80
	37.5	0 to 15
	19	0 to 5
3	63	100
	53	95 to 100
	37.5	30 to 65
	19	0 to 10
	11.2	0 to 5

Note — For coarse aggregates susceptible to degradation during rolling, the above grading may not hold good.

*Common burnt clay building bricks (*fifth revision*)

Note — For methods of tests refer to relevant parts of IS 2386:1963 Methods of test for aggregates for concrete and IS 5640:1970 Method of test for determining aggregate impact value of soft course aggregates.

For detailed information, refer to IS 6579:1981. Specification for coarse aggregate for water bound macadam (first revision).

SUMMARY OF IS 9394 : 1979 STONE LINTELS

1. Scope — Requirement for dimensions, physical properties, and workmanship of lintels made out of natural stone.

2. General Requirements — The stone for lintels shall be reasonably fine grained, hard and shall have a uniform texture and colour. They shall be free from weathering and decay. The stone shall be without any cracks, vents, fissures, clayholes or other similar source of weakness. The lintel shall be so cut that when set in the building, the stone is laid on its natural bed or with the bed in the same direction as it was when the test for transverse strength was carried out.

3. Physical Properties — See Table 1.

**TABLE 1 PHYSICAL PROPERTIES OF
THE STONE USED FOR LINTELS**

<i>Sl.No</i> (1)	<i>Characteristics</i> (2)	<i>Requirements</i> (3)
i)	Specific gravity	2.6 <i>Min</i>
ii)	Water absorption, percent	1.0 <i>Max</i>
iii)	Transverse strength, N/mm ²	11.0 <i>Min</i>
iv)	Durability	Shall not develop spalling or cracks

4. Dimensions and Tolerance

4.1 Stone Lintels—Shall be of rectangular cross-section. The width shall be equal to the thickness of the wall and the depth shall not be less than 100 mm. The length shall be limited to a maximum clear span of 2.65 m. A tolerance of ± 1.5 mm shall be allowed on all dimensions of 1.2 m. or less and ± 3 mm on all dimension more than 1.2 m.

4.2 Throating — A 16mm \times 8 mm throating shall be provided to the soffit of the external lintel.

4.3 Lintel Bearing — Stone lintels shall be well bonded into the masonry on either side of the opening. The bearing length on either side shall not be less than the depth of the lintel or half the width of the supporting masonry whichever is more. The bearing length shall be increased for exceptionally heavy loads and for long spans. Bed blocks shall be provided if the clear span exceeds 2 m.

5. Workmanship — The edges of the stone lintels shall be dressed as per IS 1129:1972*. The exposed surface of the lintel shall be finished as specified.

Note — For design details of stone lintels, 5 of the standard may be referred to.

*Recommendation for dressing of natural building stones (*first revision*).

Note — For methods of tests, refer to IS 1121(Part 2):1972 Methods of test for determination of strength properties of natural building stones :Part 2 Transverse strength (*first revision*), IS 1124:1974 Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones (*first revision*) and IS 1126:1974 Method of test for determination of durability of natural building stones (*first revision*).

For detailed information, refer to IS 9394:1979 Specification for stone lintels.

SUMMARY OF
IS 14223 (PART 1) : 1995 POLISHED BUILDING STONES
PART 1 GRANITE

1. Scope — Covers physical properties and finish requirements of polished granite used for various purposes.

2. General Requirements — Granites should be free from all imperfections and injurious minerals that may interfere with the appearances, strength, structural integrity and its amenability to take good polish. Hair line cracks/joints, flowers, moles, knots, white and dark lines due to segregation of light coloured minerals in multi-coloured granites and ferro-magnesium minerals in light coloured granites are considered to be the imperfections. Granities should be free from deleterious minerals such as pyrite, marcasite and minerals such as biotite, chlorite, ilmenite, etc, which interfere with the colour and appearance on weathering and also affect polishing characteristics.

3. Dimensions — The slabs shall be rectangular or square and of specified dimensions. The tolerance on length and breadth shall be ± 2 mm and on thickness ± 1 mm. The bottom face may be rough but the top surface shall be fine polished and joint faces shall be dressed with the top surface without hollowness and spalling off.

4. Physical Properties — See Table 1

5. Finish — The surface of the polished granite shall be mirror finish without any hairline crack. The polish on the surface shall be checked with glassometer instrument and shall not be less than 95 percent.

TABLE 1 PHYSICAL PROPERTIES OF GRANITE

<i>Characteristic</i>	<i>Requirements</i>	
	Pink Granite	Multi-coloured and grey Granites
Moisture content (percent)	0.15, <i>Max</i>	0.15, <i>Max</i>
Dry density (<i>M/v</i>)	2.58 to 2.63	2.60 to 2.68
Specific gravity (<i>Min</i>)	2.75	2.75
Water absorption	0.50 <i>Max</i>	0.50, <i>Max</i>
Porosity (percent)	1.02 to 2.50	1 to 2
Compressive strength (kg/cm ²)	1 000-1 500	1 300-2 200
Tensile strength (<i>Min</i>)	90 kg/cm ²	90 kg/cm ²
Shear strength (kg/cm ²)	280-425	300-540
Hardness (Mohs)	6 to 7	6 to 7
Hardness (schmidt) No.	80 to 100	85 to 110
Hardness (shore) No.	50 to 60	46 to 61
Ultrasonic pulse velocity	5 000 <i>Min</i>	5 000 <i>Min</i>
Resistance to wear	Not greater than 2 mm on the average and 2.5 mm for any individual specimen	Not greater than 2 mm on the average and 2.5 mm for any individual specimen
-		

Note — For methods of test, refer to relevant parts of IS 1121:1974 Methods of test for determination of strength properties of natural building stones, (first revision) IS 1124:1974 Methods of test for determination of water absorption, apparent specific gravity and porosity of natural building stones (first revision), IS 1706:1972 Method for determination of resistance to wear by abrasion of natural building stones (first revision), IS 12608:1989 Methods of test for hardness of rock IS 13030:1991 Methods of test for laboratory determination of water content, porosity, density and related properties of rock material, IS 13311 (Part 1):1992 Methods of non-destructive testing of concrete: Part 1 Ultrasonic pulse velocity and IS 13630 (Part 13):1993 Methods of test for ceramic tiles: Part 13 Determination of scratch hardness of surface according to Mohs.

For detailed information, refer to IS 14223 (Part 1) : 1995 Specification for polished building stones: Part 1 Granite.

SECTION 4
CLAY PRODUCTS FOR
BUILDINGS

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SUMMARY OF
IS 1077 : 1992 COMMON BURNT CLAY BUILDING BRICKS
(Fifth Revision)

1. Scope— Requirements for classification, general quality, dimensions and physical requirements of common burnt clay building bricks used in buildings with compressive strength less than 40 N/mm²

Note— For burnt clay bricks having higher strength, see IS 2180*.

2. Classification —

<i>Class Designation</i>	<i>Average Compressive Strength not Less Than N/mm²</i>
35	35.0
30	30.0
25	25.0
20	20.0
17.5	17.5
15	15.0
12.5	12.5
10	10.0
7.5	7.5
5	5.0
3.5	3.5

3. General Quality — Shall be hand or machine-moulded and shall be free from cracks and flaws and nodules of free lime. Hand-moulded bricks of 90 mm or 70 mm height shall be moulded with a frog 10 to 20 mm deep on one of its flat sides. Bricks of 40mm height as well as those made by extrusion process may not be provided with frogs. The bricks shall have smooth rectangular faces with sharp corners and uniform colour.

*IS 2180:1988 Heavy-duty burnt clay building bricks (*second revision*).

Shapes and sizes of the frog shall conform to either Fig.1A or Fig.1B of the standard.

4. Dimensions

4.1 The standard modular size of common building bricks shall be as follows:

<i>Modular</i>	190 × 90 × 90 mm 190 × 90 × 40 mm
<i>Non-Modular</i>	230 × 110 × 70 mm 230 × 110 × 30 mm
<i>Modular and Non-Modular for proper bond arrangement</i>	70 × 110 × 70 mm ½ length brick.

5. Tolerances — Dimensions of bricks shall be within the following limits per 20 bricks

	<i>Modular size mm</i>	<i>Non-Modular size mm</i>
a) Length	3 800 ± 80	4 600 ± 80
b) Width	1 800 ± 40	2 200 ± 40
c) Height	1 800 ± 40 (For 90 mm high bricks) 800 ± 40 (For 40 mm high bricks)	1 400 ± 40 (For 70 mm high bricks) 600 ± 40 (For 30 mm high bricks)

6. Physical Requirements

6.1 Compressive Strength — Minimum average strength shall be as given in 2.

6.2 Water Absorption — Shall not be more than 20 percent by weight upto class 12.5 and 15 percent for higher classes.

6.3 Efflorescence— Shall not be more than ‘moderate’ upto class 12.5 and ‘slight’ for higher classes.

Note — For methods of tests, refer to relevant parts of IS 3495 : 1992 Methods of tests of burnt clay buildings bricks (*third revision*).

For detailed information, refer to IS 1077:1992 Specification for common burnt clay bricks (fifth revision).

SUMMARY OF
IS 2180 : 1988 HEAVY DUTY BURNT CLAY BUILDING BRICKS
(Third Revision)

1. Scope — Requirements for classification, general quality, dimensions and physical properties of heavy duty burnt clay building bricks.

2. Classification — Shall be classified on the basis of average compressive strength as given below:

Class Designation	Average Compressive Strength	
	Not Less than N/mm ²	Less than N/mm ²
40	40.0	45
45	45.0	—

3. General Quality — Shall be manufactured either by pressing or extrusion. When broken, the fractured surface of the brick shall show a uniformly dense structure free from large voids, laminations and lime particles. Two bricks when struck together shall emit a clear metallic ring. The bricks shall have smooth rectangular faces with sharp corners and uniform colour.

4. Dimensions

190 mm × 90 mm × 90 mm, and

190 mm × 90 mm × 40 mm

5. Tolerances—

Dimensions	Tolerance on Individual Bricks
mm	mm
190	±4
90,40	±2

6. Physical Requirements

6.1 Compressive Strength — As given in 2.

6.2 Water Absorption — The average water absorption by mass shall not be more than 10 percent after 24 hours immersion in water absorption by mass shall not exceed 15 percent.

Note — If specified by purchaser a 5 hour boiling test may be done and water absorption by mass shall not exceed 15 percent.

6.3 Efflorescence — Rating shall be “Nil”

6.4 Bulk Density — Not less than 2.5 g/cm³

Note — Methods for tests, refer to the standard and relevant parts of IS 3495:1992 Method of test for burnt clay building bricks (third revision).

For detailed information, refer to IS 2180:1988 Specification for heavy duty burnt clay building bricks (third revision).

SUMMARY OF
IS 2222 : 1991 BURNT CLAY PERFORATED BUILDING BRICKS
(Third Revision)

1. Scope — Covers the dimensions, quality and physical requirements of perforated burnt clay bricks for use in walls and partitions.

2. General Quality — Shall be free from cracks, flaws and nodules of free lime. shall have rectangular face with sharp straight edge at right angle and uniform colour and texture.

3. Dimensions — The standard size of shall be as follows—

Modular	190 mm × 90 mm × 90 mm
Non-modular	230 mm × 110 mm × 70 mm

4. Tolerances

<i>Dimensions</i> mm	<i>Tolerances on Individual</i> mm
70, 90	+4
110, 190	+7
230	+10

5. Perforations — The area of perforation shall be between 30 percent and 45 percent of the total area of the face. In the case of rectangular perforations, the larger dimension shall be parallel to the longer side of the brick and shorter side shall be less than 20 mm. It shall be less than 25 mm diameter in case of circular perforations. area of each perforation shall not exceed 500 mm². thickness of any shell shall not be less than 15 mm and that of any web not less than 10 mm.

6. Physical Requirement

6.1 Compressive Strength — Shall have a minimum average compressive strength of 7 N/mm² on net area.

6.2 Water Absorption — Shall not be more than 20 percent by weight after immersion for 24 hours in cold water.

6.3 Efflorescence — Rating not more than “slight”

6.4 Warpage — Average shall not exceed 3 percent.

Note — For the method of tests, refer to relevant parts of IS 3495:1992 Methods of test of burnt clay building bricks (*third revision*).

For detailed information, refer to IS 2222:1991 Specification for burnt clay perforated building bricks (third revision).

SUMMARY OF
IS 2691 : 1988 BURNT CLAY FACING BRICKS
(Second Revision)

1. Scope — Specifies the dimensions, quality and strength of burnt clay facing bricks used in buildings and other structures.

2. General Quality — shall be of uniform colour, free from cracks, flaws and nodules of free lime and of even texture. Shall have plane rectangular faces with parallel sides and sharp straight right angled edges.

3. Dimensions — The standard sizes shall be
 190 mm × 90 mm × 90 mm and
 190 mm × 90 mm × 40 mm.

4. Tolerances

<i>Dimension</i> mm	<i>Tolerances</i> mm
190	+3
90,40	+2

5. Physical Requirements

5.1 Average Compressive Strength shall not be less than 10N/mm²

5.2 Water absorption after 24 hours immersion shall not exceed 15 percent.

5.3 Efflorescence shall be “Nil”.

5.4 Warpage shall not exceed 2.5 mm.

Note — For the methods of tests, refer to relevant parts of IS 3495 : 1992 Method of test for burnt clay building bricks.
(third revision)

For detailed information, refer to IS 2691:1988 Specification for burnt clay facing bricks
 (second revision).

SUMMARY OF
IS 3583 : 1988 BURNT CLAY PAVING BRICKS
(Second Revision)

1. Scope — Covers dimensions, quality and strength, and methods of sampling and test for burnt clay paving bricks for use in construction of pavements.

2. General — shall be mechanically shaped and not hand moulded. when broken, bricks show a uniformly dense structure free from lime, large voids and marked laminations. Shall have smooth rectangular faces and sharp corners.

3. Dimensions

190 mm × 90 mm × 90 mm and

190 mm × 90 mm × 40 mm

Note — The bricks shall not be provided with frogs.

4. Tolerances

<i>Dimensions</i>	<i>Total Tolerance for 20 Bricks</i>
mm	mm
190	± 80
90,40	± 40

5. Physical properties

5.1 Average compressive strength shall be not less than 40 N/mm²

5.2 Average water absorption shall be not more than 5 percent

5.3 Efflorescence shall be 'nil'.

Note — For methods of tests, refer to relevant parts of IS 3495:1992 Method of test for burnt clay building bricks (*third revision*).

For detailed information, refer to IS 3583:1988 Specification for clay paving bricks (second revision).

SUMMARY OF
IS 3952 : 1988 BURNT CLAY HOLLOW BRICKS FOR WALLS
AND PARTITIONS
(Second Revision)

1. Scope — Covers the dimensions, quality and strength requirements of hollow bricks made from burnt clay and having perforations through and at right angle to the bearing surface.

2. General Requirements

2.1 Bricks shall be free from cracks, flaws and nodules of free lime. Shall be of uniform colour. Shall have plane rectangular faces with parallel sides and shall have sharp straight edges at right angle; and a fine compact and uniform texture.

2.2 The bricks shall be free from excessive winding or bowing. Winding or bowing in length dimension concavity or convexity in external face of bricks, and angles between sides and joining edges shall be not more than 5 mm.

Note— For testing details refer to 3.2 of the standard.

3. Types

- a) *Type A* — Bricks with both faces keyed for plastering or rendering.
- b) *Type B* — Bricks with both faces smooth and suitable for use without plastering or rendering on either side, and
- c) *Type C* — Bricks with one face keyed and one face smooth.

4. Dimensions

Length mm	Width mm	Height mm
190	190	90
290	90	90
290	140	90

Thickness of any shell and web shall not be less than 11 mm and 8 mm respectively.

5. Tolerances

Dimensions	Overall Measurements of 20 Bricks (mm)	
	Min	Max
290	5680	5920
190	3720	3880
140	2740	2860
90	1760	1840

5.1 In addition, the size of any individual brick in the sample shall not exceed the corresponding modular size as given below :

Dimension of Bricks mm	Modular Size mm
290	300
190	200
140	150
90	100

6. Crushing Strength — Minimum average value shall be 3.5 N/mm². The strength of any individual brick shall not fall below the average value by more than 20 percent.

7. Water Absorption — Shall not be more than 20 percent by mass.

8. Efflorescence — Shall have a rating not more than 'slight'.

Note — For methods of tests, refer to Appendices A and B of the standard, and relevant parts of IS 3495 : 1992 Method of test for burnt clay building bricks (*third revision*).

For detailed information, refer to IS 3952:1988 Specification for burnt clay hollow bricks for walls and partitions (second revision).

SUMMARY OF
IS 4885 : 1988 SEWER BRICKS
(First Revision)

1. Scope — Specifies dimensions, quality and strength, and methods of sampling and test for burnt clay sewer bricks used for sewers of sanitary (domestic) sewage.

2. Dimensions and Tolerances

2.1 Dimensions

190 mm × 90 mm × 90 mm, and 190 mm × 90 mm × 40 mm

Note — For oval and other special shaped sewers, bricks may be tapered suitably.

2.2. Tolerance

Dimensions Total Tolerance for 20 Bricks

mm mm

190 ± 80

90, 40 ± 40

2.3. Tolerance for warpage of face or edges from plane surface and straight line shall be 2.5 mm.

3. General Quality — Shall be free from cracks, flaws and nodules of lime. shall have plane rectangular faces with sharp edges and corners. Kiln marks not exceeding 3 mm in depth shall be permitted on the opposite edges. When broken, sewer bricks shall show a fracture of uniformly fine grained and compact structure throughout.

4. Physical properties

4.1 Average compressive strength shall not be less than 17.5 N/mm² and for individual brick it shall not be less than 16 N/mm².

4.2 Average water absorption shall not exceed 10 percent and for individual it shall not exceed 12 percent.

4.3 Efflorescence shall not be more than “slight”

Note — For method of the tests refer to the relevant parts of IS 3495:1992 Method of test for burnt clay building bricks *(third revision)*.

For detailed information, refer to IS 4885:1988 Specification for Sewer bricks (first revision).

SUMMARY OF
IS 5779 : 1986 BURNT CLAY SOLING BRICKS
(First Revision)

1. Scope — Requirements for dimensions, general quality and physical properties for burnt clay bricks for use in soling of roads.

2. General Quality — Shall be free from cracks and other flaws and nodules of free lime. Shall have, plane rectangular faces and straight right angle edges.

3. Dimensions

190 mm × 90 mm × 90 mm and

190 mm × 90 mm × 40 mm

4. Tolerances — Overall dimensions of 20 bricks, shall be as follows :

Length		380 ± 8 cm
Width		180 ± 4 cm
Height	for 90 mm high	180 ± 4 cm
	for 40 mm high	80 ± 4 cm

5. Physical Properties

5.1 Compressive Strength — Shall be not less than 10 N/mm².

5.2 Water Absorption — Shall not be more than 20 percent.

5.3 Efflorescence — Shall not be more than “slight”.

Note — For methods of tests, refer to relevant parts of IS 3495:1992 Method of test for burnt clay building bricks (*third revision*).

For detailed information, refer to IS 5779:1986 Specification for burnt clay soling bricks (first revision).

SUMMARY OF IS 6165 : 1992 DIMENSIONS FOR SPECIAL SHAPES OF CLAY BRICKS

(First Revision)

1. Scope — Dimensions for special shapes of clay brick used in building and other civil engineering construction. It does not lay down the specification of the special shapes for clay bricks and same shall conform to IS 1077:1991* and IS: 2180:1988†.

* Common burnt clay building bricks (*fifth revision*).

† Heavy duty burnt clay building bricks (*third revision*).

2. Dimensions

2.1 Size of modular and non-modular bricks shall be :

	Length	Width	Height
	mm	mm	mm
Modular Size	190	90	90
Non-Modular Size	230	110	70

2.2 Sizes of special shapes of clay bricks shall be as follows :

Shape	Major Overall Dimensions mm	Shape	Major Overall Dimensions mm
a) Closers —		e) Plinth bricks —	
i) Snapheader closer	90 × 90 × 90	i) Plinth stop	190 × 90 × 90
ii) King closer	190 × 90 × 90	ii) Plinth stretcher	
iii) Queen closer	190 × 40 × 90	iii) Plinth internal return	
b) Copings —		iv) Plinth header	
i) Half round coping	290 × 90	v) Plinth internal return	
ii) Saddle back coping	290 × 90 × 145	vi) Plinth external return	
c) Bullnose Bricks —		f) Culvert bricks —	
i) Single bullnose or bullnose header	190 × 90 × 90	i) Culvert 10 cm	190 × 90 × 90
ii) Double bullnose		ii) Culvert 20 cm	
iii) Bullnose stretcher		g) Chimney or well type bricks—	
iv) Bullnose mitre		i) Chimney or well header	190 × 90 × 90
v) Bullnose double		ii) chimney or well stretcher	
vi) Bullnose on end			
d) Corner bricks —			
i) Squint 300	190 × 90 × 90		
ii) Birdsmouth 300			
iii) Header splay			
iv) Single cant or plinth header			
v) Double cant			

Note —For exact shape of clay bricks and detailed dimensions, refer to Fig. 1 to 7 of the standard.

For detailed information, refer to IS 6165:1992 Specification for dimensions for special shapes of clay bricks (first revision)

SUMMARY OF

IS 13757 : 1993 BURNT CLAY FLY ASH BUILDING BRICKS

1. Scope — Requirement for classification, general quality, dimensions and physical requirements of common clay building bricks used in buildings.

Note — Burnt clay flyash bricks having compressive strength less than 30 N/mm² (approximately 300 kgf/cm²) are covered in this standard and for higher strength, see **IS 2180 :1988*** and **IS 1077 : 1992****

2. Classification

<i>Class Designation</i>	<i>Average Compressive Strength not less than N/mm²</i>
30	30.0
25	25
20	20.0
17.5	17.5
15	15.0
12.5	12.5
10	10.0
7.5	7.5
5	5.0
3.5	3.5

3. General Quality — Shall be hand or machine moulded and shall be free from cracks and flaws as black coring, nodules of stone and/or free lime and organic matter. Hand-moulded bricks of 90 mm or 70 mm height shall be moulded with a frog 10 to 20 mm deep on one of its flat sides; and bricks of 40 or 30 mm height as well as those made by extrusion process may not be provided with frogs. Shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour.

* Heavy duty burnt clay building bricks (*third revision*).

** Common burnt day building bricks (*fifth revision*).

4. Dimensions

<i>Modular</i>	: 190 mm × 90 mm × 90 mm 190 mm × 90 mm × 40 mm
<i>Non-Modular</i>	: 230 mm × 110 mm × 70 mm 230 mm × 110 mm × 30 mm

Modular and non-modular for proper bond arrangement

70 mm × 110 mm × 70 mm 1/3 length brick

230 mm × 50 mm × 70 mm 1/2 length brick

5. Tolerances — Dimensions of bricks shall be within the following limits per 20 bricks.

	<i>Modular size</i>	<i>Non-modular size</i>
a) Length	3 800 ± 80	4 600 ± 80
b) Width	1 800 ± 40	2 200 ± 40
c) Height	1 800 ± 40	1 400 ± 40
	(For 90 mm high bricks) 800 ± 40	(For 70 mm high bricks) 600 ± 40
	(For 40 mm high bricks)	(For 30 mm high bricks)

6. Physical Requirements

6.1 Compressive Strength — Average strength shall be as given in **2**.

6.2 Water Absorption — Shall not be more than 20 percent

6.3 Efflorescence — Not more than “moderate” for class 12.5 and ‘slight’ for brighter classes.

For methods of tests, refer to relevant parts of IS 3495:1992 Method of test for burnt clay building bricks (*third revision*).

For detailed information, refer to IS 13757:1993 Specification for burnt clay fly ash building bricks.

SUMMARY OF
IS 7556 : 1988 BURNT CLAY JALLIES
(First Revision)

1. Scope — Covers dimensions, quality and strength requirement of burnt clay jallies having perforations of ornamental designs.

Note — Burnt clay jallies are suitable for providing a screen on Verandah, Construction of parapet or boundary walls, etc.

2. Dimensions and tolerances

2.1. Dimensions (in mm)

190 × 190 × 100	190 × 190 × 50
190 × 140 × 100	190 × 140 × 50
140 × 140 × 100	140 × 140 × 50
140 × 90 × 50	90 × 90 × 50

2.2 Tolerances

<i>Dimensions</i>	<i>Total Tolerance for 20 Jallies</i>
190 mm } 140 mm }	± 80 mm
100 mm } 90 mm } 50 mm }	± 40 mm

2.3. The thickness of any shell shall not be less than 10 mm and that of the web not less than 8 mm. The total void area of the jallies shall not exceed 40 percent.

2.4. Keys of bonding with mortar shall be 10 mm wide and 3 mm deep.

3. General Quality — Jallies shall be free from web or shell cracks, flaws or nodules of free lime. Shall be uniform in colour and texture. In the case of wire-cut jallies, the cut faces shall be at right angles and parallel to each other and the edges of shell and webs shall be trimmed to a smooth finish. The jallies shall not exhibit excessive warpage when placed between two parallel straight-edges. The maximum warpage permissible shall be 3 percent in any direction.

4. Physical Requirements

4.1. Average breaking load shall not be less than 12 N per mm width :

4.2. Average water absorption shall not be more than 15 percent

4.3. Efflorescence rating shall be not more than “slight”.

Note — For methods of tests, refer to Appendices A to C of the standard.

For detailed information, refer to IS 7556:1988 Specification for Burnt clay allies (first revision)

SUMMARY OF
IS 654 : 1992 CLAY ROOFING TILES, MANGALORE PATTERN
(Third Revision)

1. Scope — Covers the machine-pressed clay interlocking roofing tiles of the 'Mangalore Pattern.'

2. Classification — Class AA and Class A with characteristics given in Table 1.

TABLE 1 CLASSIFICATION OF ROOFING TILES

<i>Sl.no.</i>	<i>Characteristic</i>	<i>Requirement</i>
		<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Class AA 18 </div> <div style="text-align: center;"> Class A 20 </div> </div>
i)	Water absorption percent, <i>Max</i>	
ii)	Breaking load, kN, <i>Min</i>	
	a) Average	<div style="display: flex; justify-content: space-around;"> <div>1.0 (for 410 × 235 mm) 1.10 (for 420 × 250 mm and 425 × 260 mm)</div> <div>0.80 (for 410 × 235 mm) 0.90 (for 420 × 250 mm and 425 × 260 mm)</div> </div>
	b) Individual	<div style="display: flex; justify-content: space-around;"> <div>0.90 (for 410 × 235 mm) 1.00 (for 420 × 250 mm and 425 × 260 mm)</div> <div>0.68 (for 410 × 235 mm) 0.78 (for 420 × 250 mm and 425 × 260 mm)</div> </div>

3. General Quality.

3.1. Shall be free from irregularities, such as twists, bends, cracks and laminations. The roofing tile shall be free from impurities like particles of stone, lime or other foreign materials. When struck, the tile shall give a characteristic ringing sound and when broken the fracture shall be clean and sharp at the edges. The Class AA tile shall be of uniform colour.

3.2. Shape — Placed on either face on a plane surface, gap at corners shall not exceed 6 mm.

3.3. Lugs — At least 2 batten lugs and 2 eave lugs of thickness not less than 15 mm at bottom and 10 mm at top shall be provided. Projection shall be 7 to 12 mm for batten lugs and not less than 10 mm for eave lugs.

3.4. Tie-down hole — 1.6 to 2 mm diameter.

4. Dimensions

<i>Overall Length</i>	<i>Overall Width</i>
mm	mm
410	235
420	250
425	260

Minimum overlap shall be 60 mm length wise and 25 mm widthwise

Note — For typical details of Mangalore tile see Fig 1 of the standard.

Note — For the methods of tests, refer to Appendices A to B of the standard.

4.1. For measurement of variations in length/width of tiles the difference between—

- a) The overall length/width of three tiles and
- b) The length/width of a tile is calculated and this value shall be within the limits mentioned below—

<i>For Tile Sizes</i>	<i>Value for Length</i>	<i>Value for Width</i>
mm	mm	mm
410 × 235	630 to 650	410 to 430
420 × 250	670 to 690	420 to 440
425 × 260	690 to 710	430 to 450

Note — For tolerances, refer 6.2 of the standard.

5. Weight — Average of 6 tiles shall not be less than 2 kg and not more than 3 kg

6. Strength Requirement

6.1. Water Absorption — See Table 1.

6.2. Permealibility — Water shall not drip at the bottom when tested as per Annex B of the stanard.

6.3. Breaking load test — Shall conform to Table 1 when tested as per annex C of the standard.

For detailed information, refer to IS 654:1992 Specification for clay roofing tiles, Mangalore pattern (third revision).

SUMMARY OF
IS 1464 : 1992 CLAY RIDGE AND CEILING TILES
(Second Revision)

1. Scope — Covers machine pressed clay ridge and ceiling tiles. It does not cover tiles of irregular sizes, shapes and colour and those made to meet special requirements.

3. Shape — Common patterns of ridge and ceiling tiles are shown in Fig. 1 and 2 of the standard. Gap at corners of ceiling tiles, when placed on a plane surface in normal position, shall be not more than 6 mm. Ceiling tiles are of two types, namely double lug and single lug.

4. General Quality — shall be uniform in shape and shall be free from irregularities, such as twists, bends, cracks and laminations. shall be free from impurities like particles of stone, lime or other foreign materials. When struck, the tile shall give a ringing sound and when broken, the fracture shall be clean, dense and sharp at the edges.

5. Dimensions of Ridge Tiles

- a) *Length* — 375, 400 and 435 mm.
The tolerance shall be ± 5 mm.
- b) *Width and Height* — Shall have a base of 265 mm and height of 100 mm with a tolerance of ± 5 mm.

2. Classification — Class AA and class A with characteristics given in Table 1.

- c) *Thickness* — shall be not less than 10 mm throughout excluding ornamentation, etc.
- d) *Rib* — The rib at the rear end of the tile shall be of such a height and shape as to prevent effectively the tendency of the front face of the tile interlocked to slide over it.

6. Dimension of Ceiling Tiles — The length of the double lug ceiling tile at the bottom shall be such that when a tile is placed between two battens the space between the face of the batten and that of end of tile shall be between 3 and 6 mm. The length of the single lug ceiling tile at the bottom shall be 30 mm less than the face to face spacing of battens. The length of the lug shall not be more than 20 mm. Thickness of the tile or lug shall be not less than 10 mm.

TABLE 1 CLASSIFICATION OF RIDGE AND CEILING TILES

Sl No.	Characteristic	Requirement for	
		Class AA	Class A
(1)	(2)	(3)	(4)
i)	Water absorption percent (for ridge and ceiling tiles), <i>Max</i>	18	20
ii)	Breaking strength (for ridge tiles only) kN, <i>Min</i>	0.015 0 (1.5 kg)	0.011 0 (1.10 kg)
		0.012 5 (1.25 kg)	0.009 5 (0.95 kg)

Note — For methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to IS 1464:1992 Specification for clay ridge and ceiling tiles (second revision).

SUMMARY OF
IS 1478 : 1992 CLAY FLOORING TILES
(Second Revision)

1. Scope — Requirements for dimensions, quality and strength for clay flooring tiles.

2. Classification — Class 1, class 2, and class 3 with characteristics given in Table 1.

TABLE 1 CLASSIFICATION OF FLOORING TILES

SI.No.	Characteristic	Requirements for		
		Class 1	Class 2	Class 3
i)	Water absorption percent, <i>Max</i>	10	19	24
ii)	Flexural strength, kg/cm width, <i>Min</i>			
	a) Average	6	3.5	2.5
	b) Individual	5	3.0	2.0
iii)	Impact maximum height in mm of drop of steel ball:			
	a) 15 mm thick	25	20	15
	b) 20 mm thick	60	50	40
	c) 25 mm thick	75	65	50
	d) 30 mm thick	80	70	60

3. General Quality — shall be free from irregularities, such as twists, bends, cracks, flaws, laminations and imperfections. Faces of tiles shall be plain, grooved fluted or figured as specified and the edges shall be square.

4. Dimensions

- i) 150 × 150 × 15 mm
- ii) 150 × 150 × 20 mm
- iii) 200 × 200 × 20 mm
- iv) 200 × 200 × 25 mm
- v) 250 × 250 × 30 mm

Depth of the grooves or frogging on the underside shall not exceed 3 mm.

5. Tolerances

- a) Length and breadth — Average + 5 mm, individual + 2 mm.
- b) Thickness — Average + 2 mm, individual + 1 mm.

6. Warpage — Shall not exceed 2 percent along edges and 1.5 percent along diagonals.

Note — For methods of tests, refer to Appendices A to C of the standard.

For details information, refer to IS 1478:1992 Specifications for clay flooring tiles (second revision).

SUMMARY OF
IS 2690 (PART 1) : 1993 BURNT CLAY–FLAT TERRACING TILES
PART 1 MACHINE-MADE
(Second Revision)

- | | |
|--|---|
| <p>1. Scope — Requirements for machine-made burnt clay flat terracing tiles.</p> <p>2. General Quality — Shall be uniform in shape and sizes and shall be free from irregularities, such as twists, bends, cracks and particles of stones.</p> <p>3. Dimensions and Tolerances</p> <p>3.1 Length — 250 to 150 mm in stages of 25 mm.</p> <p>3.2 Width — 200 to 100 mm in stages of 25 mm.</p> <p>3.3 Thickness — 20 and 15 mm.</p> | <p>3.4 Tolerances — ± 2 percent on all dimensions in case of machine pressed tiles and ± 3 percent in case of machine extruded tiles.</p> <p>4. Warpage — Shall not exceed 1 percent in any direction.</p> <p>5. Water Absorption — Average of 6 tiles shall not exceed 15 percent.</p> <p>6. Flexural Strength — Shall not be less than 2N/mm².</p> |
|--|---|

Note — For methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to IS 2690 (Part 1):1993 Specification for burnt clay flat terracing tiles: Part 1 Machine-made (second revision).

SUMMARY OF
IS 2690 (PART 2) : 1992 BURNT CLAY FLAT TERRACING TILES
PART 2 HAND – MADE
(Second Revision)

1. Scope — Requirements for hand-made burnt clay flat terracing tiles.

2. General Quality— Shall be uniform in shape and sizes and shall be free from irregularities, such as twists, bends, cracks and particles of stones.

3. Dimensions and Tolerances

3.1 Length — 250 to 150 mm in stages of 25 mm.

3.2 Width — 200 to 75 mm in stages of 25 mm.

3.3 Thickness— 25 to 50 mm in stages of 5 mm.

3.4 Tolerances — Shall be ± 3 percent for all dimensions.

4. Warpage— Shall not exceed 2 percent of the dimension in any direction.

5. Water Absorption — Shall not exceed 20 percent by weight.

6. Flexural Strength — Shall not be less than 1.5 N/mm².

Note — For methods of test, refer to Annex B of the standard, and relevant parts of IS 3495 Methods of tests of burnt clay building bricks (*third revision*).

For detailed information, refer to IS 2690 (Part 2):1992 Specification for burnt clay flat terracing tiles: Part 2 Hand-made (second revision).

SUMMARY OF
IS 3367 : 1993 BURNT CLAY TILES FOR USE IN LINING
IRRIGATION AND DRAINAGE WORKS
(Second Revision)

1. Scope — Covers machine-pressed, wire-cut, or hand-made rectangular burnt clay tiles used for lining irrigation canals and for drainage channels (other than sewage works).

2. General — Shall be uniform in size, shape and free from irregularities, such as cracks and laminations. Shall be free from impurities like particles of stone, lime and other foreign materials.

3. Dimensions and Tolerances.

3.1 Dimensions — 300 mm × 150 mm × 50 mm.

3.2 Tolerances — ± 10 mm in length, ± 5 mm in width, and ± 1.5 mm in thickness.

4. Classification — Class 105 and Class 75.

5. Physical Properties See Table 1.

TABLE 1 PHYSICAL PROPERTIES

Sl. No.	Characteristic	Requirements	
		Class 105	Class 75
(1)	(2)	(3)	(4)
i)	Compressive strength, N/mm ² <i>Min</i>	10.5	7.5
ii)	Water absorption percent, <i>Max</i>	15.0	20.0
iii)	Transverse strength N/mm ² , <i>Min</i>	1.5	1.2
iv)	Warp, mm, <i>Max</i>	3.0	3.0

Note — For methods of test, refer to Appendices A and B of the standard and relevant parts of IS 3495 Methods of tests of burnt clay building bricks (*third revision*).

For detailed information refer to IS 3367:1993 Specification for burnt clay tiles for use in lining irrigation and drainage works (second revision).

SUMMARY OF
IS 3951 (PART 1) : 1975 HOLLOW CLAY TILES FOR
FLOORS AND ROOFS
PART 1 FILLER TYPE
(First Revision)

1. Scope — Requirements for dimensions, quality and strength requirements of hollow clay filler tiles having perforations parallel to their length and intended for use in floors and roofs.

2. General Requirements — Shall be free from cracks, flaws and nodules of free lime. Shall be of uniform colour and shall have plane rectangular faces with parallel sides and straight right angled edges.

2.1 Winding or Bowing — Shall be not more than 5 mm per 30 cm length or width.

2.2 Concavity or Convexity — Shall be not more than 5 mm per 30 cm run at any point on either diagonal.

2.3 Angles between Sides and Joining Edges — Shall be not more than 5 mm per 30 cm run.

Note — Tests for trueness of shape are illustrated in Fig 1 to 3 on the standard.

3. Dimensions and Tolerances

3.1 Dimensions

<i>Length</i> mm	<i>Width</i> mm	<i>Height</i> mm
340, 390, 440, 490	350, 300	80, 90
540, 590, 640, 690	250, 200	100, 110
740		

3.2 Tolerances — ± 5 percent

3.3 Thickness — Shall be not less than 11 mm for shell and not less than 8 mm for web.

4. Breaking Strength — Shall be not less than 10 kgf/cm² length.

5. Water Absorption — Shall not more than 20 percent.

Note 1 — Typical shapes of hollow clay filter tiles are shown in Fig. 4 of the standard.

Note 2 — For methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to IS 3951 (Part 1):1975 Specification for hollow clay tiles for floors and roofs:Part 1 Filler type (first revision).

SUMMARY OF

IS 3951 (PART 2) : 1975 HOLLOW CLAY TILES FOR
FLOORS AND ROOFS

PART 2 STRUCTURAL TYPE

(First Revision)

1. Scope —Requirements for quality, dimensions, bulk density, water absorption and strength requirements of structural hollow clay tiles suitable for floor/roof.

2. General Requirements— Shall be free from cracks, flaws or inclusion of any deleterious materials.

2.1 Shall have at least one plane of symmetry in cross section.

2.2 Shall have serrations (not deeper than 3 mm and not wider than 6 mm) on all faces designed to be concreted or mortared or plastered.

2.3 Winding or Bowing — Shall not be more than 5 mm per 30 cm length or width.

2.4 Concavity or Convexity — Shall not be more than 5 mm per 30 cm run at any point in either diagonal.

2.5 Angle between Sides and Joining Edges— Shall not be more than 5 mm per 30 cm run

Note — Tests for trueness of shape are illustrated in Fig 1. to 3. of the standard.

3. Dimensions and Tolerances**3.1 Dimensions**

Length— 290 and 390 mm

Width — 90 to 190 mm in stages of 50 mm

Height — 125 to 200 mm in stages of 25 mm

3.2 Thickness —Shall be not less than 12 mm for shell and not less than 10 mm for web.

3.3 Tolerances — ± 5 percent on length and width. + 5 percent on height.

Note —Hollow tiles may be either with small perforations or large holes or a combination of the two.

4. Bulk Density — Shall be not below 0.9g/cm^3 and not more than 1.2g/cm^3 .

5. Compressive strength — Average not less than 200 kgf/cm^2 . Individual not less than 150 kgf/cm^2 .

6. Water Absorption — Shall not exceed 10 percent by weight.

Note 1—Typical shapes of structure clay units for flooring and roofing are shown in Fig. 4 of the standard

Note 2 — For methods of tests refer to 5.1.1 Appendices A and B of the standard.

For detailed information, refer to IS 3951 (Part 2) : 1975 Specification for hollow clay tiles for floors and roofs: Part 2 Structural type (first revision).

SUMMARY OF
IS 13317 : 1992 CLAY ROOFING COUNTRY TILES,
HALF ROUND AND FLAT TILES

1. Specification — Covers the specifications of hand made half round and flat country tiles.

2. Classification — Class AA and Class A with characteristics given in Table 1.

TABLE 1 CLASSIFICATION OF CLAY COUNTRY ROOFING TILES

Sl No.	Characteristic	Requirement			
		Half Round Tiles		Flat Tiles	
		Class AA	Class A	Class AA	Class A
(1)	(2)	(3)	(4)	(5)	(6)
i)	Water absorption percent, <i>Max</i>	19	24	19	24
ii)	Breaking load, kN, <i>Min</i>				
	a) Average	0.40 (40 kg)	0.30 (30 kg)	0.35 (35 kg)	0.25 (25 kg)
	b) Individual	0.35 (35 kg)	0.25 (25 kg)	0.30 (30 kg)	0.20 (20 kg)

3. Shape, Dimension and Tolerances — For dimensions see Table 2

TABLE 2 DIMENSIONS OF TILES

Dimensions mm						
		Overall length	Overall width		Overall height	
			Wide end	Narrow end	Wide end	Narrow end
<i>Half Round Tiles</i>						
	Size I	250	105	85	50	40
	Size II	250	120	95	60	45
<i>Flat Tile</i>						
	Size I	200	175	145	20	20
	Size II	250	200	160	25	25

When the half round or flat country tile is placed on a plane surface, the gap at the corners shall be not more than 8 mm. The cross-section of the half round and flat country tiles shall be such as to give the tile structural rigidity. The overall minimum overlap in both the type of tiles shall be 60 mm length length wise. There is no overlap width wise in these tiles. The tolerances in length and width shall be below ± 5 percent.

4. General Quality — Shall be free from irregularities, such as twists, bend, cracks and lamination. Shall be

free from impurities like particles of stone, lime or other foreign materials. Class AA tile shall be of uniform colour.

5. Weight — Average of 6 tiles when dried to constant weight at 110°C.

Half round tile 5 to 8 N, *Max*

Flat tile 7 to 10 N, *Max*

Note 1 — For typical details of country roofing tiles see Fig. 1 of the standard.

Note 2 — For methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to IS 13317:1992 Specification for clay roofing country tiles, half round and flat tiles.

SECTION 5

**GYPSUM BUILDING
MATERIALS**

CONTENTS

	<i>Title</i>	<i>Page</i>
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(Part I) : 1996	Plain gypsum plaster boards (<i>second revision</i>)	5.3
(Part 3) : 1996	Reinforced gypsum plaster boards (<i>second revision</i>)	5.5
IS 2547	Gypsum building plaster	
(Part I) : 1976	Excluding premixed light weight plaster (<i>first revision</i>)	5.7
(Part 2) : 1976	Premixed light weight plaster (<i>first revision</i>)	5.9
IS 2849 : 1983	Non load bearing gypsum partition blocks (Solid and hollow types)	5.10
IS 8272 : 1984	Gypsum plaster for use in the manufacture of fibrous plaster boards (<i>first revision</i>)	5.11

SUMMARY OF

IS 2095 (PART 1) : 1996 GYPSUM PLASTER BOARDS

PART 1 PLAIN GYPSUM PLASTER BOARDS

(Second Revision)

1. Scope— Requirements for gypsum plaster board intended to be used as a vertical or horizontal lining in building. It includes boards manufactured to receive either direct surface decoration or gypsum plaster finishes.

2. Types— Gypsum plaster boards are classified according to their use—

- a) Gypsum wallboards
- b) Gypsum Board with reduced water Absorption Rate,
- c) Gypsum wallboard with improved core Cohesion at high temperatures
- d) Gypsum plaster baseboard, and
- e) Gypsum plaster baseboard with improved core cohesion at high temperatures

3. Material — Gypsum plaster shall conform to IS 2547 (Part 1) : 1976*. By product gypsum conforming to IS 12679:1987⁺ shall be used for the preparation of plaster.

4. General— Gypsum plaster boards consist of a gypsum plaster core with or without fibre encased in and firmly bonded to strong durable paper liners to form rectangular boards. Core shall be dried across full width. The face and back papers shall be securely bonded to the core. The paper surfaces may vary according to the use of the particular type of board, and the core may contain additive to impart additional properties. The longitudinal edges are paper covered and profiled to suit the application.

The paper covered edges of gypsum wall boards are square, tapered, bevelled or rounded. The paper covered edges of gypsum baseboard are square or rounded. The ends of gypsum plaster board are square-cut.

5. Requirements

5.1 Dimensions — See Table 1.

*Gypsum plaster boards : Part 1 Plain gypsum plaster boards (second revision)

+ Specification for by product gypsum for use in plaster block and board.

TABLE 1 DIMENSIONS OF GYPSUM PLASTER BOARDS

Type of Board	Width mm	Length mm	Thickness mm
(1)	(2)	(3)	(4)
Wallboard	600, 900 and 1 200	1 800 to 3 600 in steps of 100 mm	9.5, 12.5, 15, 19, 23 and 25
Baseboard	400 and 900	1 200, 1 500 and 1 800	9.5 and 12.5

5.2 Tolerance — Shall be as given below—

Type	Tolerance in mm		
	Width	Length	Thickness
Gypsum Wallboard	0 - 5	0 - 6	± 0.6
Gypsum Baseboard—			
a) Non-Perforated	0 - 8	0 - 6	± 0.6
b) Perforated	0 - 8	0 - 16	± 0.6

TABLE 2 BREAKING LOAD OF GYPSUM PLASTER BOARDS.

Type of Board	Thickness	Breaking Load, Min	
		Transverse Direction	Longitudinal Direction
(1)	(2)	(3)	(4)
Plaster board	9.5	140	360
	12.5	180	500
	15.0	220	650
	19.0	250	750
	23.0	300	850
Base board	25.0	380	1,000
	9.5	125	180
	12.5	165	235

5.3 Breaking Load (Transverse Strength)

— See Table 2.

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5.4 Water Absorption — Shall be subject to mutual agreement between purchaser and manufacturer.

5.5 Mass of Plaster — minimum quantity of mass

of plaster per sq. m of board of 12 mm thickness shall not be less than 9.4 kg.

5.6 Taper Profile — Taper width shall be 50 to 65 mm, and depth 0.8 to 2.0 mm.

Note — For methods of tests, refer to IS 2542 (Part 2/Sec 1 to 8) : 1981 Methods of test for gypsum plaster, concrete and product: PART 2 Gypsum products (*first revision*).

For detailed information, refer to IS 2095 (Part 1) : 1996 Specification for gypsum plaster boards: Part 1 Plain gypsum plaster boards (second revision).

SUMMARY OF

IS 2095 (PART 3) : 1996 GYPSUM PLASTER BOARDS
PART 3 REINFORCED GYPSUM PLASTER BOARDS
(Second Revision)

1. Scope — Covers the method of manufacture, tests and sampling of fibrous gypsum plaster boards and glass fibre reinforced gypsum (GRG) boards for use as a lining material for ceiling, dry surfacing material for walls, door panels or for partitions.

2. Materials — See 2 of the standard

3. Method of Manufacture — See 5 of the standard.

4. Dimensions and Tolerances

4.1 Shape — The boards shall be square or rectangular in shape.

4.2 Dimensions

4.3 Mass of Plaster

4.4 Density

4.5 Tolerances

- | | |
|--------------|--------------|
| a) Length | +0 mm
- 6 |
| b) Width | +0 mm
- 5 |
| c) Thickness | ±1.0 mm |

} — See Table 1.

5. Finish

The surface of the boards shall be true and free from imperfection that would render the board unfit for use. The edge shall be straight and the corners shall be square.

6. Tests

6.1 Visual Inspection — All boards shall be sound, free from cracks, broken-edges and such other imperfections that would render them unfit for use.

6.2 Thickness — To be measured as per IS 2542.

6.3 Transverse/Flexural Strength

6.3.1 Deflection shall not exceed 19 mm under a load of 340 N.

6.3.2 Flexural strength — See Table 2.

6.3.3 Impact strength — When tested by Charpy test, shall have a value as per Table 2.

6.4 Jolting test — None of the sample should show crack or chipping off from the surface before 80 cycles of jolting.

TABLE 1. DIMENSIONS AND OTHER PROPERTIES OF FIBROUS GYPSUM PLASTER BOARD AND GRG BOARD

Board	Thickness (T) mm	Length (L) mm	Width (W) mm	Mass of Plaster per m ² of Board, kg Min	Density kg/m ³ Min
(1)	(2)	(3)	(4)	(5)	(6)
Fibrous Gypsum Plaster Board	12	1200 1500 1800	400 600 900 1200	10	834
GRG Board	4,6 8,10 12	2000 and 3000	1000 1200	4-10 6-15 8-20 10-25 12-30	2500

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6.5 Free Moisture — Shall not exceed 2 percent.

6.6 Surface hardness— Impression by a steel ball of 10 mm kept on the board for 5 minutes, shall not exceed 8 mm in diameter.

6.7 Water Absorption— Shall not exceed 15 percent in 24 hours.

6.8 Swelling— Fro GRG when tested as per IS 2380 (Part 17) the value shall not exceed 0.5 percent in 24 hours.

6.9 Fibre content — Shall be determined as per IS 2542 (Part 1)

TABLE 2 FLEXURAL AND IMPACT STRENGTH OF GRG BOARDS.

<i>Average Flexural</i>	<i>Minimum Flexural</i>	<i>Average Impact</i>	<i>Minimum Impact</i>
<i>Strength</i>	<i>Strength on</i>	<i>Strength</i>	<i>Strength on</i>
<i>Mpa</i>	<i>Either Side</i>	<i>N/mm²</i>	<i>Either Side</i>
	<i>Mpa</i>		<i>N/mm²</i>
	<i>N/mm²</i>		
18	15	17	14

Note — For methods of tests, refer to Appendices A and B on the standard, relevant parts of IS 2380 Methods of test for wood particle boards and boards from other lignocellulosic mataterials, IS 2542 (Part 2): Methods of tests for gupsum plaster, concrete and products: Part 2 gypsum products.

For detailed information, refer to IS 2095 (Part 3) : 1996 Specification for gypsum plaster boards: Part 3 Reinforced gypsum plaster boards (second revision).

SUMMARY OF
IS 2547 (PART 1) : 1976 GYPSUM BUILDING PLASTERS
PART 1 EXCLUDING PREMIXED LIGHTWEIGHT PLASTERS
(First Revision)

1. Scope — Covers the classification and chemical and physical requirements for gypsum building plasters which possess a definite set due to hydration of calcium sulphate, anhydrous or hemihydrate, to form gypsum and are used in the manufacture of gypsum building products. Premixed lightweight building plasters are not included.

2. Classification

- a) Plaster of paris,
- b) Retarded hemihydrate gypsum plaster

Type I *Under coat* —

- 1) Browning plaster,
- 2) Metal lathing plaster

Type II *Final coat plaster* —

- 1) Finish plaster,
- 2) Board finish plaster,
- 3) Anhydrous gypsum plasters are for finishing only, and
- 4) Keene's plaster is for finishing only.

3. Chemical Requirements - See Table 1

TABLE 1 CHEMICAL COMPOSITION
Requirement

<i>Sl. No.</i>	<i>Particulars</i>	Plaster of Paris	Retarded Hemihydrate Gypsum Plaster	Anhydrous Gypsum Plaster	Keene's Plaster
(1)	(2)	(3)	(4)	(5)	(6)
i)	SO ₃ , percent by mass, <i>Min</i>	35	35	40	47
(ii)	CaO, percent by mass, <i>Min</i>	2/3 of SO ₃ content	2/3 of SO ₃ content	2/3 of SO ₃ content	2/3 of SO ₃ content
iii)	Soluble magnesium salts, expressed as percentage of MgO, <i>Max</i>	0.3	0.3	0.3	0.3
iv)	Soluble sodium salts, expressed as percentage of Na ₂ O, <i>Max</i>	0.3	0.3	0.3	0.3
v)	Loss on ignition, percent by mass	Not greater than 9 and less than 4	Not greater than 9 and less than 4	3.0 <i>Max</i>	2.0 <i>Max</i>
vi)	Free lime, <i>Min</i> percent	—	3*	—	—

* Applicable to metal lathing plaster

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4. Physical Requirements — See Table 2.

Purity — No material shall be added to gypsum plasters except those which are necessary to control the setting, such as sodium citrate, break down products of keratin,

potassium sulphate, sodium sulphate alum and zine sulphate; or working characteristics such as alkyl - Aryl sulphonate or to impart anti-corrosion such as nitrates and nitrites of alkali metals or fungicidal properties.

TABLE 2 PHYSICAL REQUIREMENT

S.LNo. Particulars		Requirements			
		Plaster of Paris		Anhydrous Gypsum Plaster	Keene's Plaster
		Type A (short time setting)	Type B (long time setting)		
(1)	(2)	(3)	(4)	(5)	(6)
i)	Setting time minutes:	—	—	—	—
	a)Plaster sand mixture	45-120	120-900	—	—
	b)Neat plaster	20-40	60-180	20-360	20-360
ii)	Transverse strength kg/cm ² Min	5	4*	—	—
iii)	Soundness	Set plaster pats shall not show any sign of disintegration, popping or pitting	Set plaster pats shall not show any sign of disintegration, popping or pitting	Set plaster pats shall not show any sign of disintegration, popping or pitting	Set plaster pats shall not show any sign of disintegration, popping or pitting
iv)	Mechanical resistance of set neat plaster	—	†Diameter of the indentation shall not be less than 3 mm and not more than 4.5 mm	Diameter of the indentation shall not be more than 4 mm	Diameter of the indentation shall not be more than 3.5 mm
v)	Residue on 90 mm sieve percentage, Max	5.0	5.0* (1.0) †	2.0	2.0
vi)	Expansion on setting percentage, Max	—	0.20 at 24 h ‡	—	0.5 at 96 h

* Applicable to undercoat plasters only.
† Applicable to final coat plasters.
‡ Applicable to board finish plasters only.

Note — For methods of tests, refer to Appendices A to C of the standard, IS 1288:1982 Methods of test for mineral gypsum (second revision) and relevant parts of IS 2542 Methods of test for gypsum plaster, concrete and products.

For detailed information, refer to IS 2547 (Part 1):1976 Specification for gypsum building plaster: Part 1 Excluding premixed light weight plasters .

SUMMARY OF
IS 2547 (PART 2) : 1976 GYPSUM BUILDING PLASTER
PART 2 PREMIXED LIGHTWEIGHT PLASTERS
(First Revision)

1. Scope — Requirements for premixed lightweight plaster consisting essentially of gypsum plaster and lightweight aggregate used in general building operations.

- a) Browning plaster,
- b) Metal lathing plaster,
- c) Bonding plaster

2. Classification

Type A – *Under coat plasters* —

Type B – *Final coat plaster* — Finish plaster.

3. Physical and Chemical Requirements —
 See Table 1.

TABLE -1 PROPERTIES OF DIFFERENT TYPES OF PLASTERS.

SL.No.	Particulars	UnderCoat Plasters (TypeA)			Final Coat Plasters (Type B)
		Browning Plaster	Metal Lathing Plaster	Bonding Plaster	Finish Plaster
(1)	(2)	(3)	(4)	(5)	(6)
i)	Sum of soluble sodium and magnesium salt contents, expressed as percentages of sodium oxide (Na ₂ O), and magnesium oxide (MgO) by mass, <i>Max</i>	0.25	0.25	No upper limit	0.25
ii)	Dry bulk density, <i>Max</i> , kg/m ³	640	770	770	—
iii)	Dry set density, <i>Max</i> , kg/m ³	850	1 040	1 040	—
iv)	Compressive strength, <i>Min</i> , N/mm ²	0.93	1.0	1.0	—
v)	Free lime content, by percent, mass, <i>Min</i> ,	—	2½	—	—
vi)	Mechanical resistance	—	—	—	—

Diameter of the indentation shall not be less than 4 mm and not more than 5.5 mm.

Note—For methods of tests, refer to Appendices A and B of the standard and relevant parts of IS 2542 Methods of test for Gypsum plaster, Concrete and Products.

For detailed information, refer to IS 2547 (Part 2): 1976 Specification for gypsum building plasters: Part 2 Premixed lightweight plasters .

SUMMARY OF
IS 2849 : 1983 NON-LOAD BEARING GYPSUM PARTITION
BLOCKS (SOLID AND HOLLOW TYPES)
(First Revision)

1. Scope — Requirements for gypsum partition blocks for use in non-load bearing construction in the interior of buildings and for the protection of columns, elevator shafts, etc, against fire.

2. Types and Shapes — Block may be solid type or hollow type and shall be truly rectangular in shape with straight and square edges and true surfaces.

3. Requirements

3.1 Dimensions

3.2 Tolerances —

Length	± 3.0 mm
Height and Breadth	± 1.5 mm

3.3 Scoring — When the surfaces of the block are scored, the scoring shall not reduce materially the thickness of the shell. Surfaces of the block shall be such that they afford a suitable bond with plaster.

4. Compressive Strength — Shall be not less than 2.0 N/mm² based on gross area.

5. Non-Combustibility — When tested in accordance with 6.2.1 of the standard no block shall:

- a) Cause the temperature readings of the furnace thermocouple to rise by more than 500C above the initial furnace temperature,
- b) Cause the temperature readings of the specimen thermocouple to rise by more than 500C above the initial furnace temperature, or
- c) Flame for more than 10 seconds.

6. Visual Inspection — Shall be sound, free from cracks, broken edges and other imperfections.

<i>Length</i>	<i>Height</i>	<i>Breadth</i>	<i>Hollow Blocks Side and Edge thickness, Min</i>	
			<i>Circular Holes</i>	<i>Elliptical or Rectangular Holes</i>
<i>L</i>	<i>H</i>	<i>B</i>	<i>t</i>	<i>t</i>
700 Max in multiples of 100	700 Max in multiples of 100	60	—	—
		75	15	20
		80	—	—
		100	20	20
		125	25	30
		150	15	20

Note— 1. All dimensions in millimeters —
 2. Dimensions other than length, height and breadth for guidance only

Note — For the Methods of tests, refer to IS 2542 (Part 2)-1981 Methods of test for Gypsum plaster, concrete and products-Part 2 gypsum products (*first revision*) and IS 3808:1979 Method of test for non-combustibility of building materials (*first revision*)

For detailed information, refer to IS 2849:1983 Specification for non-load bearing gypsum partition blocks (solid and hollow types) (first revision).

SUMMARY OF
IS 8272 : 1984 GYPSUM PLASTER FOR USE IN THE
MANUFACTURE OF FIBROUS PLASTER BOARDS
(First Revision)

1. Scope — Requirements and the methods of sampling and tests for calcined gypsum plaster used in manufacturing fibrous plaster boards covered in IS 8273:1984*.

Note — Gypsum building plasters are used extensively for general building operations and for the manufacture of preformed gypsum building products which have the specific advantages of lightness and high fire resistance. Fibrous plaster boards are used as coverings for walls, ceilings and partitions in normally dry environments in buildings.

2. Chemical Composition — The plaster shall consist essentially of calcium sulphate hemihydrate ($\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$). And shall contain not less than 42 percent sulphur trioxide (SO_3)

* Fibrous gypsum plaster boards *(first revision)*.

3. Properties

3.1 Fineness — Residue retained on 600 micron sieve shall not be more than 1 percent by mass.

3.2 Compressive Strength — Compressive strength of the plaster, shall not be less than 7.6 N/mm².

3.3 Initial Setting Time—Shall be between 20 and 35 minutes.

Note — For methods of tests, refer to Appendices A to E of the standard

For detailed information, refer to IS 8272:1984 Specification for gypsum plaster for use in the manufactures of fibrous plaster boards (first revision).

SECTION 6

TIMBER

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SUMMARY OF

IS 399 : 1963 CLASSIFICATION OF COMMERCIAL TIMBERS AND THEIR ZONAL DISTRIBUTION

(Revised)

1. Scope— Details of the zonal distribution of common commercial timbers of India, classified according to their various uses, and information on the availability of these timbers and on some of their important properties.

2. Uses—The uses are classified under the following categories:

- a) Constructional purposes, including building construction, houseposts, beams, rafters, cart building, bridges, piles, poles and railway sleepers;
- b) Furniture and cabinet making;
- c) Light packing cases;
- d) Heavy packing cases (for machinery and similar stores);
- e) Agricultural implements and tool handles;
- f) Turnery articles and toys; and
- g) Veneers and plywood

3. Zones— The territories comprising India, and Bhutan have been divided into five zones as indicated on the Map (*See page 85 of the standard*), which comprise roughly the following areas:

I North Zone	Jammu and Kashmir, Punjab, Himachal Pradesh, Delhi, Uttar Pradesh and Rajasthan
II East Zone	Assam, Manipur, Tripura, WestBengal, Bihar, Orissa, Sikkim, Bhutan, Andamans, Arunachal and Meghalaya and Nagaland
III Centre Zone	Madhya Pradesh, Vidharbha areas of Maharashtra State and the North East part of Andhra Pradesh (Godavari delta area)
IV West Zone	Maharashtra State (except Vidharbha areas), Gujarat and North West part of Karnataka
V South Zone	Tamil Nadu, Andhra Pradesh (except the Godavari delta area), Kerala and Karnataka (Except North West part)

4. Classification — Tables I, II, III, IV, and V of the standard list respectively important timbers commercially available in the five zones described under **3** and classified according to their uses given under **2**. Against each species of timber, the availability in that zone, average weight and the range of weight of air-seasoned timber in kg/m³ and lb/ft³, durability, treatability, refractoriness to air seasoning and strength coefficient are given

4.1 Availability— The availability of timbers is categorized under three classes indicated below:

X— Most common, 1 415 m³ (1 000 tonnes) and more per year

Y— Common, 355 m³ (250 tonnes) to 1 415 m³ (1 000 tonnes) per year

Z— Less common, below 355 m³ (250 tonnes) per year

4.2 Weight — The figure for average weight and range of weight per cubic metre (or ft³) at 12 percent moisture content for all the timbers have been given. The range of weights is given below the average weight in parentheses.

4.3 Durability — The timbers are classified for durability according to the average life of these test specimens as follows:

High — Timbers having average life of 120 months and over

Moderate — Timbers having average life of less than 120 months but of 60 months or over

Low — Timbers having average life of less than 60 months.

4.4 Treatability — The classification is based to represent approximately the degree of resistance offered by the heartwood of a species to the penetration of the preservative fluid under working pressure of 10.5 kgf/cm². The treatability of timbers has been classified as follows—

- a) Heartwood easily treatable
- b) Heartwood treatable, but complete penetration of preservative not always obtained
- c) Heartwood only partially treatable
- d) Heartwood refractory to treatment
- e) Heartwood very refractory to treatment penetration

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of preservative being practically nil from side or end

4.5 Refractoriness to Air Seasoning— The timbers are classified, as stated below, under three categories, depending upon their behaviour with respect to cracking and splitting during normal air-seasoning practice suitable for the species concerned: High refractoriness (indicated ‘High’ in the tables) Moderate refractoriness (indicated ‘moderate’ in the tables), and Low refractoriness (indicated ‘Low’ in the Tables).

4.6 Comparative Strength Coefficients — The figure for comparative strength coefficients for various uses for all the timbers have been arrived at by suitably grouping the various important mechanical properties that come into play for any particular use and giving due weightage to the relative importance of these properties.

Note 1 — For classification of timbers according to their uses for various zone, refer to Table I to V of the standard.

Note 2 — For key for field identification of commercial timber (soft woods and hard woods) based on their general properties, refers to IS 4970 :1973. key for identification of commercial timbers (*first revision*) their zonal distribution (*revised*)

For detailed information, refer to IS 399: 1963 Specification for classification of commercial timbers and their zonal distribution (revised).

SUMMARY OF

IS 12896 : 1990 INDIAN TIMBERS FOR DOOR AND WINDOW SHUTTERS AND FRAMES – CLASSIFICATION

1. Scope – Covers the general classification of Indian timber species suitable for door and window shutters and frames. It also lays down the general requirements of quality, seasoning, moisture content and preservative treatment for timber. This standard does not, however, cover the species suitable for flush doors.

2. General Requirements—The timber of all groups shall be free from decay, fungal growth, boxed heart, splits, pitch pockets or streaks on the exposed faces, and dead and loose knots. Live knots up to 25 mm diameter, not more than 3 per metre; live knots over 25 mm and up to 40 mm diameter not more than 2 per metre shall be permissible, provided they are evenly distributed and badly checked. Surface cracks not exceeding 2 mm in depth in timber intended for shutters and not exceeding 3 mm in depth in timber intended for frames shall be permitted.

3. Timber / Spices

3.1 Shutters—Timbers species for the manufacture of door and window shutters shall have adequate strength, weight, retention of shape, ease of working, ability to season well, finish smooth and shall be sufficiently durable and/or treatable. In addition, for high class polished door shutters, it shall have excellent appearance and figure and shall have good gloss after polishing. The timber species shall be classified into the following four groups based on strength coefficient, weight (expressed as a percentage of teak), durability and treatability, appearance, figure and polish adaptability, keeping also in view their seasoning behaviour, retention of shape and workability.

3.1.1 Super Group—

Strength – More than or equal to 80 coefficient
Weight – Between 75-115
Durability – I or II

In addition, these shall be excellent in figure appearance, smooth finishing and polishing. Species of this group are given in Annex A of the standard.

3.1.2 Group I —

Strength coefficient : More than or equal to 80
Weight – Between 75-115
Durability – I or II

In addition, these shall be good to very good in figure appearance and finishing. Species of this group are given in Annex B of the standard

3.1.3 Group II —

Strength coefficient : More than or equal to 70
Weight – 70-125
Durability – I, II or III (with treatability (a), (b) or (c) see 5)

Species of this groups are given in Annex C of the standard. Species which are comparable to Group II species in respect of strength, weight, seasoning, working and finishing characters but fall short only in treatability, that is, belong to durability III, with treatability (d) or (e) or whose durability/treatability data are not available shall be grouped in to Group II(A). These species are also given in Annex C of the standard. Doors made out of the timbers of Group II(A) will require special preservative treatment after fabrication.

3.1.4 Group III —

Strength : More than or equal to 60 coefficient
Weight : 65-125
Durability : Any class or not known

Species of this group are given in Annex D of the standard. Doors made out of the species in this group that have durability/treatability Class III (d or e) or whose durability/treatability is not known will require special preservative treatment after fabrication.

3.2 Frames—Timber species suitable for the manufacture of door and window frames shall be classified into following three groups depending upon strength coefficient, durability and treatability.

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3.2.1 Group I —

Strength coefficient : 80 or more

Durability : I

Species of this group are given in Annex E of the standard.

3.2.2 Group II —

Strength coefficient : 70 or more

Durability : I, II [with treatability

(a), (b), or (c) or III with treatability (a), or (b)]

3.2.3 Group III —

Strength coefficient — 65 or more

Durability— I, II (with any treatability class) or
III [with treatability (a), (b) or (c)]

Species of this group are given in Annex G of the standard.

4. Seasoning and Moisture content —

a) *Class A*—Highly refractory,

b) *Class B*—Moderately refractory, and

c) *Class C*—Non-refractory

4.1 Highly Refractory—Timber species are slow and difficult to season, free from surface and end cracking.

4.2. Moderately Refractory Timber Species—May be seasoned free from surface and end cracking within reasonably short periods, given a little protection against rapid drying conditions.

4.3 Non-refractory Timber Species—May be rapidly seasoned free from surface and end cracking even in the open air and sun. If not rapidly dried, they develop blue stain and mould on the surface. Timber shall be seasoned to moisture content conforming to IS 287:1993* by a suitable process specified in IS 1141:1993+ and moisture content shall be determined as per IS 11215:1991‡.

5. Durability and Preservative Treatment—

Timbers are classified for durability according to the average life of the test specimens as follows:

Class	Average Life (Months)
I	120 and over
II	60 and over but less than 120

* Permissible moisture content of timber used for different purposes (*third revision*).

+ Seasoning of timber (*second revision*).

‡ Methods for determination of moisture content of timber products (*first revision*).

III

Less than 60

The treatability of heartwood of different species shall be classified into 5 grades [(a) to (e)], each grade being defined as indicated below:

a) Heartwood easily treatable;

b) Heartwood treatable but complete penetration not always obtained, in case where the least dimension is more than 6 cm;

c) Heartwood only partially treatable;

d) Heartwood refractory to treatment; and

e) Heartwood very refractory to treatment penetration of preservative being practically nil even from the ends.

Sapwood of even durability Class I species and heartwood and sapwood of durability Class II and III species shall be pressure treated with suitable preservatives conforming to IS 401: 1982* except in the following conditions. Shutters manufactured from species belonging to Super Group in Annex A of the standard having durability Class II shall be pressure/vacuum treated after complete fabrication only with PCP/solvent system. Shutters manufactured from species belonging to Group II(A) and Group III in Annex C of the standard having durability/treatability III(d) or (e) or whose durability/treatability is not mentioned, shall be pressure/vacuum treated with PCP/solvent system only after complete fabrication to ensure minimum penetration of 2 mm in the finished products. For frames, timber of the species of Group III belonging to durability/treatability Class III (c) in Annex F of the standard shall be treated to refusal under pressure when proper retentions as in IS 401 : 1982* for ground contact condition are not achievable.

* Preservation of timber (*third revision*)

For detailed information, refer to IS 12896 : 1990 Specification for Indian timbers for door and window shutters and frames.

SUMMARY OF
IS 190 : 1991 CONIFEROUS SAWN TIMBER
(BAULKS AND SCANTLINGS)
(Fourth Revision)

1. Scope— Covers the requirements of coniferous sawn timber (baulks and scantling)

2. Species

<i>Trade Name</i>	<i>Botanical Name</i>	<i>Abbreviated symbol</i>
Chir	<i>Pinus roxburghi</i>	CHR
Cypress	<i>Cupressus torulosa</i>	CYP
Deodar	<i>Cedrus deodara</i>	DEO
Fir	<i>Abies spp</i> (Other than <i>Abies densa</i>)	FIR
Kail	<i>Pinus Wallichiana</i>	KAL
Khasi pine	<i>Pinus insularis</i>	KPI
Red fir	<i>Abies densa</i>	RFI
Spruce	<i>Picea simthiana</i>	SPR

3. Dimensions: *Length* — 1 m, 1.5 m, 2.0 m, 2.5 m, 3.0 m, and 3.5 m

Cross Section

200 mm × 100 mm,	200 mm × 125 mm
200 mm × 150 mm,	200 mm × 200 mm
250 mm × 125 mm,	250 mm × 150 mm
300 mm × 150 mm	

4. Measurement

4.1 Length — The length shall be measured from end to end in metres correct to 0.01 m.

4.2 Width and Thickness — The width and thickness shall be measured at the narrowest place correct to 10 mm.

4.3 Volume — The volume shall be computed in cubic

metres correct to three places of decimals.

5. Requirements— Shall be air seasoned to a moisture content not exceeding 20 percent within a depth of 15 mm from the surface, excluding a length of 300 mm from each end.

6. Grading— The coniferous sawn timber shall be of three grades, that is Special Grade, Grade I and Grade 2, depending upon prohibited and permissible defects.

7. Prohibited and Permissible Defects

7.1 Prohibited Defects— The sawn timber of all the three grades shall be free from spiral or twisted grain, warp, any kind of decay or live insect attack. Special grade sawn timber shall be free from centre heart, wane, cup shakes, borer holes (dead infestation) sapstain (bluestain) and knots also. Grade 1 shall be free from cup shakes also.

7.2 Permissible Defects—The defects to the extent specified in Table 1 of the standard.

8. End Coating — To prevent and to minimize end cracking, splitting, etc, the ends of each baulk and scantling, up to a distance of at least 25 mm more than the length of longest split, shall be adequately coated with any of the materials mentioned in IS 1141 : 1993*

*Seasoning timber — Code of Practice.

Note — For methods of measurement of defects in timber, refer to IS 3364 (Part 2): 1976 Methods of measurement and evaluation of defects in timber: (Part 2) Converted timber (*first revision*).

For detail information refer to IS 190:1991 Specifications for Coniferous sawn timber (baulks and scantlings) (fourth revision).

SUMMARY OF
IS 876 : 1992 WOOD POLES FOR OVER HEAD POWER
AND TELECOMMUNICATION LINES
(Third Revision)

1. Scope—Covers wood poles made of both broad leaved and coniferous species of timber and suitable for carrying overhead electric power transmission lines, telephone and telegraph circuits.

2. Species of Timber — The species of timber suitable for wood poles are categorized into three groups, as indicated below, based on the modulus of rupture of small clear specimens tested in the green state, that is, more than 25 percent moisture content:

- | | |
|------------------|---|
| <i>Group A -</i> | Very strong timber having a modulus of rupture in bending of 85 N/mm ² and over, represented by sal. |
| <i>Group B -</i> | Strong timber having a modulus of rupture in bending of 65 to 85 N/mm ² , represented by teak. |
| <i>Group C -</i> | Moderately strong timber having a modulus of rupture in bending of 45 to 65 N/mm ² , represented by chir. The species of timber recommended for wood poles categorized into the three groups are given in Table 1. |

3. Classification — The wood poles shall be classified in seven classes based on strength (see Note). The dimensions of different classes categorized into three groups *see* 2 are given in Table 2.

Note -

- | | |
|------------------|--|
| <i>Class 1 —</i> | Ultimate breaking load not less than 13500 N. |
| <i>Class 2 —</i> | Ultimate breaking load not less than 11000 N and not more than 13500 N. |
| <i>Class 3 —</i> | Ultimate breaking load not less than 8 500 N and not more than 11 000 N. |
| <i>Class 4 —</i> | Ultimate breaking load not less than 7 000 N and not more than 8 500 N. |

Class 5 - Ultimate breaking load not less than 5 500 N and not more than 7 000 N.

Class 6 - Ultimate breaking load not less than 4 000 N and not more than 7 000 N.

Class 7 - Ultimate breaking load not less than 3 000 N and not more than 4 000 N.

4. General Requirement—After the poles are felled, their butts shall be sawn square. The bark shall be completely removed and all the branch shall be dressed down flush with the stem. The tops shall be levelled in the shape of an inverted 'V' for length equal to top diameter or 100 mm which ever is less.

5. Preliminary Treatment— Shall be given as soon as possible, a prophylactic treatment to prevent insect attack and fungal damage.

6. Preservative Treatment — Shall be treated with a preservative so as to impregnate completely the sapwood and as much of heartwood of non-durable species as possible.

7. Defects

7.1 Defects Totally Prohibited — Decay, Hollows in the top, cross breaks and large holes.

7.2 Defects permitted to a limited extent—splits, checks, hollow heart, rot, ring shake, grain, insect damage, knots, scars, shape and straightness and short crook (*see* 10.3 of the standard).

Table 2 Classes of Wood Pole

Full length Ground Line of Pole Position from Butt End		Minimum Circumference at Ground Line Position Indicated in Col 2																				
		Class 1, Group			Class 2, Group			Class 3, Group			Class 4, Group			Class 5, Group			Class 6, Group			Class 7, Group		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
m		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
6.0	1.2	600	630	700	550	580	650	500	530	600	480	500	550	440	460	510	430	450	500	400	410	450
7.0	1.2	630	670	740	600	630	700	550	570	640	510	530	600	470	500	550	460	480	530	420	440	490
7.5 & 8.0	1.5	660	700	780	630	660	730	570	600	670	540	560	630	490	520	570	480	500	560	440	460	510
9.0	1.5	700	740	820	660	700	760	600	630	700	560	590	660	520	540	600	500	530	590	460	480	530
10.0	1.8	730	760	840	680	720	780	620	650	720	580	610	680	640	560	620	520	550	610	480	500	530
12.0	1.8	780	820	920	730	760	850	670	700	780	630	660	720	580	610	660	560	590	650	510	540	590
14.0	2.0	830	870	960	780	810	900	710	750	830	670	700	780	620	650	710	600	630	690	540	570	630
Minimum circumference at Top for All Heights in mm		500	520	570	430	460	510	410	430	480	360	380	420	300	320	350	290	310	340	260	280	300
For detailed information, refer to IS 876: 1992 Specification for wood poles for overhead power and Telecommunication lines (Third Revision).																						

SUMMARY OF
IS 1326 : 1992 NON-CONIFEROUS SAWN TIMBER
(BAULKS AND SCANTLING)
(Second Revision)

1. Scope— Covers the requirements of non-coniferous sawn timber in the form of baulks and scantling.

2. Species— Refer to **Annex A** and **Annex B** of the standard for the species of timber covered.

3. Dimensions and Measurements

3.1 The sawn timber is generally available in the following lengths and cross sections:

Length— 1 m, 1.5 m, 2.0 m, 2.5 m, 3.0 m, and 3.5 m

Cross Section—

200 mm × 100 mm,	200 mm × 125 mm
200 mm × 150 mm,	200 mm × 200 mm
250 mm × 125 mm,	250 mm × 150 mm, and
300 mm × 150 mm.	

3.2 Length — The length shall be measured from end to end in metres correct to 0.01 m. Any end portion of sawn timber that has become rounded or damaged shall be excluded from length measurement.

Width and Thickness — The width and thickness shall be measured at the narrowest place in millimetre correct to 10 mm.

Volume — The volume shall be computed in cubic metres correct to three places of decimal by the product of length, width and thickness on the basis of accepted sizes.

4. Requirements and Grading

4.1 Requirements — Timber shall be air-seasoned to a moisture content not exceeding 20 percent within a depth

of 13 mm from the surface, excluding 300 mm from each end.

Timber shall be either sawn or axe-hewn. Any axe-hewn timber shall be reasonably even. All pieces shall have fairly straight and parallel sides and rectangular cross sections.

4.2 Grading — The non-coniferous sawn timber shall be of three grades, that is, special grade, Grade 1 and Grade 2, depending upon prohibited and permissible defects.

5. Prohibited and Permissible Defects

5.1 Prohibited Defects — The sawn timber of all the three grades shall be free from spiral or twisted grain, warp, anykind of decay or live insect attack. Special grade sawn timber shall be free from centre heart, wane, cup shakes, borer holes (dead infestation), sapstain (blue stain) and knots also. Grade 1 shall be free from cup shakes also.

5.2 Permissible Defects — Refer to Table 1 of the standard

6. Treatment — Prophylactic treatment is optional.

7. End Coatings — To prevent and to minimize end cracking splitting, etc, the ends of each baulk and scantling, up to a distance of 150 mm, or at least 25 mm more than the length of larger split (whichever is more) shall be adequately coated with any of the materials mentioned in IS 1141 : 1993*.

* Code of practice for seasoning of timber (*second revision*).

Note — For method of measurement of defects in timber refer to IS 3364 (Part 2) : 1976 Method of measurement and evaluation of defects in timber. Part 2 Converted timber (*first revision*).

For detailed information, refer to IS 1326 : 1992 Non-coniferous sawn timber (baulks and scantlings) (Second Revision).

SUMMARY OF

IS 1331 : 1971 CUT SIZES OF TIMBERS

(Second Revision)

1. Scope — Covers specification of converted timber normally stocked in timber depot both for structural and non-structural purposes. It refers to cut sizes of timber as stocked and does not take into consideration any reduction or allowance relating to subsequent use.

2. Dimensions and Tolerances

2.1 Cut sizes of timber shall be grouped in terms of width and thickness or sectional area into four groups, namely, (a) batten, (b) plank, (c) scantling, and (d) baulk.

The nominal sizes of width and thickness of cut sizes of timber shall be as given in Table 1.

The sizes of cut timber specified in Table 1 are at a moisture content of 20 percent. A method for adjustment of dimensions at different moisture contents is given in Appendix A of the standard.

2.2 Length — The preferred length of cut sizes of timber shall be 50 cm and upwards in steps of 10 cm.

2.3 The measurement of length, width and thickness of cut sizes of timber shall be made on mid line of the surface on which it is measured.

2.4 Tolerance — Permissible tolerances on cut sizes of timber shall be as follows:

- a) For width and thickness
 - 1) Up to and including 100 mm \pm_0^3 mm
 - 2) Above 100 mm \pm_3^6 mm
- b) For length \pm_0^{25} mm

3. Grading of Cut Sizes of Timber — Cut size of timber shall be graded after seasoning at a moisture content not less than 12 percent.

3.1 Grading for Structural Use — Based on permissible and prohibited defects the cut sizes of timber for structural use

- a) *Grade 1* — The estimated effect in reduction of the basic strength of timber is not more than 12.5 percent.
- b) *Grade 2* — The estimated effect in reduction of the basic strength of timber is not more than 25 percent.
- c) *Grade 3* — The estimated effect in reduction of the basic strength of timber is not more than 37.5 percent.

TABLE 1 SIZES OF CUT TIMBER FOR STOCKING PURPOSES

All measurements in centimetres.

Thickness	Width															
1.0	4.0	5.0	6.0	8.0	10.0	12.0	—	—	—	—	—	—	—	—	—	—
1.5	x	x	x	x	x	x	14.0	16.0	18.0	—	—	—	—	—	—	—
2	x	x	x	x	x	x	x	x	x	20.0	22.0	24.0	—	—	—	—
2.5	x	x	x	x	x	x	x	x	x	x	x	x	26.0	28.0	30.0	—
3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6	—	—	—	x	x	x	x	x	x	x	x	x	x	x	x	x
8	—	—	—	x	x	x	x	x	x	x	x	x	x	x	x	x
10	—	—	—	—	x	x	x	x	x	x	x	x	x	x	x	x
12	—	—	—	—	—	x	x	x	x	x	x	x	x	x	x	x
14	—	—	—	—	—	—	—	x	x	x	x	x	x	x	x	x
16	—	—	—	—	—	—	—	x	x	x	x	x	x	x	x	x
18	—	—	—	—	—	—	—	—	x	x	x	x	x	x	x	x
20	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—

x = preferred size of the width

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3.2 Grading for Non-Structural Use — Based on permissible and prohibited defects cut sizes of timber for non-structural use shall be of two grades, namely, Grade 1 and Grade 2.

4. Defects

4.1 Structural Use

Defects Prohibited — Loose grains, splits, compressive wood in coniferous timber, heart wood rot, sap rot, warp, worm holes made by powder post beetles and pitch pockets shall not be permitted.

Permissible Defects – Defects to the extent specified in Table 2 of the standard shall be permissible

4.2 Non-Structural Use

Defect Prohibited – Heart wood rot, sap rot, brashness, shanks, insect attack shall not be permitted.

Permissible Defect – Defects to the extent specified in Table 3 of the standard shall be permissible.

For detailed information, refer to IS 1331 : 1971 Specification for cut sizes of timbers (second revision).

SUMMARY OF
IS 2372 : 2004 TIMBER FOR COOLING TOWERS
(First Revision)

1. Scope — Covers the species, grades, requirements and treatments for timber used in the construction of cooling towers.

2. Species of Timber — The species of timber suitable for cooling towers shall be as given in Table 1.

Table 1 Timbers for Cooling Towers

	<i>Botanical Name</i>	<i>Trade Name</i>
1.	<i>Abies pindrow</i>	Fir
2.	<i>Cedrus deodara</i>	Deodar
3.	<i>Picea smithiana</i>	Spruce
4.	<i>Pinus kesiya</i>	Khasi pine
5.	<i>Pinus roxburghii</i>	Chir
6.	<i>Pinus wallichiana</i>	Kail
7.	<i>Tectona grandis</i>	Teak
8.	<i>Pseudotsuga taxifolia</i>	Douglas fir
9.	<i>Pinus radiata</i>	Radiata pine

3. Grading of Timber

3.1 Colling tower timbers shall be of three grades, namely, select grade, Grade I and Grade II depending on the defects permitted.

3.2 Prohibited Defects (for All Grades) — Timber with loose grain, reaction wood, heartwood, rot warp, worm holes which are likely to affect strength, pitch pockets, centreheart (pith), shakes twisted grain and wane.

3.3 Permissible Defects — The defects to the extent specified in Table 2 of the standard for different grades of timber shall be permissible.

4. Dimensions and Tolerances

4.1 Nominal sizes, rough and finished dimensions for various thicknesses are given in Table 2.

4.2 $A \pm 5$ mm tolerance in length shall normally be permissible. In other dimensions, no minus tolerances shall be permitted but a maximum plus tolerance of 2 mm shall be permitted.

Table 2 Nominal and Dressed Dimensions

Nominal rough thickness or width, in mm –	25 32 38 50 75
	over 100
Minimum rough sawn thickness or width, in mm –	23 30 35
	47.5 72.5 off 5
Dressed thickness or width, in mm –	21 27 32 45 70 off 10

5. Treatment

5.1 Following treatments are recommended—

- The structural members and the shell members are to be treated to a net retention of 12 kg/m³ of timber with copper-chrome arsenic (CCA) or acid-copper-chrome (ACC) or 16 kg/m³ of copper-chrome boron (CCB) or 128 kg/m³ of creosote/fuel oil mixture.
- Fill is to be treated under pressure with a minimum average retention of 16 kg/m³ of timber with copper-chrome-arsenic (CCA) or acid-copper-chrome (ACC) or with 20 kg/m³ of copper-chrome boron (CCB) or with 160 kg/m³ of creosote/ fuel oil mixture

5.2 Penetration of Preservatives

The depth of penetration of the preservative shall be as given in Table 3.

Table 3 Depth of Penetration of Preservative in Different Species of Timber

<i>Timber Species</i>	<i>Depth Minimum</i>	
	<i>Sapwood</i>	<i>Heartwood</i>
<i>Abies pindrow</i>	100%	5* mm
<i>Cedrus deodara</i>	100%	10 mm
<i>Picea smithiana</i>	100%	5* mm
<i>Pinus kesiya</i>	100%	20 mm
<i>Pinus roxburghii</i>	100%	20 mm
<i>Pinus wallichiana</i>	100%	10 mm
<i>Tectona grandis</i>	100%	Needs no treatment
Douglas fir	100%	5* mm
Radiata pine	100%	20 mm

* For structural members incision of about 15 mm should be made on all surfaces (except end) to achieve the required absorption.

For detailed information, refer to IS 2372:2004 Specification for timber for cooling towers (Second revision).

SUMMARY OF
IS 3337 : 1978 BALLIES FOR GENERAL PURPOSES
(First Revision)

1. Scope — Covers the requirements of BALLIES used for general purposes.

2. Species of Timber — The species of timber suitable for BALLIES are given in Appendix A of the standard.

3. Manufacture — Bark shall be completely removed and all the branches and excrescences shall be dressed down flush with the surface. The top and bottom ends shall be cut square.

4. Dimensions — BALLIES shall conform to the dimensions given below; unless otherwise ordered.

<i>Class of Ballies</i>	<i>Diameter at the Top</i>	<i>Diameter at the Butt End</i>	<i>Length</i>
	cm	cm	m
1 Over	8.5 upto 12.5	Over 15 upto 20	3 to 9
2 Over	6.5 upto 8.5	Over 11.5 upto 15	3 to 9
3 Over	5 upto 6.5	Over 7.5 upto 11.5	3 to 9

5. Requirements — BALLIES shall be air-dried to a moisture content not exceeding 20 percent within a depth of 12 mm from the surface when measured at one third length of the Ballies from its butt end. Shall be reasonably straight, and shall be free from cuts across the grain, live insect attack, any kind of decay (rot), pronounced spiral or twisted grain, hollow heart and dead knots exceeding 5 cm in diameter.

6. Permissible Defects

6.1 Surface Cracks

6.2 End Cracks

6.3 Spiral or Twisted Grain

6.4 Curvature

6.5 Short Crooks

6.6 Pin Hole (Dead Infestation) — For extent of defects permitted, refer to 7 of the standard.

7. Measurements

7.1 Length — Shall not be more than 7.5 cm shorter or more than 15 cm longer than the 'ordered' length.

7.2 Diameter — The top and butt end diameters shall be measured at the extreme ends.

8. Preservation — Whenever required shall be preserved by dipping, brushing or spraying with any one of the following compositions:

- a) Creosote — fuel oil mixture 50:50,
- b) 6 percent solution of copper-arsenic composition,
- c) 6 percent solution of acid-cupric-chromate composition,
- d) 8 percent solution of copper-chrome-boric composition, and
- e) 1.0 percent solution of sodium pentachlorophenate.

For detailed information, refer to IS 3337: 1978 Specifications for ballies for general purposes.

SUMMARY OF
IS 3629 : 1986 STRUCTURAL TIMBER IN BUILDINGS
(First Revision)

1. Scope — Covers the various requirements of structural timber for use in buildings. It includes classification and grouping of different species of timber, their suitability for permanent and temporary structures, factors affecting strength, tolerances on dimensions, influence of defects and allowance for such defects in timber.

2. Material

2.1 The species of timber recommended for various construction purposes are given in Table 1.

2.2 Based on permissible defects, cut sizes of structural timbers are classified in three grades, namely, select grade, Grade I and Grade II, materials may be structural rejects, not suitable for structural members.

2.3 Moisture content of timber for various situations of buildings in different climate zones of the country shall conform to the requirement of IS 287: 1993*

3.0 Suitability for a given purpose depends on —

- a) Durability and treatability of species .
- b) Strength characteristics of the species, and
- c) Grading in respect of freedom from defects.

3.1 *Suitability in Respect of Durability and Treatability for Permanent Structures.*

3.1.1 *First choice* — The species shall be of any one of the following categories —

- a) Untreated heartwood of high durability as listed in Table 1. Heartwood of these species of timber, if containing more than 15 percent sapwood, needs treatment for protection.
- b) Treated heartwood of moderate and low durability and Class ‘a’ and Class ‘b’ treatability as listed in Table 1.
- c) Heartwood of moderate durability and Class ‘c’ treatability after pressure impregnation

3. Suitability and Grouping

TABLE 1 GROUPING OF TIMBERS FOR STRUCTURAL USE

<i>Species for Permanent Structures</i>		<i>Species for Temporary Structure or Semi Structural Use</i>
<i>First Choice</i>	<i>Second Choice</i>	
Group A — Ping	Dhaman (Madras)	Red Kutch (Lal Khair), Bruguira, (Mangrove) Chooi Padri (MADRAS)
Group B — Babul, Haldu, Karani Hollong, Myrobalan (Harda), Black chuglam,	Maniawaga Dhaman (West Bengal, Gurjan, Oak (West Bengal) Kusum (Bihar), Behera	Safed Khair, Mundani, Aglaia, Yon, Jungli, Nimbo, Jutili, Amari, Dhup, Kasood, Casuarina, Poon, Chestnut, Satin-Wood, Paili, Tali, Ebony, Gurjar, Eucalyptus, Pipili, Ash, Lendi Machilus, Sianohor (kayea) Karol, Bola Assam, red bombeve, Oak (Meghalaya), Hoom, Narikel, Jamen, White chuglam and Bhendi.
Group C — Haldu, Kadam, Indian Chestnut (West Bengal) Toon, Chickrassy, Dillenia, Kanju, Mango, aam, Kaim, Bonsum, Chir, Kail, Oak (Nefa) Arjun, Whitehollock, and White bombeve		Hiwar, Blackwood, Black wattle Mapie, Bael, Horse chentnut, Gokul, Kardhai, Supari, Birch uriam (Bishop-wood) , Tad (Palm), Muntenga, Poone, Dhuna, Coconut, Dillenia Ebony Lampathi, Rudrakshi, Mysore-gum Gardenia, Palang, Walnut, Eucalyptus. Jarul, Jhingan, Banati, Subabul, Machilus, Champ, Raini, Neem, Domsal, Mulberry, Tooli, Pohu, Khasipine, Klaskar, Singhi Debdaru, Arupati, Hathipaila, Thitmin, Vedankonnai, Chilauni, Makai, Padriwood, , Yew Imli and vellapine

* Permissible moisture content for timber used for different

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as listed in Table 1.

- d) Sapwood of all classes of ability after through treatment with preservatives.

Note — All such species which can be adequately treated to desired retention of preservative may be used.

3.1.2 Second choice — The species shall be heartwood of moderate durability and Class 'd' treatability. Small thicknesses up to 60 mm when treated under pressure impregnation, shall be used for components under cover and out of contact with ground. Such timbers are listed in col 3 of Table 1.

3.1.3 Suitability in Respect of Durability and Treatability for Temporary Structures and for Semi-Structural Uses — Heartwood of low durability and Class 'e' treatability or the species whose durability and/or treatability is yet to be established may be used where life of the structure is not primary consideration. Such timbers are listed in col 4 of Table 1.

3.2 Grouping —

Groups	Modulus of Elasticity (E) N/mm ²	Limit (Ft) N/mm ²
A	Above 12, 600	18.0
B	Above 9, 800 and upto 12, 600	12.0
C	Above 5, 600 and upto 9, 800	8.5

4. Permissible Stresses — See Table 2

4.1

TABLE 2 FACTORS OF SAFETY TO BE APPLIED TO BASIC STRESS TO OBTAIN SAFE PERMISSIBLE STRESS.

Sl No.	Types of Stress	Grade 1		
		(Standard Location)		
		Inside	Outside	Wet
(1)	(2)	(3)	(4)	(5)
i)	Extreme fibre in beams for broad leaved species. <i>Min</i>	5	6	7.5
ii)	Extreme fibre stress for beams in conifers	6	7	8.5
iii)	Shear along grain	7	7	7
iv)	Horizontal shear in beams	10	10	10
v)	Compressive stress parallel to grain	4	4.5	5.5
vi)	Compressive stress perpendicular to grain	1.75	2.25	2.75

4.2 For other grades permissible stresses given in IS 883 : 1994 shall be multiplied by

a) For select grade timber	1.16
b) For Grade II timber	0.84

5. Dimensions and Tolerances

5.1 Sawn Timber — The cut sizes of timber for Structural purposes and the tolerance shall be those as given in IS 4891: 1988^{*} except where net dimensions are specifically mentioned

Permissible tolerances in measurements shall be as follows —

a)	For measurements up to and including 100 mm in width or thickness	— 0 mm + 3 mm
b)	For measurements above 100mm in width or thickness	— 3 mm + 6 mm
c)	For measurements of all sizes in length	— 0 mm + 10 mm

6. Defects

6.1 Prohibited Defects

- Timber with loose grain, splits, compression wood in coniferous structural timber, heart wood rot and sap rot and crookedness.
- Worm holes made by powder post beetles and pitch pockets.

6.2 Permissible Defects

- Wanes are permitted provided they are not combined with knots and the reduction in strength on account of the wanes is not more than the reduction with the maximum allowable knots. Wanes may also be permitted provided there is no objection to its use as bearing area nailing edge and affects general appearances
- Worm holes other than those due to powder post beetles located and grounded to reduce the strength of timber shall be evaluated in the same way as knots; and
- All other defect which do not affect any of the mechanical properties of timber shall be permitted.

^{*} Design of structural timber in building (fourth revision).

[#] Preferred cut sizes of structural timber (first revision).

For detailed information, refer to IS 3629 : 1981 Specification for structural timber in buildings (first revision).

SUMMARY OF
IS 3731 : 1985 TEAK SQUARES
(First Revision)

1. Scope — Covers the requirements of various grades of teak squares based on defects.

2. Grades

Grade 1 — No single square shall contain more than 2.0 units of defects and the average for the whole consignment shall be not more than 0.75 units of defects.

Grade 2 — No single square shall contain more than 4.0 units of defects and the average for the whole consignment shall not be more than 1.5 units of defects.

Grade 3 — No single square shall contain more than 6.0 units of defects and the average for the whole consignment shall not be more than 3 units of defects.

For squares more than 5m in length the above limits shall be derived by the following equation—

Permissible number of defects in squares

more than 5m in length — $L/5 \times \text{Permissible defect value according to grade.}$

where L — *length of squares in m. The value derived shall not exceed twice the number of units of defects permitted for each grade.*

3. General Requirements—Teak squares shall be either sawn or hewn to a reasonable evenness. All pieces shall have fairly straight and parallel sides with the planes of end-sections fairly perpendicular to the planes of the

side surfaces. All squares shall be of good sound wood and free from defects other than those permitted

Plugging or covering of the visible defects shall not be permitted in any form. All pieces shall be air-seasoned to a moisture content not exceeding 20 percent up to a depth of 15 mm from any portion of the surface excluding 30 cm from each end.

4. Dimension and Their Measurements—All cross-sectional measurements shall be made at mid length of the teak square correct to 0.5 cm. Length shall be measured from end to end correct to the nearest lower 0.05m at the corners of the ends, the shortest length parallel to longitudinal edges shall be taken as the length of the teak square. The volume of any piece shall be computed in m³ to the nearest third decimal place.

5. Permissible Defects and Their Evaluation

5.1 Curvature

5.2 Taper

5.3 Wane

5.4 Knots

5.5 Holes

5.6 Shakes

5.7 Checks and Splits

5.8 Other Defects—For extent of defects permitted, refer to 6 of the standard

Note —For methods of measurement and evaluation of defects in timber, refer to IS 3364 (Part 2) : 1976 Methods of measurement and evaluation of defects in timber Part 2 Converted timber (*first revision*).

For detailed information refer to IS 3731 : 1985 Specification for teak squares (first revision).

SUMMARY OF
IS 4891 : 1988 PREFERRED CUT SIZES OF STRUCTURAL TIMBER
(First revision)

1. Scope — Covers preferred cut sizes of timber for use in the following units:

- a) Roof trusses,
- b) Roof purlins, rafters, floor beams, etc;
- c) Partitions framing, covering;
- d) Centering; and
- e) Door / window/ventilators

sizes shall be the same as for partition framing covered in Table 3.

3. Tolerances

- a) (i) For measurement
up to 100 mm 0 to +3mm
- (ii) Measurement
above 100 mm – 3 to + 6 mm
- b) Length for all sizes 0 to +10 mm

2. Preferred Sizes — Preferred cut sizes shall be as covered in Tables 1 to 4. For centering the preferred

TABLE 1 PREFERRED CUT SIZES OF STRUCTURAL TIMBERS FOR ROOF TRUSSES

(Span from 3 to 20 meters)

Thickness in mm	Width in mm							
20	40	50	60	80	100	—	—	—
25	40	50	60	80	100	120	140	160
30	40	50	60	80	100	120	140	160
35	—	—	60	80	100	120	140	160
40	—	—	60	80	100	120	140	160
50	—	—	60	80	100	120	140	160
60	—	—	—	80	100	120	140	160
80	—	—	—	—	100	120	140	160

Note1 — For truss spans marginally above 20 m, preferred cut sizes of structural timber maybe allowed.

Note2 — Preferred length of timber : 1, 1.5, 2, 2.5 and 3 m.

**TABLE 2 PREFERRED CUT SIZES OF STRUCTURAL TIMBER FOR
ROOF PURLINS, RAFTERS, FLOOR BEAMS, ETC**

Thickness in mm	Width in mm							
50	80	100	120	140	—	—	—	—
60	80	100	120	140	160	—	—	—
80	—	100	120	140	160	—	—	—
100	—	—	—	140	160	180	200	—

Note— Preferred length of timber: 1.5, 2, 2.5 and 3 m.

TABLE 3 PREFERRED CUT SIZES OF STRUCTURAL TIMBER FOR PARTITION FRAMING AND COVERING

Thickness in mm	Width in mm								
10	40	50	60	80	—	—	—	—	—
15	40	50	60	80	100	—	—	—	—
20	40	50	60	80	100	120	160	200	—
25	40	50	60	80	100	120	160	200	240
30	40	50	60	80	100	120	160	200	240
40	40	—	60	80	100	120	160	200	240
50	—	50	—	80	100	120	160	200	240
60	—	—	60	80	100	120	160	200	240
80	—	—	—	80	100	120	160	200	240

Note — Preferred length of timber : 0.5, 1, 1.5, 2, 2.5 and 3 m.

TABLE 4 PREFERRED CUT SIZE OF TIMBER FOR DOOR/ WINDOW VENTILATOR COMPONENTS

Thickness	Width in mm														
in mm															
15	—	—	—	—	—	—	—	—	—	—	160	180	200	220	240
20	—	—	—	—	50	60	80	100	—	—	—	—	—	—	—
25	25	—	—	—	50	60	80	100	—	—	—	—	—	—	—
30	—	30	—	—	50	60	80	100	—	—	—	—	—	—	—
35	—	—	35	—	50	60	80	100	—	—	160	—	—	—	240
40	—	—	—	40	50	60	80	100	—	—	160	—	—	—	240
50	—	—	—	—	—	—	80	100	120	—	—	—	—	—	—
60	—	—	—	—	—	—	—	100	120	140	—	—	—	—	—

Note— Preferred timber lengths (wall opening module of 100 mm) for frames— 590, 790, 890, 990, 1 190, 1 290, 1 990 and 2090 mm. Preferred timber length for shutters— 460, 500, 700, 800, 900, 1 100, 1 200, 1 905 and 2 005 mm

Tolerances in door/window/ventilator components shall be permissible as under —

- a) Frames ± 3 mm
- b) Shutters
- 1) Doors
 - i) Width ± 3 mm
 - ii) Thickness ± 1 mm
- No tolerance for panels
- 2) Window/ventilators, etc
 - Width 40 mm and less ± 1 mm
 - Above 40 mm ± 3 mm

Cut sizes of timber as stocked and specified in tables are normal at moisture content of 20 percent. But at the time of fabrication and erection, the timber members are required to possess 12 to 20 percent of moisture content of the oven-dry weight. Thus a lateral shrinkage effect in the stocked sizes of timber will take place and, therefore, the ultimate shrinkage to which the timber will be subjected to has got to be compensated at the time of converting the timber at 20 percent moisture content for stocking purposes.

For detailed information, refer to IS 4891 : 1988 Specification for preferred cut sizes of structural timber (first revision).

SUMMARY OF
IS 4895 : 1985 TEAK LOGS
(First Revision)

1. Scope — Covers the requirements of various grades of teak logs intended for conversion purposes. It does not cover the requirements of teak logs for veneering purposes.

2. General Requirements — The logs shall be free from hollow heart, shatter, any kind of decay (rot) and live insect attack.

All buttresses, remnants of branches and large knots shall be trimmed flush with the bole of log. The two ends should be clean-cut with a saw and shall be as close to the plane at right angles to the axis as possible.

Plugging or covering of the visible defects shall not be permitted in any form.

3. Permissible Defects

3.1 *Curvature*

3.2 *Shakes*

3.3 *Flutes*

3.4 *Knots*

3.5 *Check and Splits*

3.6 *Twist*

3.7 Holes — For extent of defects permitted refer to 4 of the standard.

4. Grades — The logs of 2.5 m length shall be graded as below depending on cumulative value of the permissible defects:

Grade 1 — No single log shall contain more than 2.5 units of defects.

Grade 2 — No single log shall contain more than 5 units of defects

Grade 3 — No single log shall contain more than 7.5 units of defects

For logs more than 2.5 m in length, the limits given above shall be derived by the following equation;

Permissible number of defects in logs more than 2.5 m

$$\text{in length} = \frac{L}{2.5} \times P$$

Where

L — length of log in m, and

P — permissible defect value for 2.5 m in length.

5. Dimensions — The minimum dimensions of the logs shall be the following

Length — 2.5 m

Mid – girth — 1 m

Note — For method of measurement of defects in timber, refer to IS 3364 (Part 1) : 1976 Methods of measurement and evaluation of defects in timber Part 1 Logs (first revision).

For detailed Information, refer to IS 4895 : 1985. Specification for Teak logs (first revision)

SUMMARY OF
IS 5246 : 2000 CONIFEROUS LOGS
(First revision)

1. Scope — Covers the requirements of three grades of coniferous logs, that is, Grade 1, Grade 2 and Grade 3, for conversion into timber.

2. Grades

<i>Grade 1</i> —	6 minor defects or 2 major and 2 minor defects.
<i>Grade 2</i> —	9 minor defects or 3 major and 3 minor defects.
<i>Grade 3</i> —	12 minor defects or 3 major and 6 minor defects.

3. Species—The logs shall be of the species of timber listed below—

<i>Trade Name</i>	<i>Botanical Name</i>	<i>Abbreviation</i>
Fr	<i>Abies pindrow</i> Royale	FIR
Deodar	<i>Cedrus deodara</i> D.Don	DEO
Cypress	<i>Cupressus torulosa</i> D.Don	CYP
Spruce	<i>Picea Smithiana</i> Boiss	SPR
Kail	<i>Pinus excelsa</i> Wall	KAL
Khasi Pine	<i>Pinus Khasya</i> Royle	KPI
Chir	<i>Pinus Roxburg</i> Sargent	CHR

4. Dimensions

Minimum length	2.5 m
Minimum mean mid-girth	1 m

5. Requirements — The logs shall be free from hollow centre above 15 percent of the basal area of the

log, spiral grain, any kind of decay (rot), insect attack and any other defects (except those permitted in 6 below). The hollow centre throughout the length of the log shall not be permitted.

6. Permissible Defects

6.1 *Lack of Straightness*

6.2 *Taper*

6.3 *End Splits*

6.4 *Surface Cracks*

6.5 *Cup Shakes*

6.6 *Knots*

6.7 *Hollow Centre*

6.8 *Wounds* - For extent of defects permitted, refer to 8 of the standard

7. End Coating — Shall be adequately coated, up to a distance of at least 125 mm, with any of the materials mentioned in IS 1141 : 1993*. Application of end coating on the logs shall be done soon after the inspection of the log.

*Code of practice for seasoning of timber (*second revision*).

For detailed Information, refer to IS 5246 : 2000 Specification for coniferous logs first revision

SUMMARY OF

IS 6056 : 1970 JOINTED WOOD POLES FOR OVERHEAD
POWER TELECOMMUNICATION LINES

1. Scope — Covers the specification of jointed wood poles made of both broad leaved, and coniferous species of timber, grown in India, and suitable for carrying overhead electric power transmission lines, telephone and telegraph circuits.

2. Species of Timber — Three groups, based on the modulus of rupture of small clear specimens tested in the green condition, that is more than 25 percent moisture content. (see Appendix A of the standard).

Group A Very strong timbers having a modulus of rupture in bending of 850 kg/cm² and above, represented by sal.

Group B Strong timbers having a modulus of rupture in bending of 630 to 850 kg/cm², represented by teak.

Group C Moderately strong timbers having a modulus of rupture in bending 450 to 630 kg/cm², represented by chir.

3.1 Classification

Class 1 Ultimate breaking load not less than 1 350 kg.

Class 2 Ultimate breaking load not less than 1 100 kg and not more than 1 350 kg.

Class 3 Ultimate breaking load not less than 850 kg and not more than 1 100 kg.

Class 4 Ultimate breaking load not less than 700 kg and not more 850 kg.

Class 5 Ultimate breaking load not less than 550 kg and not more than 700 kg.

Class 6 Ultimate breaking load not less than 400 kg and not more than 550 kg.

Class 7 Ultimate breaking load not less than 300 kg and not more than 400 kg.

The above loads are assumed to be applied at a distance 60 cm from the top of the jointed pole.

3.2 Dimensions — See Table 1**3. Classification and Dimensions**

TABLE 1 DIMENSION OF THE JOINTED WOOD POLES																								
Overall Height of Full Length of Wood Poles	Groundline Position From Butt End of lower Component	Minimum Circumference at Ground LinePosition Indicated in Col. 2 for the Lower Components																						
		Class 1 Group			Class 2 Group			Class 3 Group			Class 4 Group			Class 5 Group			Class 6 Group			Class 7 Group				
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C		
		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)		
		m	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)		
m	m	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm		
6	1.2	62	65	72	60	63	70	55	58	65	50	53	60	48	50	55	46	48	50	44	46	48		
7	1.2	65	69	76	63	67	74	60	63	70	55	57	64	51	53	60	48	50	52	46	48	50		
7.5 and 9	81.5	68	71	80	66	70	78	63	66	73	57	60	67	54	56	63	51	53	55	48	50	52		
	1.5	72	76	84	70	74	82	66	70	76	60	63	70	56	59	66	53	56	59	50	53	56		
10	1.8	73	78	86	73	76	84	68	72	78	62	65	72	58	61	68	55	58	61	52	55	58		
12	1.8	78	84	94	78	82	92	73	76	85	67	70	78	63	66	72	58	61	63	53	56	59		
14	2.0	83	89	98	83	87	96	78	81	90	71	75	83	67	70	78	61	64	67	56	59	62		
Minimum circumference at top of upper component for at heights in cm		50	52	57	43	46	51	41	43	48	36	38	42	30	32	35	29	31	34	26	28	30		

Note — The circumferences for different species at the joints of the components are covered under 8.1.1 and 8.1.2, of the standard and the length of the components are covered under individual types of joints. For poles of intermediate length in Table 1, the circumferences given for the next larger pole shall be used

4. Preparation of Components of Jointed Poles—The bark of the components shall be completely removed and all the branches shall be dressed down flush with the stem. The tops of the upper components shall be bevelled in the shape of an inverted ‘V’ for a length equal to top diameter or 10 cm whichever is less.

5. Preliminary Treatment— A prophylactic treatment shall be given.

6. Preservative Treatment — Shall be treated with a preservative so as to impregnate completely the sapwood and as much of heartwood of non-durable species as possible.

7. General Requirements — As far as possible the upper and lower sections shall be of the same species or at least species of the same group. Jointing sections belonging to species of different groups is not recommended. The sections being jointed shall have approximately same girth at the joint.

8. Defects

For detailed information, refer to IS 6056 : 1970 Specification for jointed wood poles for overhead power telecommunication lines.

8.1 Defects Totally Prohibited

- a) Sap rot,
- b) Hollows in the top,
- c) Cross breaks,
- d) Large holes, and
- e) Short crooks

8.2 Defects Permitted to a Limited Extent—Dead streaks, Decay, Spilt or checks, Hollow heart, Rot, Ring shake, grain, insect damage, knots, sears, Shape and straightness .

For extent of defects permitted refer to **10** of the standard.

9. Types of Jointed Poles

- a) Wire bound lap jointed poles
- b) Z-Type lap jointed poles
- c) V-Type lap jointed poles
- d) Angle iron butt jointed poles
- e) Half — Sleeve Half - lap jointed poles
- f) Half — Sleeve Tongue and Groove jointed poles

Note — For details refer to **11** of the standard

SUMMARY OF
IS 7308 : 1999 NON-CONIFEROUS LOGS
(First Revision)

1. Scope — Covers the requirements of three grades of non-coniferous logs, for conversion into sawn timber.

2. Grades —

Grade I — No single log of length 2.5 m shall contain more than 3 units of defects

Grade II — No single log of length 2.5 m shall contain more than 6 units of defects.

Grade III — No single log of length 2.5 m shall contain more than 9 units of defects.

For logs other than 2.5 m in length, the limits given in above shall be derived by the following equation—
 Permissible number of defect in logs other than 2.5 m in length = $L/2.5 \times P$

Where

L = length of log in m, and

P = permissible defect value for 2.5 m length

3. Species — The logs shall be of the species of timber given in Appendix A of the standard.

4. Dimensions — The minimum dimensions of logs shall be the following :

Length	2.5 m
Mean mid-girth	1 m

5. Requirements — The logs shall not be knobbly. They shall be free from brashness, hollow centre, shatter, spiral grain, any kind of decay (rot), live insect attack and any other defects which may reduce the usefulness of logs for conversion into sawn timber. All buttresses, remnants of branches and large knots shall be trimmed flush with the bole of log. The two ends should be clean cut with a saw and shall be as close to the plane at right angles to the axis as possible.

6. Permissible Defects

6.1 *Bend*

6.2 *Taper*

6.3 *End Splits (Including Heart or Star Shakes)*

6.4 *Surface Cracks*

6.5 *Cup shakes (Including Ring Shakes)*

6.6 *Knots*

6.7 *Wounds*

6.8 *Flutes*

6.9 *Buttress*

6.10 *Twist*

6.11 *Hollow heart*—For extent of defects permitted, refer to 8 othe standard.

7. End Coating — Shall be adequately coated up to a distance of at least 15 cm with any of the materials mentioned in IS 1141 : 1993*.

*Code of Practice for preservation of timber (*third revision*)

For detailed information, refer to IS 7308 : 1999 Specification for non-coniferous logs (first revision).

SUMMARY OF

IS 10394 : 1982 WOODEN SLEEPERS FOR RAILWAY TRACK

1. Scope — Covers the requirements of wooden sleepers and wooden specials used for broad gauge, metre and narrow gauge railway tracks.

2. Timber Species — See Appendix A of the standard for recommended species and their composite sleeper Index (CSI).

3. Dimensions and Tolerances

3.1 Track Sleepers — See Table 1

3.2 Special Sleepers for Bridges and Crossings — See Table 2

4. Preservative Treatment — Sleepers containing sap wood and those without an asterisk mark in Appendix A shall be given preservative treatment.

5. Grading — Class I and Class II, depending on permissible defects. A sleeper shall be classified as of the Class II even if it is of that class in terms of only one defect and is of the Class I in terms of all other defects. Likewise, a sleeper shall be rejected if the permissible range in any one of the defects is exceeded.

Special sleepers shall be of Class I only.

6. Permissible Defects — Refer Table 4 of the standard.

TABLE 1 DIMENSIONS FOR STANDARD TRACK SLEEPERS

Gauge	Length (cm)	Tolerance in Length, %	Cross Sectional Dimensions (cm)	Tolerance in Cross Section, %
Broad gauge (BG)	275	+10, -2.5 }	25 × 13	+10, -5 }
Metre gauge (MG)	180	do }	20 × 11.5	do }
Narrow gauge (NG)	150	do	18 × 11.5	do

TABLE 2 DIMENSIONS FOR SPECIAL SLEEPERS

Gauge	Cross-Section Tolerance in (cm)	Cross-section %	Length (cm)	Tolerance in Length, %
BG	25 × 15	+5 -2.5 }	275, 305, 335 and onwards varying by 30 cm	+5 -1.25 }
	28 × 15	do	do	do
	25 × 18	do	do	do
MG	20 × 13	do	185, 215, 245 and onwards varying by 30 cm	do
	25 × 13	do	do	do
	20 × 15	do	do	do
NG	18 × 13	do	do	do
	20 × 13	do	do	do
	25 × 13	do	do	do

For detailed information, refer to IS 10394 : 1982 Specification for wooden sleeper for railway track

SECTION 7
BITUMEN AND TAR PRODUCTS

CONTENTS

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IS 9912 : 1981	Coal tar based coating materials and suitable primers for protecting iron or steel pipe lines.	7.15

SUMMARY OF
IS 73 : 1992 PAVING BITUMEN
(Second Revision)

1. Scope — Covers physical and chemical requirements of paving bitumens for use in roadways, runways and allied constructions.

2. Types and Grades

a) *Type 1*— Paving bitumen from non-waxy crude; and

b) *Type 2*—Paving bitumen from waxy crude.

2.1 Paving Bitumen Type 1— Shall be classified into six grades according to their penetration and each grade shall be given a designation as given in Table 1 with letter 'S' denoting the type and a numeral representing the mean of the limits of the penetration specified for the grade.

2.2 Paving bitumen Type 2— Shall be classified into four grades according to their penetration and each grade shall be given a designation as given in Table 2 with letter 'A' denoting the type and a numeral representing the mean of the limit of the penetration specified for the grade.

3. Requirements — The material shall be homogeneous and shall not foam when heated to 175°C.

For a given lot under each type the softening point for samples taken from different parts of the lot shall not vary by more than 8°C from maximum to minimum and shall not fall outside the range of the test range of the test limits specified in Tables 1 and 2.

TABLE 1 REQUIREMENTS FOR PAVING BITUMEN TYPE 1

Sl	Characteristics	Requirements for Grades					
		S35 (3)	S45 (4)	S55 (5)	S65 (6)	S90 (7)	S200 (8)
i)	Specific gravity at 27 °C, <i>Min</i>	0.99	0.99	0.99	0.99	0.99	0.99
ii)	Water, percent by mass, <i>Max</i>	0.2	0.2	0.2	0.2	0.2	0.2
iii)	Flash point, cleveland open cup, °C, <i>Min</i>	175	175	175	175	175	175
iv)	Softening point °C	50 to 65	45 to 60	45 to 60	40 to 55	35 to 50	30 to 45
v)	Penetration at 25°C 100g, 5Second., 1/10 mm	30 to 40	40 to 50	50 to 60	60 to 70	80 to 100	175 to 225
vi)	Penetration ratio*, <i>Min</i>	35	35	35	35	35	35
vii)	Ductility at 27 °C, cm, <i>Min</i>	50	75	75	75	75	--
viii)	Paraffin wax content, percent by mass, <i>Max</i>	4.5	4.5	4.5	4.5	4.5	4.5
ix)	Frass breaking point, °C, <i>Min</i>	– 4	– 4	– 6	– 6	– 8	– 10
x)	Loss on heating, in thin film oven test, percent by mass, <i>Max</i>	1	1	1	1	1	2
xi)	Retained penetration after thin film oven test, 25 °C 100g, 5 second, 1/10mm percent of original, <i>Min</i>	55	55	52	52	47	42
xii)	Matter soluble in trichloroethylene percent by mass, <i>Min</i>	99	99	99	99	99	99
xiii)	Viscosity at						
	a) 60°C, Poises	2 500±500	2 000±400	1 500±300	1 000±200	500±100	250±50
	b) 135°C, CSt, Min	220	210	180	150	110	20

$$* \text{ Penetration ratio} = \frac{\text{Penetration at } 4^{\circ}\text{C, 200g, 60s}}{\text{Penetration at } 25^{\circ}\text{C, 100g, 5s}} \times 100$$

TABLE 2 REQUIREMENTS FOR PAVING BITUMEN TYPE 2					
Sl No.	Characteristics	Requirements for Grades			
		A35	A55	A65	A90
(1)	(2)	(3)	(4)	(5)	(6)
i)	Specific gravity at 27°C, <i>Min</i>	0.99	0.99	0.99	0.98
ii)	Water, percent by mass, <i>Max</i>	0.2	0.2	0.2	0.2
iii)	Flash point, Cleveland open cup, °C, <i>Min</i>	175	175	175	175
iv)	Softening point °C	55 to 70	45 to 60	45 to 60	35 to 50
v)	Penetration at 25°C, 100g, 5 sec., 1/10mm	30 to 40	50 to 60	60 to 70	80 to 100
vi)	Penetration ratio*, <i>Min</i>	25	25	25	25
vii)	Ductility at 27°C, cm, <i>Min</i>	10	15	15	15
viii)	Paraffin wax content, percent by mass, <i>Max</i>	10	10	10	10
ix)	Frass breaking point, °C, <i>Min</i>	–4	–6	–8	–10
x)	Loss on heating in thin film oven test, percent by mass, <i>Max</i>	1	1	1	1
xi)	Retained penetration after thin film oven test, 25°C 100 g, 5 second, 1/10 mm percent of original, <i>Min</i>	57	57	47	42
xii)	Matter soluble in trichloroethylene percent by mass, <i>Min</i>	99	99	99	99
xiii)	Viscosity at				
	a) 60°C, Poises	1 000 ±300	400 ±300	300 ±100	200 ±50
	b) 135°C, cost, <i>Min</i>	250	100	70	50

$$\text{*Penetration ratio} = \frac{\text{Penetration at } 4^{\circ}\text{C, 200g, 60s}}{\text{Penetration at } 25^{\circ}\text{C, 100g, 5s}} \times 100$$

Note—For methods of tests, refer to.

IS 1202 : 1978 Methods of testing tar and bituminous material: Determination of specific gravity (*first revision*).

IS 1203 : 1978 Determination of penetration (*first revision*).

IS 1205 : 1978 Determination of softening point (*first revision*).

IS 1206 (Part 2):1978 Determination of viscosity, Part 2 Absolute viscosity (*first revision*).

IS 1206 (Part 3):1978 Determination of viscosity Part 3 Kinematic viscosity (*first revision*).

IS 1208 : 1978 Determination of ductility (*first revision*).

IS 1211 : 1978 Determination of water content (dean and Stark method) (*first revision*).

IS 1212 : 1978 Determination of loss on heating (*first revision*).

IS 1216 : 1978 Determination of solubility in carbon disulphide trichloroethylene (*first revision*).

IS 1448 (Part 69):1969 Methods of tests for petroleum and its products Part 69: Flash and fire point by Cleveland (open) cup

IS 9381:1979 Methods of testing tar and bituminous materials: Determination of FRAASS breaking point of bitumen.

IS 9382 : 1979 Determination of effect of heat and air by thin film oven tests.

IS 10512:1983 Methods for determination of wax content in bitumen.

For detailed information, refer to IS 73:1992. Specification for paving bitumen (second revision).

SUMMARY OF
IS 212 : 1983 CRUDE COAL TAR FOR GENERAL USE
(Second Revision)

1. Scope — Covers the requirements of crude coal tar used for general purposes, such as treatment of wooden poles and sleepers, toilet walls, fishing nets, etc.

2. Composition Shall be obtained as a by product of destructive distillation of coal.

3. Requirements See Table 1

TABLE 1 REQUIREMENTS OF CRUDE COAL TAR

<i>Sl. No.</i>	<i>Characteristics</i>	<i>Min</i>	<i>Max</i>
(1)	(2)	(3)	(4)
i)	Specific gravity 27°C/27°C	1.09	1.24
ii)	Water Content percent/ weight	—	4
iii)	Viscosity BRTA 4mm at 30°Cs,	30	100
iv)	Distillation fractions percent w/w		
	Up to 200°C	—	4
	200 to 230°C	2	10
	230 to 270°C	6	12
	270 to 300°C	4	7
	300 to 350°C	12	17
v)	Mineral matter (Ash)	0	1
vi)	Matter insoluble in benzene percent by weight	5	25

Note — For methods of tests refer to

IS 1202 : 1978 Methods of testing tar and bituminous materials: Determination of specific gravity (*first revision*)

IS 1206 (Part 3):1978 Determination of viscosity Part 3 Kinematic viscosity (*first revision*)

IS 1211 : 1978 Determination of water content (Dean and Stark method) (*first revision*).

IS 1213 : 1978 Distillation test (*first revision*).

IS 1214 : 1978 Determination matter insoluble in benzene (*first revision*)

IS 1217 :1978 Determination of mineral matter (ASH) (*first revision*)

For detailed information, refer to IS 212:1983 Specification for crude coal tar for general use (second revision).

SUMMARY OF
IS 215 : 1995 ROAD TAR
(Third Revision)

1. Scope — Covers two types of tar each having five grades of road tars with different viscosity ranges suitable for different types of road construction under the climatic conditions prevailing in various parts of the country.

2. Types and Grades

2.1 Types

Type A — for surface dressing and dense tarsurfacings.

Type B — for open graded premix carpet with or without seal coat.

2.2 Grades — There shall be five grades of road tar as follows :

RT-1 — For surface dressing under cold weather conditions and use on hill

roads at high altitudes as well as for priming the base;

RT-2 — For surface painting in normal climatic conditions;

RT-3 — a) For surface painting and renewal coat;
 b) For premix chipping carpet (top course and light carpets);

RT-4 — For premix tar macadam (base course) and dense tar surfacing; and

RT-5 — For grouping and water proofing.

3. Requirements

3.1 Road tars shall be prepared entirely from crude tar produced as a by- product of carbonization of coal to cover both high temperature (HT) and low temperature (LT) coal tars in coke ovens or retorts.

TABLE 1 REQUIREMENTS FOR TYPE A ROAD TARS

Sl. No.	Characteristics	Limits for Grades				
		RT-1 (3)	RT-2 (4)	RT-3 (5)	RT-4 (6)	RT-5 (7)
i)	Specific gravity at 27/27°C	1.16-1.26	1.16-1.26	1.18-1.28	1.18-1.28	1.18-1.28
ii)	Viscosity by standard tar viscometer (10 mm cup) —					
	a) Temperature of test, °C	35	40	45	55	65
	b) Viscosity in seconds	30-55	30-55	35-60	40-60	40-60
iii)	Equiviscous temperature (EVT)°C	32-36	37-41	43-46	53-57	63-68
iv)	Softening point (R&B), °C	15-19	20-24	26-29	26-40	45-50
v)	Distillation fractions, percent by weight (g per 100g) Distilling —					
	a) Light oil below 200°C	0.5	0.5	0.5	0.5	0.5
	b) Middle oil 200°C-270°C	5-12	2-9	1-6	0.5-4	0-4
	c) Heavy oil 270°C-300°C	4-10	4-8	3-6	2-7	1-5
	d) Anthracene oil 300°C-350°C	15-25	16-26	17-27	18-29	18-29
	e) Pitch residue converted to 76°C (R &B)	45-60	50-65	55-70	60-75	65-80
vi)	Softening point (R&B) of the pitch residue — percent by weight, <i>Max</i>					
	a) at 300°C, <i>Max</i>	48	50	52	54	56
	b) at 360°C, <i>Max</i>	90	90	90	90	90
vii)	Water content, percent by weight, <i>Max</i>	0.5	0.5	0.5	0.5	0.5
viii)	Phenols, percent by weight, <i>Max</i>	2.0	2.0	2.0	2.0	2.0
ix)	Naphthalene, percent by weight, <i>Max</i>	4.0	3.5	3.0	2.5	2.0
x)	Raw anthracene, percent by weight, <i>Max</i>	3.5	4.0	4.0	4.0	4.0
xi)	Matter insoluble in toluene, percent by weight, <i>Max</i>	22	22	24	24	24

TABLE 2 REQUIREMENTS FOR TYPE B ROAD TAR

<i>Sl.No. Characteristics</i>		<i>Limits of Grades</i>				
(1)	(2)	RT-1	RT-2	RT-3	RT-4	RT-5
		(3)	(4)	(5)	(6)	(7)
i)	Specific gravity at 27/27°C	1.10-1.28	1.10-1.28	1.12-1.28	1.12-1.28	1.14-1.28
ii)	Viscosity by standard tar viscometer (10 mm cup):					
	a) Temperature of test, °C	35	40	45	55	65
	b) Viscosity in seconds	30-55	30-55	35-60	35-70	35-70
iii)	Equiviscous temperature (EVT) °C	32-36	37-41	43-46	53-57	63-67
iv)	Softening point (R&B), °C	-	-	-	-	45-50
v)	Distillation fractions, percent by weight (g per 100g)					
	Distilling :					
	a) Light oil below 170°C	0.5	0.5	0.5	0.5	0.5
	b) Middle oil 170°C-270°C	5-12	2-9	1-6	0-4	0-4
	c) Heavy oil 270°C-300°C	4-10	4-8	3-6	2-7	1-5
	d) Anthracene oil above 300°C	17-27	18-28	18-28	19-30	19-30
	e) Pitch residue converted to 76°C (R&B)	50-70	61-71	64-74	67-77	70-80
vi)	Softening point (R&B) of the pitch residue, °C					
	a) at 300°C, <i>Max</i>	40	40	40	40	40
	b) at 360°C, <i>Max</i>	80	80	80	80	80
vii)	Water content, percent by weight, <i>Max</i>	0.5	0.5	0.5	0.5	0.5
viii)	Phenols, percent by weight, <i>Max</i>	2.0	2.0	2.0	2.0	2.0
ix)	Naphthalene, percent by weight, <i>Max</i>	4.0	3.5	3.0	2.5	2.0
x)	Raw anthracene, percent by weight, <i>Max</i>	3.5	4.0	4.0	4.0	4.0
xi)	Matter insoluble in toluene, percent by weight, <i>Max</i>	22	22	24	24	24

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Note — For methods of tests, refer to

IS 1202 : 1978 Methods of testing tar and bituminous material : Determination of specific gravity (*first revision*).

IS 1205 : 1978 Determination of Softening point (*first revision*).

IS 1206(Part 1) : 1978 Determination of viscosity: Part 1 Industrial viscosity (*first revision*).

IS 1207 : 1978 Determination of equiviscous temperature (EVT) (*first revision*).

IS 1211: 1978 Determination of water content (Deam and Stark method) (*first revision*).

IS 1215 : 1978 Determination of matter insoluble in toluene (*first revision*).

IS 1218 : 1978 Determination of phenols (*first revision*).

IS 1219 : 1978 Determination of naphthalene (*first revision*).

For detailed information, refer to IS 215 : 1995 Specification for road tar (third revision).

SUMMARY OF
IS 216 : 1961 COAL TAR PITCH
(Revised)

1. Scope — Requirements for the range of four grades of coal tar pitch from soft to hard consistencies with softening points varying from 45 to 92°C intended for the production of waterproofing, protective and binding compounds employed in masonry, steel, timber and concrete structures and also for the preparation of roofing felts.

Note — Coal tar pitch is also used for caulking of decks, as a binder for carbon electrodes and coal briquetters, for damp-proof courses, flooring mastics and as a base for coal tar paints. This is not suitable for formulation of quick drying black enamels nor for road construction.

2. Grades — Shall be classified into the following four grades:

- a) Soft pitch,
- b) Soft medium pitch,
- c) Hard medium pitch,
- d) Hard pitch.

3. Requirements

3.1 Composition — The material shall be:

- a) either the residue of the direct distillation of crude tar produced by the high temperature carbonization of coal in coke ovens or retorts, or
- b) obtained by fluxing back such pitch residues with high boiling coal tar distillates to give products of the desired softening point.

3.2 The material shall also comply with the requirements, according to grade, given in Table 1.

TABLE 1 REQUIREMENTS FOR COAL TAR PITCH

Sl. Characteristics No.		Requirements for Grades			
		Soft Pitch	Soft Medium Pitch	Hard Medium Pitch	Hard Pitch
(1)	(2)	(3)	(4)	(5)	(6)
i)	Specific gravity at 27°C	1.20 to 1.30	1.22 to 1.32	1.22 to 1.32	1.28 to 1.38
ii)	Softening point	45 to 55°C	58 to 68°C	70 to 80°C	82 to 92°C
iii)	Distillate :				
	Percent by weight below 270°C, Max	4	4	3	No Test
	Percent by weight below 300°C, Max	8	8	4	No Test
iv)	Matter insoluble in toluene (free carbon), percent by weight, Max	25	28	30	35
v)	Ash, percent by weight, Max	0.5	0.5	0.75	0.8

Note — For methods of tests, refer to IS 1202:1978 methods of testing tar bituminous material: Determination of specific gravity (*first revision*)

IS 1205:1978 Determination of softening point (*first revision*).

IS 1213:1978 Distillation test (*first revision*).

IS 1215:1978 Determination of matter insoluble in toluene (*first revision*).

IS 1217:1978 Determination of mineral matter (*first revision*).

For detailed information, refer to 216 : 1961 Specifications for Coal tar pitch (Revised).

SUMMARY OF

IS 218 : 1983 CREOSOTE OIL FOR USE AS WOOD PRESERVATIVES

(Second Revision)

1. Scope— Covers materials commercially known as coal tar creosote (or creosote oil) primarily used for preservation of wood.

2. Types

- a) Type I — Obtained from tar produced by the high temperature carbonization of coal, and
- b) Type II — Obtained from tar produced by the medium or low temperature carbonization of coal.

3. Requirements

3.1 Description — It shall be homogeneous liquid and shall consist essentially of distillate of coal tar

3.2 Liquidity — It shall liquefy completely on being warmed to 38°C, with stirring and shall remain liquid on cooling down to 32°C, and on standing at that temperature for 2 hours.

3.3 The materials shall also comply with the requirements prescribed in Table.1

4. Precautions

4.1 Safety — All persons handling the creosote should be fully aware of the hazards involved in handling. Skin should be protected from coming in direct contact with the liquid. Eyes should be protected by using safety goggles, while handling the material.

4.2 First-Aid Treatment.

4.2.1 Skin — The affected area may be washed immediately with industrial methylated spirit, followed by a wash with soap and water.

4.2.2 Eye — Immediate treatment is vital. Eye/ eyes may be washed thoroughly with running cold water. Alternatively, if quick application is possible, use copious quantities of buffered phosphate solution prepared by mixing 700 g anhydrous potassium di- hydrogen phosphate ($\text{KH}_2\text{PO}_4 \cdot 12 \text{H}_2\text{O}$) in 850 ml distilled water. The solution can be stored for 3 months only. For use it should be diluted with three times of water.

TABLE 1 REQUIREMENTS FOR CREOSOTE

Sl No.	Characteristics	Type I		Type II	
		Min	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
i)	Specific gravity 38/ 38°C	1.03	—	0.95	—
ii)	Water content percent v/v	—	2.0	—	2.0
iii)	Matter insoluble in toluene percent w/w	—	0.5	—	0.5
iv)	Alkali soluble tar acids percent v/v	—	—	15	—
v)	Distillation fractions percent v/v distilling up to	—	—	—	—
a)	210°C	—	5	—	5
b)	235°C	—	30	5	20
c)	315°C	—	75	40	60
d)	355°C	—	—	75	—
e)	Residue soft and nonsticky	—	—	—	—
f)	Specific gravity of distillation fraction 235 °C to 315 °C at 38/38 °C	1.025	—	0.935	—
g)	Alkali soluble tar acids, in fraction 235 °C to 315 °C percent v/v	—	—	15	—

Note — for methods of tests, refer to

IS 1202:1978 Methods of testing tar and bituminous materials, determination of specific gravity (first revision).

IS 1211:1978 Determination of water content (Dean and Stark method) (first revision).

IS 1213:1978 Distillation test (first revision).

IS 1215:1978 Determination of matter insoluble in toluene (first revision).

For detailed information, refer to IS 218 : 1983 Specifications for creosote oil for use as wood preservatives (second revision).

SUMMARY OF
IS 454 : 1994 CUTBACK BITUMEN FROM WAXY CRUDE
(Second Revision)

1. Scope— Covers the physical and chemical requirements of cutbacks bitumen from waxy crude of indigenous origin.

2. Grades

a) *Light grade* — For use as primer.

b) *Medium grade* — For surface dressing and resurfacing operations, and

c) *Heavy grade*— For pre-mix type of construction.

Note — The source and grade shall be stated by the manufacturer.

3. Requirements— See Table 1

TABLE 1 REQUIREMENTS FOR CUTBACK BITUMEN FROM WAXY CRUDE

Sl.No. Characteristics		Requirement for Grades					
		<i>Light</i>		<i>Medium</i>		<i>Heavy</i>	
(1)	(2)	Min (3)	Max (4)	Min (5)	Max (6)	Min (7)	Max (8)
i)	Kinematic viscosity, 60°C cst	70	140	800	1600	3000	6000
ii)	Flash point, Pensky Martens closed type, 0°C	38	—	55	—	55	—
iii)	Distillate volume, percent of total distillate up to 360°C						
	a) Up to 190° C	10	—	30	—	—	—
	b) Up to 225° C	50	—	30	—	—	—
	c) Up to 260° C	70	—	30	—	—	—
	d) Up to 315° C	85	—	75	—	50	—
iv)	Residue from distillation up to 360°C, percent by volume (by difference)	55	—	75	—	80	—
v)	Tests on residue from distillation upto 360°C						
	a) Viscosity at 60° C, poises	600	2400	100	2400	100	2400
	b) Ductility at 27° C	12	—	10	—	10	—
	c) Matter soluble in Trichloroethylene percent by mass	99	—	99	—	99	—
	d) Penetration 25° C /100g/5Sec	35	70	50	100	25	50
vi)	Water content percent by mass	—	0.2	—	0.2	—	0.2

Note— For methods of tests, refer to

IS 1203 : 1978 Determination of penetration (*first revision*).

IS 1206 (Part1):1978 Determination of viscosity Part 1 Industrial viscosity (*first revision*).

IS 1208 : 1978 Determination of ductility (*first revision*).

IS 1209 : 1978 Determination of flash point and fire point (*first revision*).

IS 1211 : 1978 Determination of water content (Dean and Stark method) (*first revision*).

IS 1213 : 1978 Distillation test (*first revision*).

IS 1203 : 1978 Determination of solubility in carbon disulphide trichloroethylene (*first revision*).

For detailed information, refer to IS 454 : 1991 Specifications for cutback bitumen from waxy crude (second revision).

SUMMARY OF
IS 702 : 1988 INDUSTRIAL BITUMEN
(Second Revision)

1. Scope — Covers the physical and chemical requirements of industrial bitumen for use in buildings and other industrial purposes.

d) 115/15

e) 135/10

f) 155/6

Note— The two values given in the grade denotes approximately softening point and penetration respectively

2. Grades —

a) 85/25

b) 85/40

c) 90/15

3. Requirements — See Table 1

TABLE 1 REQUIREMENTS OF INDUSTRIAL BITUMEN

Sl. No.	Characteristics	Requirements for Grades					
		85/25	85/40	90/15	115/15	135/10	155/6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Specific gravity at 27°C	1.00 to 1.05	1.00 to 1.05	1.01 to 1.06	1.02 to 1.07	1.02 to 1.07	1.02 to 1.07
ii)	Flash point, cleveland open cup, °C	225	225	225	225	225	225
iii)	Softening point, °C	80 to 90	80 to 90	85 to 100	110 to 120	130 to 140	150 to 160
iv)	Penetration at 25°C, 100g, 5 sec, 1/10mm	20 to 30	35 to 45	10 to 20	8 to 20	7 to 12	2 to 10
v)	a) Loss on heating, percent by mass, <i>Max</i>	0.30	0.30	0.30	0.30	0.30	0.30
	b) Penetration of the residue at 25°C, 100g, 5s, percent of original <i>Min</i>	60	60	60	60	60	60
vi)	Ductility at 27°C, cm, <i>Min</i>	3	3	2	2	1	0
vii)	Matter soluble in trichloro-ethylene, percent by mass, <i>Min</i>	99	99	99	99	99	99

Note—For methods of tests, refer to

IS 1202:1978 Methods of testing tar and bituminous materials, determination of specific gravity (*first revision*).

IS 1203:1978 Determination of penetration (*first revision*)

IS 1205:1978 Determination of softening point (*first revision*)

IS 1208:1978 Determination of ductility (*first revision*)

IS 1212:1978 Determination of loss on heating (*first revision*)

IS 1216:1978 Determination of solubility in carbon disulphide trichloroethylene (*first revision*)

IS 1448 (Part 69):1969 Methods of tests for petroleum and its products, Part 69 Flash and fire point by cleveland (open) cup.

For detailed information, refer to IS 702 : 1988 Specifications for industrial bitumen (second revision).

SUMMARY OF
IS 3117 : 2004 BITUMEN EMULSION FOR ROADS
AND ALLIED APPLICATIONS (ANIONIC TYPE)
(First Revision)

1. Scope — Physical and chemical requirements of grades of bitumen emulsion (anionic type) for roads and allied applications.

2. Materials

2.1 Bitumen — The bitumen straight or fluxed, used for the manufacture of the emulsion, shall comply with the following requirements.

- a) The penetration shall be between 100 and 350;
- b) Softening point (Ring and Ball) shall not be higher than 48°C;
- c) Solubility in carbon disulphide shall not be less than 99.0 percent; and
- d) The loss of weight after heating for five hours at 163° shall not exceed two percent of the original weight. After carrying out this test the penetration of bitumen shall not be less than 60 percent of its original value.

2.1.1 If it is desired to modify the performance of the emulsion during periods of low temperature, fluxing the bitumen with the addition of a quantity of fluxing agent not exceeding five percent by weight of bitumen shall be permitted. Unless otherwise agreed to between the manufacturer and the purchaser, the fluxing agents shall comply with the following requirements:

- a) Initial boiling point not less than 140°C; and
- b) Distillate at 350°C not less than 90 percent by volume.

2.2 Emulsifying Agent — The emulsifying agent, in the proportion in which it is present in the bitumen deposited by the emulsion, shall not have any deleterious effect upon the properties of that bitumen.

3. Types

3.1 a) Rapid Setting – Type RS

b) *Medium Setting* – Type MS

c) *Slow Setting* – Type SS

3.2 Applications

a) *Type RS* — A quick setting, emulsified bitumen used for penetration and surface treatments;

b) *Type MS* — A medium setting emulsified bitumen used for plant mixes with coarse aggregate, substantially all of which is retained on 2.80-mm IS Sieve with practically no material passing a 75- micron IS Sieve

c) *Type SS* — A slow setting emulsified bitumen used for fine aggregate mixes in which a substantial quantity of aggregate passes a 2.80-mm IS Sieve and a portion may passing a 75 micron IS Sieve.

Note — These types are to be used only down to a temperature of 5°C. Below 5° C the utility of the bitumen emulsion is likely to be impaired because of freezing as such they should be preferably be stored above 4 °C.

4. Requirements

4.1 Bitumen emulsion shall be homogeneous. Within 90 days after manufacture it shall show no undispersed bitumen after thorough mixing.

4.2 Physical and chemical requirements shall be as given in Table 1.

Note -Care shall be exercised to the that materials used in the manufacture of bitumen shall not have any time effects on the plant or animal life.

TABLE 1 REQUIREMENTS OF BITUMEN EMULSION

Sl. No.	Characteristic	Rapid Setting (3)	Medium Setting (4)	Stow Setting (5)	Method of Test, Ref to Annex (6)
(1)	(2)				
i)	Viscosity by Sabybolt Furol viscometer, in second at 25°C	20-100	20-100	20-100	A
ii)	Bitumen content, percent by mass, Min	65	65	57	B
iii)	Settlement, 5 days, percent, Max	3	3	3	C
iv)	Demulsibility, 35 ml of 0.02 N calcium chloride, percent Min	60	—	—	D
v)	Miscibility ¹ in water, coagulation in 2 h	—	Nil	—	E
vi)	Modified miscibility with water difference of bitumen content, Max	—	—	4.5	F
vii)	Cement mixing test, percent, Max	—	—	2.0	G
viii)	Coating ability and water resistance				
	a) Coating dry aggregate	—	Good	—	
	b) Coating after spraying	—	Fair	—	
	c) Coating wet aggregate	—	Fair	—	H
	d) Coating after spraying	—	Fair	—	
ix)	Sieve test, percent, Max	0.10	0.10	0.5	J
x)	Particle charge	Negative	Negativ	Negative	K

¹If the sample of emulsified bitumen being tested fails to conform to the requirement, the sample shall be tested for 5-day settlement and for miscibility and if the numerical difference between the average percentage of residue in the 5-day settlement test is less than 3, and if the miscibility test shows no appreciable coagulation in 2h, then the emulsified bitumen shall be considered conforming to this standard.

Note — The emulsified bitumen shall not show an a preciable separation of bituminous base from the water of the emulsion and shall coat the aggregate thoroughly.

Note — For methods of tests, refer to IS 1211:1978 Methods for testing tar and bitumen: Determination of water content (Dean and Stark method) (*first revision*) and Appendices A to J of the stand.

For detailed information, refer to IS 3117 : 2004 Specifications for Bitumen emulsion for roads and allied application. (Anionic type)

SUMMARY OF
IS 8887 : 2004 BITUMEN EMULSION FOR ROADS
(CATIONIC TYPE)
(Second Revision)

1. Scope — Covers the physical and chemical requirements of bitumen emulsions (cationic type) for roads.

c) Medium setting MS
d) Show setting - 1 SS - 1
e) Show setting - 2 SS - 2
Requirement

2. Grades Grade
a) Rapid setting - 1 Rs - 1
b) Rapid setting - 2 Rs - 2

3.1 Shall be homogeneous. Within one year after manufacture date it shall show no undispersed bitumen after thorough mixing.

TABLE 1 PHYSICAL AND CHEMICAL REQUIREMENTS OF BITUMEN EMULSION (CATIONIC TYPE)

Sl No.	Characteristic	Grade of Emulsion					Method of Test		Ref. to
		RS-1	RS-2	MS	SS-1	SS-2	IS No.	Annex of this Standard	
	1	2	3	4	5	6	7	8	
9									
i)	Residue on 600 micron IS Sieve, percent by mass, <i>Max</i>	0.05	0.05	0.05	0.05	0.05	—	B	
ii)	Viscosity by saybolt furol viscometer, seconds: 1) At 25° C 2) At 50° C	— 20–100	— 100–300	— 50–300	20–100 —	31–150 —	3117	—	—
iii)	Coagulation of emulsion at low temperature ¹	Nil	Nil	Nil	Nil	Nil	—	C	
iv)	Storage stability after 24 h, percent, <i>Max</i>	2	1	1	2	2	—	D	
v)	Particle charge	Positive	Positive	Positive	Weak Positive	Positive	—	E	
vi)	Coating ability and water resistance: 1) Coating, dry aggregate 2) Coating, after spraying 3) Coating, wet aggregate 4) Coating, after spraying	— — — —	— — — —	Good Fair Fair Fair	— — — —	— — — —	—	F	
vii)	Stability to mixing with cement (percentage coagulation), <i>Max</i>	—	—	—	2	2	—	G	
viii)	Miscibility with water	No Coagulation	No Coagulation	No Coagulation	—	No Coagulation	—	H	
ix)	Test on residue: 1) Residue by evaporation percent, <i>Min</i> 2) Penetration 25 °C/100 g/ 5sec 3) Ductility 27° C/cm, <i>Min</i> 4) Solubility : In trichloroethylene, Percent by mass, <i>Min</i>	60 80-150 50 98	67 80-150 50 98	65 60-150 50 98	50 60-350 50 98	60 60-120 50 98	— 1203 1208 1216	J	— — — —
x)	Distillation in percent, by volume at: 1) 190 °C 2) 225 °C 3) 260 °C 4) 315 °C	— — — —	— — — —	— — — —	20-55 30-75 40-90 60-100	— — — —	— — — —	—	— — — —
xi)	Water content, percent by mass, <i>Max</i>	—	—	—	20	—	—	—	—

¹This requirement shall be applicable only under situations where the ambient temperature is below 15 °C

For detailed information, refer to IS 8887 : 2004. Specifications for Bitumen emulsion for roads (Cationic type) (first revision).

SUMMARY OF

IS 9912 : 1981 COAL TAR BASED COATING MATERIALS AND SUTABLE PRIMERS FOR PROTECTING IRON OR STEEL PIPE LINES

1. Scope — Requirements of hot applied coal tar based coatings and their associated primers used for protecting iron and steel pipes. This standard covers two types of coating materials suitable for extremes of temperature (See Table 1).

2. Hot Applied Coating Material — The material shall be produced by digestion of bituminous coal or its selected fractions suitable for this purpose together with an approved inert filler (like talc, etc) sized to ensure that not less than 100 percent passes through 45-micron IS Sieve.

3. Primers

3.1 The primers shall be of two types, namely, Type A and Type B.

3.2 Type A primer shall be composed of processed coal tar pitch suitably blended with selected grades of solvents, to a fluid that may be applied cold by brushing, spraying or any other method. The primer shall also comply with the requirement given in Table 2.

3.3 Type B primer shall consist of chlorinated rubber and synthetic plasticiser together with solvents needed to give a consistency suitable for application by brush or spray. Type B primer shall comply with the requirements of Table 3.

TABLE 1 REQUIREMENTS OF HOT APPLIED COATING MATERIAL

Sl No.	Characteristics	Requirements			
		Type I		Type II	
		Min	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
i)	Softening point (R&B)°C	105	115	105	115
ii)	Penetration (see Note):				
	at 25°C/100 g/5 second	5	10	12	20
	at 45°C/50g/5 second	10	25	20	50
iii)	Specific gravity at 270C	1.4	1.6	1.4	1.6
iv)	Ash, percent	25	35	25	35
v)	Sag test at 70°C	—	1.5 mm	—	1.5 mm
vi)	Cracking at 20°C		Not applicable		None
vii)	Impact test				
	Disbonded area, Max :				
	Direct		70 cm ²		50 cm ²
	Indirect		20 cm ²		10 cm ²
viii)	Peel-initial/delayed				
	at 30°C, Max		3 mm		3 mm
	at 40°C, Max		3 mm		3 mm
	at 50°C, Max		3 mm		3 mm
	at 60°C, Max		3 mm		3 mm
	at 70°C, Max		3 mm		3 mm

Note — Coal dispersion pitches have a tendency to form a hard thin skin while hot, and penetration values tend to show a wide variation, on the prior preparation of the sample, which is not easy to control, and dependent on the point chosen on the surface for the test. The behaviour and performance of these coal dispersion pitches are functions of the property of the body of the material and not of any surface skin. To overcome this, fill the cup up to the brim and after cooling down, pour a little excess of material slowly and carefully to form a convex surface. The excess material is to be cut with a hot knife after cooling for 15 min at room temperature.

TABLE 2 REQUIREMENTS OF TYPE A PRIMER

<i>Sl No.</i>	<i>Characteristics</i>	<i>Requirements</i>
i)	Viscosity at 25°C	20 to 40 Second
ii)	Flash point	35°C (Min)
iii)	Volatile matter at 145°C-150°C	40 to 60 percent by weight
iv)	Drying time	Conditions of Appendix C shall apply

TABLE 3 REQUIREMENTS OF TYPE B PRIMER

<i>Sl No.</i>	<i>Characteristics</i>	<i>Requirements</i>
i)	Viscosity at 25°C	20 to 40 Second
ii)	Flash point	35°C (Min)
iii)	Volatile matter at 100-110°C	60 to 80 percent by weight
iv)	Drying time	Conditions of Appendix C shall apply

Note — For methods of tests, refer to Appendices of the standard and the following:

- IS 82:1973 Methods of sampling and test for thinners and solvent for paints (*first revision*).
- IS 1202:1978 Methods of testing tar and bituminous materials, Determination of specific gravity (*first revision*).
- IS 1203:1978 Determination of penetration (*first revision*).
- IS 1205:1978 Determination of softening point (*first revision*).
- IS 1206 (Part 1):1978 Determination of Viscosity : Part 1 Industrial viscosity (*first revision*).
- IS 1207:1978 Determination of equiviscous temperature (*first revision*).

For detailed information refer to IS 9912 : 1981 Specifications for coal tar based coating materials and suitable primers for protecting iron or steel pipe lines.

SECTION 8
FLOOR, WALL, ROOF COVERINGS
AND FINISHES

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SUMMARY OF
IS 1237 : 1980 CEMENT CONCRETE FLOORING TILES
(Second Revision)

1. Scope — Requirements for cement concrete flooring tiles of plain cement, plain coloured and terrazo types. Chequered tiles are not covered.

2. Terminology

2.1. Plain Cement Tiles— Tiles having a wearing surface wherein no pigments and stone chips are used.

2.2. Plain Coloured Tiles— Tiles having a plain wearing surface wherein pigments are used but no stone chips.

2.3. Terrazo Tiles— Tiles at least 25 percent of whose wearing surface is composed of stone chips in a matrix of ordinary or coloured Portland cement mixed with or without pigments and mechanically ground and filled.

3. Classification

- a) *General Purpose*— Used for flooring of normally lightly loaded, such as in office building, schools colleges, hospitals and residential buildings.
- b) *Heavy Duty Floor Tiles*— Used for heavy conditions, foot paths, entrances and staircases of public buildings, passages of auditoriums and storage godowns.

4. Dimensions

4.1 Size shall be as follows:

Length mm	Breadth mm	Thickness mm
200	200	20
250	250	22
300	300	25

4.1.1 Half tiles rectangular in shape shall also be available.

4.1.2 Other shapes and sizes of tiles may be manufactured when agreed to mutually provided all other requirements are met.

5. Tolerances

5.1 On length or breadth, it shall be ± 1 mm and on thickness $+5$ mm.

5.2. Thickness of Wearing Layer — The minimum thickness for various classes of tiles shall be as specified in Table 1.

TABLE 1 THICKNESS OF WEARING LAYER

Sl. No.	Class of Tile	Minimum Thickness of Wearing Layer mm
i)	Plain cement and plain coloured tiles for general purpose	5
ii)	Terrazo tiles with chips of size varying from the smallest up to 6 mm, for general purpose	5
iii)	Terrazo tiles with chips of size varying from the smallest up to 12 mm, for general purpose	5
iv)	Terrazo tiles with chips of size varying from the smaller up to 20 mm, for general purpose	6
v)	Plain cement and plain coloured tiles for heavy duty	6
vi)	Terrazo tiles with chips of size varying from the smallest up to 20 mm, for heavy duty	6

6. General Quality — Wearing layer of tiles shall be free from projections, depressions, cracks, holes, cavities and other blemishes. Edges of wearing layer may be rounded.

7. Finish — Colour and texture of wearing layer shall be uniform throughout its thickness. No appreciable difference in appearance of tiles from point of view of colour of aggregate, its type and its distribution on surface of wearing layer shall be present.

8. Physical Requirements — All tests shall be carried out not earlier than 28 days from the date of manufacture.

8.1 Flatness of tile Surface—The amount of concavity and convexity shall not exceed 1 mm.

8.2 Perpendicularity – The longest gap between the arm of the ‘square’ and the edge of tile shall not exceed 2 percent of length of edge.

8.3 Straightness – The gap between the thread and the plane of tile shall not exceed 1 percent of length of edge.

8.4 Water Absorption – Average value shall not exceed 10 percent.

8.5 Wet Transverse Strength—Average value shall not

be less than 3 N/mm

8.6 Resistance of Wear – The wear shall not exceed the following values —

a) For general purpose tiles—

- 1) Average wear 3.5 mm
- 2) Wear on individual specimen 4 mm

b) For heavy duty floor tiles —

- 1) Average wear 2 mm
- 2) Wear on individual specimen 2.5 mm

Note — For requirements in regard to materials, manufacture and for methods of tests refer to the standard.

For detailed information, refer to IS 1237 : 1980 Specification for cement concrete flooring tiles (first revision).

SUMMARY OF
IS 1542 : 1992 SAND FOR PLASTER
(Second Revision)

1. Scope — Requirements of naturally occurring sands and crushed gravel sands used in mortars for internal wall and ceiling plastering, and external plastering using mixes of lime, cement, composite lime-cement, activated lime pozzolana mixture (ALMP) or gypsum with or without admixtures and sand.

2. Quality of sand

2.1 General — The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain clay, silt and dust more than specified.

2.2 Deleterious Materials

2.2.1 The sand shall not contain any harmful impurities, such as, iron pyrites, alkalis, salts, coal, mica, shale or similar laminated materials, soft fragments, sea shells and organic impurities in such quantities as to affect adversely the hardening, the strength, the durability or the appearance of the plaster of applied decoration, or to cause corrosion of metal lathing or other metal in contact with the plaster.

2.2.2 Maximum quantities of clay, fine silt, fine dust and organic impurities in the sand shall not exceed the following limits:

- a) Clay, silt and dust not more than 5 percent by weight.
- b) Organic impurities colour of liquid below that indicated by comparison with the standard solution specified in 6.2.2 of IS 2386 (Part 2) : 1963*

2.3. Average compressive strength of mortar cubes composed of one part of cement and six parts of sand conforming to gradation in Table 1 shall not be less than 3 N/mm² at 28 days.

*IS 2386 Methods of test for aggregates for concrete Part 2— Estimation of deleterious materials and organic impurities.

TABLE 1 GRADING OF SAND FOR INTERNAL WALL OR EXTERNAL WALL OR CEILING PLASTER

<i>IS Sieve Designation</i>	<i>Percentage Passing</i>
10 mm	100
4.75 mm	95-100
2.36 mm	95-100
1.18 mm	90-100
600 micron	80-100
300 micron	20-65
150 micron	0-15

Note — For crushed stone sands and crushed gravel sands, the permissible limit on 150 micron IS Sieve is increased to 20 percent. This does not affect 5 percent allowance permitted.

3. Grading of Sand

3.1 The particle size grading of sand for plaster work shall be as specified in Table 1. Where the grading falls outside the limits of the grading zones of sieves other than 150, 300 and 600 micron IS Sieve by a total amount not exceeding 5 percent, it shall be regarded as falling within the grading.

3.2 The fineness modulus of sand shall be not less than 1.4 in case of crushed stone sands and crushed gravel sands and not less than 1.5 in case of naturally occurring sands.

3.3 The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

3.4 The required grading may often be obtained by screening and /or by blending together either natural sands or crushed stone screenings, which are by themselves of unsuitable grading.

Note — For methods of tests, refer to

IS 1727 : 1967 Methods of test pozzolanic materials (*first revision*).

IS 2250 : 1981 Code of practice for preparation and use of masonry mortars (*first revision*).

For detailed information refer to IS 1542:1992 Specification for sand for plaster (second revision).

SUMMARY OF
IS 2116 : 1980 SAND FOR MASONRY MORTARS
(First Revision)

1. Scope — Requirements of naturally occurring sands, crushed stone sands and crushed gravel sands used in mortars for construction of masonry.

2. Quality of Sand

2.1. General — The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified.

2.2. Deleterious Material

2.2.1 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.

2.2.2 Maximum quantities of clay, fine silt, fine dust and organic impurities in the sand shall not exceed the following limits:

- | | |
|---|---|
| a) Clay, fine silt and fine dust— | |
| 1) In natural sand or crushed gravel sand | Not more than 5 percent by mass |
| 2) In crushed stone sand | Not more than 5 percent by mass |
| b) Organic impurities— | Colour of the liquid shall be lighter than that indicated by the specified in IS: 2386 (Part 2) : 1963* |

3. Grading of Sand

3.1 The particle size grading of sand for use in mortars shall be within the limits as specified in Table 1.

TABLE 1 GRADING OF SAND FOR USE IN MASONRY MOTORS

<i>IS sieve designation</i> (1)	<i>Percentage passing by mass</i> (2)
4.75 mm	100
2.36 mm	90 to 100
1.18 mm	70 to 100
600 micron	40 to 100
300 micron	5 to 70
150 micron	0 to 15

3.2 Various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

3.3 The required grading may often be obtained by screening and/or by blending together either natural sands or crushed stone screenings, which are, by themselves unsuitable.

Note: For methods of test, refer to IS 2386 Methods of tests for aggregates for concrete

Part 1 : 1963 Particle size and shape

* Part 2 : 1963 Estimation of deleterious materials and organic impurities.

For detailed information, refer to IS 2116 : 1980 Specificaion for sand for masonry mortars (first revision).

SUMMARY OF

IS 4457 : 1982 CERAMIC UNGLAZED VITREOUS ACID
RESISTING TILES*(First Revision)*

1. Scope — Requirements for ceramic unglazed vitreous acid resisting tiles.

2. Dimensions and Tolerances

2.1 Sizes —

- (i) 100 × 100 mm or 98.5 × 98.5 mm
- (ii) 150 × 150 mm or 148.5 × 148.5 mm and
- (iii) 200 × 200 mm or 198.5 mm × 198.5 mm

2.2 Thickness — Shall be 25, 20, 12 and 10 mm.

2.3 The depth of the grooves on the under side of the tiles shall not exceed 3 mm.

Note — The thickness of the tiles shall be measured after filling the grooves with cement mortar and drying.

2.4 Half tiles for use as full tiles, if manufactured, shall have dimensions which shall be such as to make the half tiles, when jointed together, match with the dimension of a full tile.

2.5 Tolerances — Tolerances on length, width and thickness of the tiles shall be ± 2.5 percent.

3. Requirements

TABLE 1 REQUIREMENT OF CERAMIC UN-GLAZED VITREOUS ACID RESISTING TILES

Sl. No.	Characteristic	Requirement
(1)	(2)	(3)
i)	Squareness	The gap between the inner edge of the square and the adjacent side of the tile shall not exceed 1 mm per 100 mm run
ii)	Warpage	
	for size(i)	± 1.5 mm
	for size(ii)	± 2.0 mm
	for size(iii)	± 2.5 mm
iii)	Water absorption	2 percent, <i>Max</i>
iv)	Compressive strength	70 N/mm ² (700 kgf/cm ²), <i>Min</i>
v)	Flexural strength	20 N/mm ² (200 kgf/cm ²), <i>Min</i>
vi)	Resistance to acid	Loss in mass shall not exceed 1.5 percent
vii)	Abrasion resistance	i) Average wear 2 mm, <i>Max</i> ii) Wear on individual specimen 2.5 mm, <i>Max</i> .

Note — For methods of tests, refer to Appendices of the standard.

For detailed information, refer to IS 4457 : 1982 Specification for ceramic unglazed vitreous acid resisting tiles (first revision).

SUMMARY OF

IS 4832 (PART 1) : 1969 CHEMICAL RESISTANT MORTARS

PART I – SILICATE TYPE

1. Scope — Requirements for chemically setting silicate type of chemical resistant mortars for bonding chemical resistant masonry units. Such mortars are resistant to most type of acids except hydrofluoric acid and concentrated orthophosphoric acids. They are not resistant to alkalis or to boiling water and steam. They deteriorate by continued exposure to water.

2. Materials

2.1 Binder — Solution of sodium silicate or potassium silicate with silica/sodium oxide or silica/potassium oxide molecular ratio of 3 to 3.7. Specific gravity 1.4.

2.2 Fillers — Silica, quartz, ganister, andesite, etc.

2.3 Selling Agent — Fluoride or acid compound.

3. Physical Requirements — See Table 1.

4. Chemical Requirements — Limits of chemical resistance may be settled between the purchaser and the supplier.

TABLE 1 PHYSICAL REQUIREMENTS OF SILICATE TYPE CHEMICAL RESISTANT MORTARS

Sl No.	Property	Requirement	
		Sodium Silicate	Potassium Silicate
(1)	(2)	Type (3)	Type (4)
(i)	Working time at $27 \pm 2^\circ \text{C}$, <i>Min</i> , minutes	15	20
(ii)	Flexural strength at 7 days, <i>Min</i> , kgf/cm^2	35	40
(iii)	Compressive strength at 7 days <i>Min</i> , kgf/cm^2	100	150
(iv)	Bond strength, <i>Min</i> kgf/cm^2	5	5
(v)	Absorption of toluene, <i>Max</i> , percent by weight	18	18

Note 1— For method of tests, refer to IS 4456 (Part 1) : 1967 Methods of test for chemical resistant mortar: Part I Silicate type and resin type

Note 2— For general guide for chemical resistance of silicate type mortars to various substances, refer to Table 1 of IS 4441:1980 Code of practice for use of silicate type chemical resistant mortars (*first revision*).

For detailed informations, refer to IS 4832 (Part 1) : 1969 Specification for chemical resistant mortars: Part 2 Silicate type.

SUMMARY OF
IS 4832 (PART 2) : 1969 CHEMICAL RESISTANT MORTARS
PART 2 RESIN TYPE

1. Scope — Requirements of resin type chemical resistant mortars for bonding chemical resistant masonry units. Such mortars have good resistance to non-oxidizing mineral acid and poor resistance to oxidizing mineral acid. Fairly resistant to inorganic alkalis. Resistant to water; hence give impermeable joints. Used for joining acid-proof bricks and tiles.

2. Materials

2.1 Resins — Penolic, furane, epoxy, polyester.

2.2 Fillers— Siliceous or other inert fillers. Shall be graded so as to permit 1.5 mm joints.

2.3 Catalyst — May be incorporated in fillers

3. Physical Requirements — See Table 1.

4. General Requirements — Resin shall have viscosity. Filler material shall have properly graded particles that will permit preparation of a minimum joint thickness of 1.5 mm.

5. Chemical Resistance Requirement — The limits may be settled between the purchaser and supplier.

6. Shelf Life — For phenolic and polyester resins is about 3 months and for furane and epoxy resins about 12 months from date of manufacture.

TABLE 1 PHYSICAL REQUIREMENTS OF RESIN TYPE CHEMICAL RESISTANT MORTARS

Sl No.	Particular	Requirements for Type of Mortar			
		Phenolic Type	Furane Type	Epoxy Type	Polyester Type
(1)	(2)	(3)	(4)	(5)	(6)
i)	Working time at $27 \pm 2^\circ\text{C}$, <i>Min</i> minutes	20	20	20	20
ii)	Flexural strength at 7 days, <i>Min</i> , kgf/cm ²	75	75	150	150
iii)	Compressive strength at 7 days, <i>Min</i> , kgf/cm ²	350	350	500	500
iv)	Bond strength, <i>Max</i> , kgf/cm ²	10	10	12	12
v)	Absorption, <i>Max</i> , Percent by weight	1.0	1.0	1.0	1.0

Note— In the test for bond strength the joint shall not fail at or below the value specified.

Note 1— For methods of tests, refer to IS 4456(Part I) : 1967 Methods of test for chemical resistant mortars: Part I Silicate type and resin type.

Note 2—For general guide for chemical resistance of resin type mortars to various substances, refer to Table 1 of IS 4443:1980. Code of practice for use of resin type chemical resistant mortar (*first revision*).

For detailed information, refer to IS 4832 (Part 2) : 1969 Specification for chemical resistant mortars: Part 2 Resin type.

SUMMARY OF
IS 4832 (PART 3) : 1968 CHEMICAL RESISTANT MORTARS
PART 3 – SULPHUR TYPE

1. Scope— Requirements of sulphur type chemical resistant mortars for bonding chemical resistant masonry units.

Note — Such mortars have good resistance against most of the acids except concentrated oxidizing acids, but have poor resistance to alkalis. Used for jointing acid resistance bricks or tiles.

2. Composition

- a) Sulphur—55 to 70 percent
- b) Inert filler—30 to 45 percent
- c) Sieve analysis of silica filler

The percent material retained on different sieves shall not exceed the following:

<i>IS Sieve Designation</i>	<i>Percentage Retained by Mass</i>
425 micron	5 max
150 micron	10 min
75 micron	35 min

Note — For other fillers, requirements given at SI No. (vii) of Table 1 shall apply.

3. Physical Requirements — See Table 1

Note 1 — For methods of tests, refer to IS 4456(Part 2) : 1967 Methods of test for chemical resistant mortars: Part 2 Sulphur type.

Note 2— For general guide for chemical resistance of sulphur type mortars to various substances, refer to Table 1 of IS 4442:1980 Code of practice for use of resin type chemical resistant mortar (*First Revision.*)

For detailed information, refer to IS 4832 (Part 3) : 1968 Specification for chemical resistant mortars: Part 3 Sulphur type.

TABLE 1 PHYSICAL REQUIREMENTS OF SULPHUR TYPE CHEMICAL

RESISTANT MORTARS		
<i>S.No.</i>	<i>Property</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Compressive strength at 48 hours, <i>Min</i> , kgf/cm ²	280
ii)	Tensile strength at 48 hours, <i>Min</i> , kg/cm ²	30
iii)	Flexural strength at 48 hours, <i>Min</i> kg/cm ²	70
iv)	Bond strength at 48 hours <i>Min</i> kg/cm ²	10
v)	Proportion of original strength retained after Shock test, <i>Min</i> percent	20.0
vi)	Moisture absorption, <i>Max</i> , present	1.0
vii)	Tendency of aggregate to settle, <i>Max</i> variation from unity	0.6

4. Chemical Resistance Requirements—

The limits may be settled between the purchaser and the supplier.

5. Storage Life — Shall not be less than 2 years. Shall be placed in a dry place away from fire.

SUMMARY OF IS 4860 : 1968 ACID – RESISTANT BRICKS

1. Scope — Requirements of acid-resistant bricks. Such bricks are designed primarily, for use in chemical allied industries and are used in masonry, flooring, etc, subject to acid attack, lining of sewers carrying industrial effluents, etc. Made out of suitable clay or shale with low lime and iron content, felspar, flint or sand and vitrified at high temperatures.

2. Classification

2.1 Class I — Recommended for severe type of corrosive environments as obtained in storage tanks, pickling tanks etc.

2.2 Class II — Recommended for areas subject to occasional pillage of acids, fumes, and contact with dry chemicals as in fertilizer silos.

3. Performance Requirements—See Table 1

4. Dimensions — $230 \times 114 \times 64$ mm.

5. Tolerances

<i>Dimensions</i> (mm)	<i>Tolerances</i> (mm)
230	± 3.5
114	± 2.0
64	± 1.0

6. Warpage — Not more than 2.5 mm at any point.

Note— For measurement of warp, refer to 2.4.1 of the standard.

TABLE 1 PERFORMANCE REQUIREMENTS OF ACID RESISTANT BRICKS

S. No.	Characteristic	Requirements	
		Class I Bricks	Class II Bricks
(1)	(2)	(3)	(4)
i)	Water absorption, percent, Max	2	4
ii)	Flexural strength, kgf/cm ² , Min	100	70
iii)	Compressive strength, kgf/cm ² , Min	700	500
iv)	Resistance to acid	Loss in weight shall not exceed 1.5 percent	Loss in weight shall not exceed 4.0 percent
v)	Resistance to wear (optional)	Average wear shall not	exceed 2 mm

Note — For methods of tests, refer to Appendices A to D of the standard and Appendix A of IS 1237:1980 Specification for cement concrete flooring tiles (first revision).

For detailed information, refer to IS 4860 : 1968 Specification for acid resistant bricks.

SUMMARY OF

IS 13753 : 1993 DUST- PRESSED CERAMIC TILES WITH WATER ABSORPTION OF E>10% GROUP B III

1. Scope — Specifies sizes, dimensional tolerances, mechanical, physical and chemical requirements, surface quality requirements and marking of ceramic tiles.

1.1 It is applicable only to dust-pressed ceramic glazed tiles first quality, with a water absorption ($E > 10\%$) according to Group B III of IS 13712 : 1993* for use as both wall and floor coverings. Tiles in this group are mainly used in areas not subject to severe mechanical load. They are not intended for applications where conditions of frost may apply.

1.2 There is a small production of dust-pressed ceramic unglazed tiles with a water absorption greater than 10% that is not covered by this standard.

2. Description — The surface of tiles and components belonging to this group can be smooth, profiled, wavy, decorated or finished in some other way. It can be glossy, matt or semi-matt (GL).— Tiles may have spacer lugs.

3. Shapes and Sizes

3.1 The modular preferred coordinating sizes (work size + joint width) in cm are M30×30, M30×15, M25×15, M20×20, M20×15, M15×15, M15×7.5 and M10×10. The manufacturers shall choose the work size (dimension of the visible faces, length and width) in order to allow a nominal joint width between 1.5 and 5 mm.

3.2 The most common non-modular nominal sizes in cm are 40×40, 33×33, 30×30, 30×15, 25×25, 21.6×10.8, 20×40, 20×30, 20×20, 20×15, 15.2×15.2, 15.2×7.6, 15×15, 15×7.5, 10.8×10.8 and 10×20. The manufactures shall choose work size such that difference between the work size and nominal size is not more than ± 2 mm. For spacer lug tiles, work size shall apply for each nominal size within the limits mentioned above.

3.3 The thickness including the profile on the visual face and on the rear side shall be specified by the manufacturer.

Note— For details of shapes, refer to Fig 1 and 2 of the standard.

4. Spacer Lug Tiles—Spacer Lugs are projections, usually of 0.6 mm, which are located along certain edges of tiles so that when two tiles are placed together in line, the lugs on adjacent edges separate the tiles by a distance not less than the specified width of joint. Lugs are positioned so that the joint between the tiles may be filled with grout without the lugs remaining exposed.

Dust – pressed tiles may be made with other spacer lug systems and in such cases the manufacturer's work size shall apply.

Note— Some tiles have one or more manufacturing projections part way along certain edges and smaller than 0.3 mm. These are not intended as spacer lugs and shall not be used to space joints

5. Requirements : See Table 1.

* Ceramic tiles — definition, classification, characteristics and marking.

TABLE 1 REQUIREMENTS

Characteristics	Requirements	Test According to IS 13630
A) Dimensions and Surface Quality		
i) <i>Length and Width</i>		Part 1
e The deviation in % of the average size for each tile (2 or 4 sides) from the work size	$1 \leq 12 \text{ cm}; \pm 0.75)^{1)}$ $1 > 12 \text{ cm}; \pm 0.5$	
Tiles with spacer lugs	$+0.6/-0.3$	
f The deviation in % of the average size for each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides)	$1 \leq 12 \text{ cm}; \pm 0.5)^{1)}$ $1 > 12 \text{ cm}; \pm 0.3$	
Tiles with spacer lugs	± 0.25	
ii) <i>Thickness</i>		Part 1
The deviation in mm of the average thickness of each tile from the work size thickness		
<250 cm ²	± 0.5	
>250 to 500 cm ²	± 0.6	
>500 to 1000 cm ²	$+ 0.7$	
>1000 cm ²	± 0.8	
iii) <i>Straightness of sides² (facial sides)</i>		Part 1
The maximum deviation from straightness in % related to the corresponding work size	± 0.3	
iv) <i>Rectangularity²⁾</i>		Part 1
The maximum deviation from rectangularity, in % related to the corresponding work sizes	$+ 0.5$	
Tiles with spacers lugs	$+ 0.3$	
v) <i>Surface flatness</i>		Part 1
The maximum deviation from flatness in % for tiles with spacer lugs values are in mm (in brackets)		
a) Centre curvature, related to diagonal calculated from the work size	$+ 0.5/-0.3(+0.8/-0.1 \text{ mm})$	
b) Edge curvature, related to the corresponding work size	$+0.5/-0.3 (+0.8/-1 \text{ mm})$	
c) Warpage, related to diagonal calculated from the work sizes	$\pm 0.5(\pm 0.5 \text{ mm})$	
vi) <i>Surface Quality</i>	Min 95% of tiles shall be free from visible defects that would impair the appearance of major area of tiles	Part 1
B) Physical Properties		
i) <i>Water absorption % by weight</i>	Average 10-20%. When the value exceeds 20% this shall be indicated by the manufacturer	Part 2
ii) Modulus of rupture in N/mm ²	Average $15 \leq 7.5 \text{ mm}$ thickness Average $12 \leq 7.5 \text{ mm}$ thickness	Part 6
iii) Scratch hardness of surface (Moh's)	Min 3 (walls), Min 5 (floors)	Part 13
iv) Resistance to surface abrasion of tiles intended for floors	Abrasion class shall be specified by the manufacturer	Part 11
v) Co-efficient of linear thermal expansion from ambient temperature to 100°C	$\text{Max } 9 \times 10^{-6} \text{ K}^{-1}$	Part 4
vi) Thermalshock resistance	Required	Part 5
vii) Crazing resistance ³⁾	Required	Part 9
C) Chemicals Properties		
i) Resistance to staining	Min Class 2	Part 8
ii) Resistance to household chemicals and swimming poolswater cleaners except to cleansing agents containing hydrofluoric acid and its compounds	Min Class B	Part 8
ii) Resistance to acids and alkali (with the exception of hydrofluoric acid and its compounds)	Required, if agreed according to the Chemical resistance class indicated by the manufacturer	Part 8
1).For tiles having one or more adjacement glazed tiles.		
2).Not application for tiles having curved shapes.		
3). Certain decorative effects may have the tendency to craze. These shall be identified by the manufaturer in which case the crazing tests not applicable.		

Note — For methods of tests, refer to various parts of IS 13630 Methods of tests for Ceramic tiles

For detailed information, refer to IS 13753:1993 Specification for Dust-pressed ceramic tiles with water absorption of $E > 10\%$ (Group – B111)

SUMMARY OF

**IS 13754 : 1993 DUST – PRESSED CERAMIC TILES WITH
WATER ABSORPTION OF $6\% < E \leq 10\%$
(GROUP B II B)**

1. Scope — Specifies the sizes, dimensional tolerances, mechanical, physical and chemical requirements, surface quality requirements and marking of ceramic tiles.

It is applicable only to dust-pressed ceramic tiles of first quality, including tiles premounted on sheets, with a water absorption of $6\% < E \leq 10\%$ according to Group B- IIb of IS 13712:1993* for interior and exterior use on both floors and walls.

2. Description — The surface of tiles and components belonging to this group can be smooth, profiled, wavy, decorated or finished in some other way. It can be unglazed (UGL), glossy, matt or semi-matt (GL). Although tiles have visible surface and usually a surface which is intended to be adhered and bears a back panel, they may have identical surface without a panel or marking. Tiles may have spacer lugs.

3. Shapes and Sizes

3.1 The modular preferred coordinating sizes (work size+joint width) in cm are M10×10, M15×15, M20×10, M20×15, M20×20 and M30×30. The manufacturer shall choose the work size (dimensions of the visible faces, length and width) in order to allow a nominal joint width between 2 and 5 mm.

3.2 The most common non-modular nominal sizes in cm are 10×10, 15×7.5, 15×10, 15×15, 15.2×7.6, 15.2×15.2, 20×10, 20×20, 25×25, 30×15, 30×20, 30×30 and 40×30. The manufacturer shall choose the work size in such a way that the difference between the work size and the nominal size is not more than ± 2 percent and 5 mm.

3.3 The thickness including profile on the visible face and on the rear side shall be specified by the manufacturer.

Note: For details of shape, refer to Fig 1 and 2 of the standard.

4. Spacer Lug Tiles—Spacer lugs are projections, which are located along certain edges of tiles so that when two tiles are placed together, in line, the lugs on adjacent edges separate the tiles by a distance not less than the specified width of joint. Lugs are positioned so that the joint between the tiles may be filled with grout without the lugs remaining exposed.

Dust-pressed tiles— may be made with other spacer lug systems and in such cases the manufacturer's work size shall apply.

Note — Some tiles have one or more manufacturing projections part way along certain edges and smaller than 0.3 mm. These are not intended as spacer lugs and lugs and should not be used to space joints.

5. Requirements— See Table 1

* Ceramic tiles— definition, classification, characteristics and marking

TABLE 1 REQUIREMENTS

<i>Characteristics</i>		<i>Surface S of the Product (cm²)</i>			
A)	Dimensions and Surface Quality	S ≤ 90	90 < S ≤ 190	190 < S ≤ 410	S > 410
i)	<i>Length and width</i> — The deviation in % of the average size of each tile (2 to 4 sides) from the work size. The deviation in % of the average size of each tile (2 or 4 sides) from the average size of 10 test specimens (20 or 40 sides)	± 1.2	± 1.0	± 0.75	± 0.6
ii)	<i>Thickness</i> — The deviation in % of the average thickness of each tile from the work size thickness	± 0.75	± 0.5	± 0.5	± 0.5
iii)	<i>Straightness of sides¹⁾ (facial sides)</i> — The maximum deviation from straightness in % related to the corresponding work size.	± 10	± 10	± 5	± 5
iv)	<i>Rectangularity¹⁾</i> The maximum deviation from rectangularity in % related to the corresponding work size	± 0.75	± 0.5	± 0.5	± 0.5

Characteristics	Surface S of the Product (cm ²)				Test According to IS 13630
	S ≤ 90	90 < S ≤ 190	190 < S ≤ 410	s > 410	
(A) Dimensions and surface Quality					
i) <i>Length and width</i>					Part 1
e The deviation in % of the average size of each tile (2 or 4 sides) from the work size (W)	± 1.2	± 1.0	± 0.75	± 0.6	
f The deviation in % of the average size of each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides)	± 0.75	± 0.5	± 0.5	± 0.5	
ii) <i>Thickness</i>					Part 1
The deviation in % of the average thickness of each tile from the work size thickness	± 10	± 10	± 5	± 5	
iii) <i>Straightness of sides¹ (facial sides)</i>					Part 1
The maximum deviation from straightness in % related to the corresponding work sizes	± 0.75	± 0.5	± 0.5	± 0.5	
iv) <i>Rectangularity¹⁾</i>					Part 1
The maximum deviation from rectangularity in % related to the corresponding work sizes					
v) <i>Surface flatness</i>					Part 1
The maximum deviation from flatness in:					
a) centre curvature, related to diagonal calculated from the work sizes	± 1.0	± 0.5	± 0.5	± 0.5	
b) Edge curvature, related to the corresponding work size	± 1.0	± 0.5	± 0.5	± 0.5	
c) Warpage, related to diagonal calculated from the work sizes	± 1.0	± 0.5	± 0.5	± 0.5	
vi) <i>Surface quality²⁾</i>	Min 95% of tiles shall be free from visible defects that would impair the appearance of a major area of tiles				Part 1
B Physical Properties					
i) Water absorption % by weight	Average 6 < E ≤ 10 Individual Max 11.0				Part 2
ii) Modulus of rupture in N/mm ²	Average ≤ 18, Individual Min 16				Part 6
iii) Scratch hardness of surface (Mohs' scale)					
a) Glazed tiles	Min 5				
b) Unglazed tiles	Min 6				
iv) Abrasion resistance:					
a) Resistance to deep abrasion of unglazed tiles, removed volume in mm ³	Max 540				Part 12
b) Resistance of abrasion of glazed tiles Class I-IV	Average to the abrasion class indicated by The manufacturer				Part 11
v) co-efficient of linear thermal expansion from ambient temperature to 1000°C (K ⁻¹)	Max 9 × 10 ⁻⁶				Part 4
vi) Thermal shock resistance	Required				Part 5
vii) Craze resistance ³⁾ glazed tiles	Required				Part 9
viii) Frost resistance	Required, if agreed				Part 10
ix) Moisture expansion unglazed tiles mm/m	Max 0.6				Part 3

C) Chemical Properties

i) Resistance to staining of glazed tiles Class 1 - 3	Min Class 2	Part 8
ii) REsistance to household chemicals and swimming pool water cleansers, except to cleansing agents containing hydrofluoric acid and its compounds		
a) Glazed tiles Class AA-D	Min Class B	Part 8
b) Unglazed tiles	Required	Part 7
iii) Resistance to acids and alkalis (with the exception of hydrofluoric acid its comounds)		
a) Glazed tiles Class AA-D	Required if agreed according to the chemical ersistance class indicated by the manufacturer	Part 8
b) Unglazed tiles	Required ⁴⁾	part 7

-
- 1) Not applicable for tiles having curved shapes
 - 2) Because of firing slight vartiations from the standard colour are unavoidable. This does not apply to intentional irregularities of colour variation of the face of dust-pressed tiles of low water absorption(which can be unglazed,glazed, or partly glazed)or to the colour variation over a tile areas which is characteristic for this type of tile and desirable.Spots or coloured dots which are introduced for decorative purposes are not consid ered a defect.
 - 3) Certain decorative effects may have a tendency to craze. These shall be identified by the manufacturer in which case the crazing test is not applicable.
 - 4) If the hue becomes slightly different this is not considered to be chemical attack.

Note 1— For details regarding classification and characteristics, refer to IS 13712:1993 Ceramic tiles- definitions, classifications, characteristics and marking.

Note 2—For methods of tests, refer to various parts of IS 13630 Methods of tests for ceramic tiles.

For detailed information refer to IS 13754:1993 Specification for Dust-pressed ceramic tiles with water absorption of $6\% < E \leq 10\%$ (Group-BII b).

SUMMARY OF
IS 13755 : 1993 DUST- PRESSED CERAMIC TILES
WITH WATER ABSORPTION OF $3\% < E \leq 6\%$
(GROUP – B II A)

1. Scope – Specifies the sizes, dimensional tolerances, mechanical, physical and chemical requirements, surface quality requirements and marking of ceramic tiles.

It is applicable only to dust-pressed ceramic tiles of first quality, including tiles premounted on sheets, with a water absorption of $3\% < E \leq 6\%$ according to Group B IIa of IS 13712 : 1993* for interior and exterior use on both floors and walls.

2. Description— Mosaic is a tile of any geometrical shape whose surface area is equal to or less than 90cm^2 .

The surface of tiles and components belonging to this group can be smooth, profiled, wavy, decorated or finished in some other way. It can be unglazed (UGL), glossy, matt or semi-matt (GL). Although tiles have visible surface and usually a surface which is intended to be adhered and bears a back panel, they may have identical surface without a panel or marking. Tiles may have spacer lugs.

3. Shapes and Sizes

3.1 The modular preferred coordinating sizes (work size + joint width) in cm are M10×10, M15×15, M20×10, M20×15, M20×20 and M30×30. The manufacturer shall choose the work size (dimensions of the visible faces, length and width) in order to allow a nominal joint width

between 2 and 5 mm.

3.2 The most common non-modular nominal sizes in cm are 10×10, 15×7.5, 15×10, 15×15, 15.2×7.6, 15.2×15.2, 20×10, 20×20, 25×25, 30×15, 30×20, 30×30 and 40×30. The manufacturer shall choose the work size in such a way that the difference between the work size and the nominal size is not more than ± 2 percent and 5 mm.

3.3 The thickness including profile on the visible face and on the rear side shall be specified by the manufacturer.

Note—For details of shapes, refer to Fig 1 and 2 of the standard.

4. Spacer Hug Style – Spacerlugs are projections, which are located along certain edges of tiles so that when two tiles are placed together, in line, the lugs on adjacent edges separate the tiles by a distance not less than the specified width of joint. Lugs are positioned so that the joint between the tiles may be filled with grout without the lugs remaining exposed.

Dust – pressed tiles – may be made with other spacer lug systems and in such case the manufacturer's work size shall apply.

Note– Some tiles have one or more manufacturing projections part way along certain edges and smaller than 0.3 mm. These are not intended as spacer lugs and should not be used to space joints.

5. Requirements — See Table 1

*Ceramic tiles— definitions, classification, characteristics and marking

TABLE 1 REQUIREMENTS

<i>Characteristics</i>		Surface S of the Product (cm^2)			
A) Dimensions and Surface Quality		$S < 90$	$90 < S < 190$	$190 < S < 410$	$S > 410$
i)	Length and width— The deviation in % of the average size of each tile (2 of 4 sides) from the work size The deviation in % of the average size of each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides)	± 1.2	± 1.0	± 0.75	± 0.6
ii)	Thickness— The deviation in % of the average thickness of each tile from the work size thickness	± 0.75	± 0.5	± 0.5	± 0.5
iii)	Straightness of sides ¹⁾ (facial sides)— The maximum deviation from straightness in % related to the corresponding work size.	± 10	± 10	± 5	± 5
iv)	Rectangularity ¹⁾ — The maximum deviation from rectangularity in % related to the corresponding work size	± 0.75	± 0.5	± 0.5	± 0.5
		± 1.0	± 0.6	± 0.6	± 0.6

Characteristics	Surface S of the Product (cm ²)				Test According to IS 13630
	S ≤ 90	90 < S ≤ 190	190 < S ≤ 410	s > 410	
(A) Dimensions and surface Quality					
i) <i>Length and width</i>					Part 1
e The deviation in % of the average size of each tile (2 or 4 sides) from the work size (W)	± 1.2	± 1.0	± 0.75	± 0.6	
f The deviation in % of the average size of each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides)	± 0.75	± 0.5	± 0.5	± 0.5	
ii) <i>Thickness</i>					Part 1
The deviation in % of the average thickness of each tile from the work size thickness	± 10	± 10	± 5	± 5	
iii) <i>Straightness of sides¹ (facial sides)</i>					Part 1
The maximum deviation from straightness in % related to the corresponding work sizes	± 0.75	± 0.5	± 0.5	± 0.5	
iv) <i>Rectangularity¹⁾</i>					Part 1
The maximum deviation from rectangularity in % related to the corresponding work sizes					
v) <i>Surface flatness</i>					Part 1
The maximum deviation from flatness in:					
a) centre curvature, related to diagonal calculated from the work sizes	± 1.0	± 0.5	± 0.5	± 0.5	
b) Edge curvature, related to the corresponding work size	± 1.0	± 0.5	± 0.5	± 0.5	
c) Warpage, related to diagonal calculated from the work sizes	± 1.0	± 0.5	± 0.5	± 0.5	
vi) <i>Surface quality²⁾</i>	Min 95% of tiles shall be free from visible defects that would impair the appearance of a major area of tiles				Part 1
B Physical Properties					
i) Water absorption % by weight	Average 3 < E ≤ 6 Individual Max 11.0				Part 2
ii) Modulus of rupture in N/mm ²	Average ≤ 22, Individual Min 20				Part 6
iii) Scratch hardness of surface (Mohs' scale)					
a) Glazed tiles	Min 5				
b) Unglazed tiles	Min 6				
iv) Abrasion resistance:					
a) Resistance to deep abrasion of unglazed tiles, removed volume in mm ³	Max 345				Part 12
b) Resistance of abrasion of glazed tiles Class I-IV	According to the abrasion class indicated by The manufacturer				Part 11
v) co-efficient of linear thermal expansion from ambient temperature to 1000°C (K ⁻¹)	Max 9 × 10 ⁻⁶				Part 4
vi) Thermal shock resistance	Required				Part 5
vii) Crazing resistance ³⁾ glazed tiles	Required				Part 9
viii) Frost resistance	Required, if agreed				Part 10
ix) Moisture expansion unglazed tiles mm/m	Max 0.6				Part 3

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C) Chemical Properties

i) Resistance to staining of glazed tiles Class 1 - 3	<i>Min</i> Class 2	Part 8
ii) REsistance to household chemicals and swimming pool water cleansers, except to cleansing agents containing hydrofluoric acid and its compounds		
a) Glazed tiles Class AA-D	<i>Min</i> Class B	Part 8
b) Unglazed tiles	Required	Part 7
iii) Resistance to acids and alkalis (with the exception of hydrofluoric acid its comounds)		
a) Glazed tiles Class AA-D	Required if agreed according to the chemical ersistance class indicated by the manufacturer	Part 8
b) Unglazed tiles	Required ⁴⁾	part 7

1. Not applicalbe for tiles having curved shapes.
2. Because of firing, slight variations fromthe standard colour are unavoidable. This does not apply to intentional irregularities of colour variation of the face of dust pressed tiles of low water absorption(which can be unglazed, glazed or partly glazed) or to the colour variation over a tile area, which is characteristic for this type of tile and desirable. Spots or coloured dots which are introduced for decorative purposes are not considered defect.
3. Certain decorative effects may have a tendency to craze. These shall be identified by the manufacturer, in which case the crazing test in not applicable.
4. If the hue becomes slightly different this is not considered to be chemical attack,

For detailed information refer to IS 13755:1993 Dust-pressed ceramic tiles with water absorption of $3\% < E \leq 6\%$ (Group—BII a)

SUMMARY OF

IS 13756 : 1993 DUST – PRESSED CERAMIC TILES WITH LOW WATER ABSORPTION OF $E \leq 3\%$ GROUP B1

1. Scope —Specifies the sizes, dimensional tolerances, mechanical, physical and chemical requirements, surface quality requirements and marking of ceramic tiles.

It is applicable only to dust-pressed ceramic tiles including tiles premounted on sheets of first quality, with a low water absorption ($E \leq 3\%$) according to Group BI of IS 13712 : 1993 Ceramic tiles— Definitions, Classifications, Characteristics and marking. For interior and exterior use on both floors and walls.

2. Shapes and Sizes

2.1 The modular preferred coordinating sizes (work size + joint width) in cm are M 10×10, M15×15, M20×10, M20×15, M20×20 and M 30×30. The manufacturer shall choose the work size (dimensions of the visible faces, length and width) in order to allow a nominal joint width between 2 and 5 mm.

2.2 The most common non-dodular nominal sizes in cm are 10×10, 15×7.5, 15×10, 15×15, 15.2×7.6, 15.2×15.2, 20×10, 20×20, 25×25, 30×15, 30×20, 30×30 and 40×30. The manufacturer shall choose the work size in such a way that the difference between the work size and the nominal size is not more than ± 2 percent and 5 mm.

2.3 The thickness including profile on the visible face and on the rear side shall be specified by the manufacturer.

Note— For details of shapes, refer to Fig. 1 and 2 of the standard.

3. Spacer Lug Tiles—Spacer lugs are projections, which are located along certain edges of tiles so that when two tiles so that wen two tiles are placed together, in line, the lugs on adjacent edges separate the tiles by a distance not less than the specified width of joint lugs are positioned so that the joint between the tiles may be filled with grout without the lugs remaining exposed.

Dust–Pressed tiles– may be made with other spacer lug systems and in such cases the manufacturer’s work size shall apply.

Note—Some tiles have one or more manufacturing projections part way long certain edges and smaller than 0.3mm. These are not intended as spacer lugs and shall not be used to space joints.

5. Requirements— See Table 1

TABLE 1 REQUIREMENTS

A).	Characteristics <i>Dimensions and Surface Quality</i>	Surface S of the Product (cm ²)			
		S≤90	90<S≤190	190<S≤410	S>410
i)	<i>Length and width</i> — The deviation in % of the average size of each tile (2 of 4 sides) from the work size The deviation in % of the average size of tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides)	± 1.2	± 1.0	±0.75	±0.6
ii)	<i>Thickness</i> — The deviation in % of the average thickness of each tile from the work size thickness	± 0.75	±0.5	± 0.5	±0.5
iii)	<i>Straightness of sides¹⁾ (facial sides)</i> — The maximum deviation from straightness in % related to the corresponding work size.	± 10	± 10	± 5	±5
iv)	<i>Rectangularity¹⁾</i> — The maximum deviation from rectangularity in % related to the corresponding work size	± 0.75	±0.5	± 0.5	±0.5
v)	<i>Surface flatness</i> The maximum deviation from flatness, in— a) Centre curvature, related to diagonal calculated from the work size	± 1.0	±0.5	± 0.5	±0.5

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Characteristics	Surface S of the Product (cm ²)				Test According to IS 13630
	S ≤ 90	90 < S ≤ 190	190 < S ≤ 410	s > 410	
(A) Dimensions and surface Quality					
i) <i>Length and width</i>					Part 1
e The deviation in % of the average size of each tile (2 or 4 sides) from the work size (W)	± 1.2	± 1.0	± 0.75	± 0.6	
f The deviation in % of the average size of each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides)	± 0.75	± 0.5	± 0.5	± 0.5	
ii) <i>Thickness</i>					Part 1
The deviation in % of the average thickness of each tile from the work size thickness	± 10	± 10	± 5	± 5	
iii) <i>Straightness of sides¹ (facial sides)</i>					Part 1
The maximum deviation from straightness in % related to the corresponding work sizes	± 0.75	± 0.5	± 0.5	± 0.5	
iv) <i>Rectangularity¹⁾</i>					Part 1
The maximum deviation from rectangularity in % related to the corresponding work sizes	± 1.0	± 0.6	± 0.6	± 0.6	
v) <i>Surface flatness</i>					Part 1
The maximum deviation from flatness in:					
a) centre curvature, related to diagonal calculated from the work sizes	± 1.0	± 0.5	± 0.5	± 0.5	
b) Edge curvature, related to the corresponding work size	± 1.0	± 0.5	± 0.5	± 0.5	
c) Warpage, related to diagonal calculated from the work sizes	± 1.0	± 0.5	± 0.5	± 0.5	
vi) <i>Surface quality²⁾</i>	Min 95% of tiles shall be free from visible defects that would impair the appearance of a major area of tiles				Part 1
B Physical Properties					
i) Water absorption % by weight	Average ≤ 3 Individual Max 3.3				Part 2
ii) Modulus of rupture in N/mm ²	Min 27				Part 6
iii) Scratch hardness of surface (Mohs' scale)					
a) Glazed tiles	Min 5				
b) Unglazed tiles	Min 6				
iv) Abrasion resistance:					
a) Resistance to deep abrasion of unglazed tiles, removed volume in mm ³	Max 205				Part 12
b) Resistance of abrasion of glazed tiles Class I-IV	According to the abrasion class indicated by The manufacturer				Part 11
v) co-efficient of linear thermal expansion from ambient temperature to 1000°C (K ⁻¹)	Max 9×10^{-6}				Part 4
vi) Thermal shock resistance	Required				Part 5
vii) Craze resistance ³⁾ glazed tiles	Required				Part 9
viii) Frost resistance	Required				Part 10
ix) Moisture expansion unglazed tiles mm/m					Part 3

C) Chemical Properties

i) Resistance to staining of glazed tiles Class 1 - 3	<i>Min</i> Class2	Part 8
ii) REsistance to household chemicals and swimming pool water cleansers, except to cleansing agents containing hydrofluoric acid and its compounds		
a) Glazed tiles Class AA-D	<i>Min</i> Class B	Part 8
b) Unglazed tiles	Required	Part 7
iii) Resistance to acids and alkalis (with the exception of hydrofluoric acid its comounds)		
a) Glazed tiles Class AA-D	Required if agreed according to the chemical ersistance class indicated by the manufacturer	Part 8
b) Unglazed tiles	Required ⁴⁾	part 7
i) Not applicable for tiles having cured shapes		
ii) Because of firing slight vartiations from the standard colour are unavoidable. This does not apply to intentional irregularities of colour variation of the face of dust-pressed tiles of low water absorption(which can be unglazed,glazed, or partly glazed)or to the colour variation over a tile areas which is characteristic for this type of tile and desirable.Spots or coloured dots which are introduced for decorative purposes are not considered a defect.		
iii) Certain decorative effects may have a tendency to craze. The shall be identified by the manufacturer in which case the crazing test is not applicable.		
iv) If the hue becomes slightly different this is not considered to be chemical attack.		

Note — For methods of tests, refer to IS 13630 methods of test for ceramic tiles.

For detailed information refer to IS 13756:1993 Specification for Dust-pressed ceramic tiles with water absorption $E < 3\%$ (Group— BI)

SUMMARY OF

IS 14862 : 2000 FIBRE CEMENT FLAT SHEETS

1. Scope

1.1 This standard covers the characteristics and establishes methods of control and test as well as acceptance conditions for fibre cement flat sheets.

It covers sheets intended for external applications, such as cladding facades, curtain walls, soffits, etc, and sheets intended for internal use, such as partitions, floors, ceiling, etc, with a wide range of properties appropriate to the type of application. These sheets may have either a smooth or textured surface.

1.2 This standard does not apply to the following products, most of which are covered under separate standard:

- a) Asbestos cement flat sheets;
- b) Asbestos cement building boards;
- c) Gypsum plaster board;
- d) Boards of cement reinforced with fibrous wood particles;
- e) Fibre cement slates and siding shingles;
- f) Silica- asbestos-cement flat sheets; and
- g) Non- combustible fibre-reinforced boards of calcium silicate or cement for insulation and fire protection.

2. Classification

2.1 Flat sheets covered by this standard shall be of two types, namely, Type A and Type B.

- a) *Type A* — Type A sheets are intended for external applications where they may be subjected to the direct action of sun, rain and/or snow. They may be supplied coated or uncoated. Type A sheets shall comply with the requirements of the type characteristics given in 6.
- b) *Type B* — Type B sheets are not subjected to the type tests and are intended for internal applications and external applications where they will not be subjected to the direct action of sun, rain and/or snow.

Note — If sheets of type B are used in external applications where they are directly exposed to the weather but are protected (for example, coating or impregnation), the weather resistance of the product is determined by the quality of the protection and methods for control and test are outside the scope of this standard.

2.2 The sheets are further classified into five categories according to their modulus of rupture as given in Table 1.

2.3 The manufacturer shall declare the type and category of his product in his literature.

3. Acceptance Characteristics

3.1 Dimensional and Geometrical Characteristics

3.1.1 Nominal length and width — Flat fibre cement sheets shall be available in nominal lengths up to 3000 mm and nominal widths up to 1220 mm. Sheets of greater nominal lengths and widths may be supplied as agreed between the manufacturer and the supplier.

Note — The nominal dimensions (width and length) may be creased by 20 to 30 mm (over size sheets) for application where the sheet is required to be cut by the user.

3.1.2 Thickness — Flat fibre cement sheets shall normally be available in thickness from 3 to 9 mm.

3.1.3 Tolerances on dimensions — Tolerances on nominal dimensions shall be as follows—

- a) On length and width (indicated by d)

$$d \leq 1000 \text{ mm} : \pm 5 \text{ mm}$$

$$1000 \text{ mm} < d \leq 1600 \text{ mm} : \pm 0.5 \text{ mm}$$

$$d \leq 1600 \text{ mm} : \pm 8 \text{ mm}$$

These tolerances do not apply to oversize sheets.

- b) On thickness, e —

$$e \leq 6 \text{ mm} : \pm 0.6 \text{ mm}$$

$$e > 6 \text{ mm} : \pm 0.10 \text{ percent}$$

For sheets without texture on the exposed face, the maximum difference between extreme values of the thickness measurements within one sheet shall not exceed 15 percent of the maximum measured value.

Note—Tighter tolerances may be adopted by agreement between the manufacturer and the purchaser.

3.1.4 Tolerance on shape

3.1.4.1 Straightness of edges—The tolerance on the straightness of edges shall be 3 mm/m for the relevant dimension (length or width).

3.1.4.2 Squareness of edges—The tolerance on the squareness of sheets shall be 4 mm/m

Note—Tighter tolerances may be adopted by agreement between the manufacturer and the purchaser.

3.2 Mechanical and Physical Characteristics—Where the product is supplied coated, the following mechanical and physical specifications shall apply to the coated (that is finished) product. When sampling is to be done from continuous production, testing of the base sheet prior to coating is acceptable when it can be shown that there is a correlation between the results of y tests on sheets with and without coating.

3.2.1 Bending Strength—shall be as specified in Table 1. The modulus of rupture shall be the average of the values obtained from testing the samples in both directions.

TABLE 1 MINIMUM MODULUS OF RAPTURE		
<i>Category</i>	<i>Modulus of Rapture, Min (MPa)</i>	
	Type A Sheet	Type B Sheet
(1)	(2)	(3)
1	—	4
2	—	7
3	7	10
4	13	16
5	18	22

Type A sheet strength shall only be specified in the wet condition and the specimens shall be tested in the wet condition.

Type B sheet strengths shall only be specified in the equilibrium condition and the specimens shall be tested in the equilibrium condition. When sampling is to be done from continuous production, these sheets may be tested on dry or saturated specimens, provided a relationship can be established between the equilibrium values and the dry or saturated values.

Note — If the manufacturer includes product strengths in his literature, it should be clearly stated whether they are mean or minimum values.

3.2.2 Apparent density—shall be not less than the

value specified by the manufacturer.

3.2.3 Other characteristics—The manufacturer shall provide such technical data as is necessary to confirm the suitability of the product for any particular recommended application.

4. Type Characteristics — This clause applies to Type A sheets only. These tests shall be carried out on products as delivered. Where the tests are carried out on coated sheets, this shall be stated in the report.

4.1 Bending Strength—Shall not be less than the values for the appropriate category specified in Table 1. When tested in equilibrium and wet condition. In addition, the mean modulus of rupture under wet conditions shall be not less than 50 percent of the mean modulus of rupture under equilibrium conditions.

4.2 Water Impermeability—Traces of moisture may appear on the underside of the sheet, but in no instance shall there be formation of drops of water.

4.3 Frost Resistance— For sheets for frost resistant applications, after 50 freeze-thaw cycles, the limit L_f of the average ratio r shall not be less than 0.75.

4.4 Warm Water—The limit L_f of the average ratio r shall be greater than 0.75.

4.5 Soak-Dry— The limit L_f of the average ratio r shall be greater than 0.75.

4.6 Heat-Rain—Any visible cracks, delamination or other defects in the sheets shall not be of a degree such as to affect their performance in use.

5. Tests

5.1 Acceptance Tests

- Dimensional and Geometrical characteristics (compulsory)
- Bending Strength (compulsory)
- Apparent density (compulsory)

5.2 Type Test—The following type tests shall be carried out:

- Bending strength
- Water impermeability
- Freeze-thaw
- Warm- water
- Soak-dry
- Heat-rain test

Warm-water, Freeze-thaw and heat-rain test are optional tests as per the requirement of the purchaser.

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6. Safety Rules

- a) *Production Identification*—Sheet shall be marked with indelible characters to show that they do not contain asbestos.
- b) *Information to Users*—The company should, through its distribution system, supply adequate information to the users concerning safety precautions to be taken during handling or machining of products and that excessive exposure to dust by cutting, drilling, sanding and turning or similar operations should be

avoided by one or several of the following means

- 1) Using low speed power tools,
- 2) Wetting the product,
- 3) Using personal protective equipment (respirator), and
- 4) Use of hand-tools.

Note 1— For method of measurement of different dimensions of sheets refer to Annex. B of the standard.

Note 2— For method of tests, refer to Annex. C, D, E, F, G, H and J of the standard.

For detailed information refer to IS 14862 : 2000 Specification for fibre cement flat sheets.

SUMMARY OF

IS 14871 : 2000 PRODUCTS IN FIBRE REINFORCED CEMENT—LONG CORRUGATED OR ASYMMETRICAL SECTION SHEETS AND FITTINGS FOR ROOFING AND CLADDING

1. Scope

1.1 This standard covers the requirement for straight fibre cement profiled sheets of more than 0.9 m length and their fittings used as roofing and cladding materials. It also specifies tests for checking these characteristics as well as marking and conditions for acceptance.

1.2 Some of these requirements may apply, after agreement between the manufacturer and the purchaser, to curved corrugated sheets.

1.3 This standard does not apply to asbestos cement profiled sheets which are covered by IS 459.

2. Sheets

2.1 General Appearance and Finish—The surface of the sheets intended to be exposed to the weather shall

Type A —The thickness of the sheets shall be approximately constant throughout the width of profile.

Type B — The thickness of the sheets shall vary regularly between the valley and the crown for corrugated sheets or between the lower part and the upper part of ribs for asymmetrical section sheets, in the same cross-section.

2.2.3 According to minimum breaking load in

be gradually of smooth finish. Variations of the surface appearance, due to the method of manufacture, which do not impair the strength or performance of the sheets, are permitted.

The sheets may be left with their natural colour or colouring matter may be added in the composition. They may also receive adherent coloured or uncoloured coating in their either side surfaces.

2.2 Classification

2.2.1 According to nominal height of corrugations—The sheets shall be of categories based on height of their corrugations, *h* and minimum thickness, *e* in accordance with Table-1.

2.2.2 According to thickness—

Bending — For each category of sheet the minimum breaking load requirement shall be as given in Table 1.

2.3 Characteristics

2.3.1 Dimensions—Nominal dimensions shall be declared by the manufacturer. Standard dimensions for corrugated sheet shall include length; overall width, effective nominal thickness of sheet, and depth and pitch of corrugation. The profile and other dimensions shall be tested in accordance with Annex. B of the standard.

2.3.2 Tolerances on dimensions—Following tolerances

TABLE 1 CATEGORY AND CLASS (MINIMUM BREAKING LOAD IN N/M)

Category	Minimum Thickness, <i>e</i> , mm	Class									
		1	2	3	4	5	6	7	8	9	10
A (15 mm ≤ <i>h</i> ≤ 55 mm)	3	600	800	1000	1400	—	—	—	—	—	—
B (25 mm ≤ <i>h</i> ≤ 55 mm)	4	—	—	1000	1400	2000	2500	3300	—	—	—
C (40 mm ≤ <i>h</i> ≤ 80 mm)	4.5	—	—	—	1400	2000	2500	3300	—	—	—
D (60 mm ≤ <i>h</i> ≤ 150 mm)	5.5	—	—	—	—	—	—	3300	4250	5600	7400

Note — The sheet being commonly manufactured in India at the time of formulation of this standard fall under category B and C and Class 7.

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shall apply to nominal dimensions given by manufacturer:

- a) Tolerance on pitch a —
- | | | |
|--|--------------|----|
| $a \leq 75 \text{ mm}$ | +4.0
-2.0 | mm |
| $75 \text{ mm} < a \leq 180 \text{ mm}$ | +6.0
-2.0 | mm |
| $180 \text{ mm} < a \leq 260 \text{ mm}$ | +8.0
-3.0 | mm |
| $260 \text{ mm} < a$ | +9.0
-3.0 | mm |
- Tolerance for pitch of corrugation relates to measurement over extreme corrugation
- b) Tolerance on height of corrugation, h —
- | | |
|---|-----------------------------|
| $15 \text{ mm} \leq h \leq 45 \text{ mm}$ | $\pm 2 \text{ mm}$ |
| $45 \text{ mm} < h \leq 150 \text{ mm}$ | $\pm 3 \text{ mm}$
$- 5$ |
- c) *Tolerance on length* $\pm 10 \text{ mm}$
- d) Tolerance on overall Width and effective width,
- | | | |
|-------|------------|----|
| W_e | +10
- 5 | mm |
|-------|------------|----|
- e) Tolerance on nominal thickness, e : ± 10 percent but not more than $\pm 0.6 \text{ mm}$ of the nominal thickness.
- f) Out of squareness of sheets—less than 10mm.
- g) Tolerance on height of edges — The producer shall specify this tolerance in their literature when it is necessary to ensure the weather tightness of the roof, only for sheets having an ascending edge one side and a descending edge on the other side.

2.3.3 Mechanical characteristics

Note — For non-roofing and cladding applications, alternative mechanical characteristics may be agreed between the manufacturer and the purchaser.

2.3.3.1 Breaking load—Sheet shall have a breaking load at least equal to the requirements specified in Table 1.

2.3.3.2 Deflection—When tested as prescribed, the increase in deflection f_p between applying 20 percent ($f_{0.2}$) and 70 percent ($f_{0.7}$) of the load specifying the class shall not exceed the conventional value, f given by the following equation:

$$f = 0.7 \times 10^{-3} \times \frac{I_2}{h}$$

2.3.4 Physical characteristic

2.3.4.1 Impermeability—Traces of moisture may appear on the under face of the sheet but in no instance shall there be any formation of water drops during 24 h of the test.

2.3.4.2 Frost resistance—Any visible cracks, ination or other defects in the sheets, shall not be of a degree as to affect their performance in use.

2.3.4.3 Apparent density—Shall have an apparent density equal to value indicated by the manufacturer with a tolerance of ± 10 percent.

2.3.4.4 Warm water—Any visible cracks, delamination or other defects in the sheets shall not be of a degree as to affect their performance in use.

2.3.4.5 Heat-rain—Any visible cracks delamination or other defects in the sheets shall not be of a degree as to affect their performance in use.

3. Tests

3.1 Acceptance Tests

3.1.1 Compulsory tests

- a) Dimensions and
- b) Mechanical characteristics : breaking load

3.1.2 Optional tests (at purchaser's request) Apparent density

3.2 Type Tests

- a) Mechanical characteristics: deflection
- b) Impermeability,
- c) Frost resistance,
- d) Warm water and
- e) Heat-rain.

Frost resistance, warm water and heat-rain tests are optional tests as per the requirements of the purchaser.

4. Fittings

4.1 General Appearance at Finish — Fittings are components with particular shapes which are fitted to profiled sheets and complete the roofing at the verge, ridge and eaves or perform functions such as ventilation, daylight-admission etc.

Fittings shall have straight and clean edges. They may have lapping joints. They may be left in their natural colour or colouring matter may be added in the composition. They may also receive adherent coloured or uncoloured coatings on their surface.

4.2 Characteristics

4.2.1 Dimensions—Shall have dimensions and tolerances appropriate for use with their corresponding sheets.

4.2.2 Frost resistance (type characteristics)—Any visible cracks, delamination or other defects in the fittings should not be of a degree as to affect their performance in use.

5. Safety Rules

a) *Product Identification* — Sheets shall be marked with indelible characters to show that they do not contain asbestos.

b) *Information to Users* — The manufacturer should, through its distribution system, supply adequate information to the users concerning safety precautions to be taken during handling or machining of products, like excessive exposure to dust by cutting, drilling, sanding and turning or similar operations should be avoided by one or several of the following means:

- 1) Using low speed power tools,
- 2) Wetting the product,
- 3) Using personal protective equipment, (respirators), and
- 4) Use of hand-tools.

Note– 1. For method of testing profile and other dimensions, refer to Annex B of the standard.

Note– 2. For method of tests, refer to Annex C & D of the standard.

For details refer to IS 14871 : 2000 Specification for products in fibre reinforced cement— Long corrugated or asymmetrical section sheets and fittings for roofing and cladding

SUMMARY OF
IS 1195 : 2002 BITUMEN MASTIC FOR FLOORING
(Second Revision)

1. Scope— Specifies requirements for four grades of bitumen mastic for building, composed of ground limestone, coarse aggregate and pigment, if required, incorporated with asphaltic cements. This standard does not cover special grades of bitumen mastic flooring such as chemical resistant, oil resistant or spark free flooring, for these purpose special bitumen mastics are available. A guide to the selection of the appropriate grade is given in Appendix A of the standard.

2. Grades—Bitumen mastic floorings are graded according to usage as follows:

Grade I	Special flooring
Grade II	Light duty flooring
Grade III	Medium duty flooring
Grade IV	Industrial factory flooring

Grades I and II may be used as a polished flooring for light traffic or as an underlay to other floor coverings.

3. Materials

3.1 Bitumen used shall conform to the requirements in Table 1.

3.2 Aggregate

3.2.1 Fine Aggregate — The fine aggregate shall consist of naturally occurring limestone rock ground to a grading as given in Table 2, and shall have a calcium carbonate content of not less than 80 percent by weight

3.2.2. Coarse Aggregate : The coarse aggregates shall consist of clean igneous or calcareous rock or siliceous material obtained from natural deposits either directly or by screening, crushing or other mechanical process, as free from dust as is practicable. Where limestone chippings are used for flooring, the quality of the limestone shall be such that the aggregate crushing value shall not be greater than 28. The percentage and size of coarse aggregate incorporated in the bitumen mastic will be dependent primarily upon the thickness of the finished work. The size shall be within the limits specified in Table 3. The percentage shall be such that the total percentage of material retained on a 600-micron IS Sieve, on analysis of the bitumen mastic as laid, including the material derived from the fine aggregate, shall fall within the appropriate limits specified in Table 3.

TABLE 1 PHYSICAL PROPERTIES OF BITUMEN

SL No.	Characteristics	Requirements for Grade I		Requirements for Grades II, III & IV	
		Mastic Asphalt for Flooring	Coloured Mastic Asphalt for Flooring	Mastic Asphalt for Flooring	Coloured Mastic Asphalt for Flooring
(1)	(2)	(3)	(4)	(5)	(6)
i)	Penetration at 25°C	—	—	5 to 15	5 to 15
ii)	Softening point (ring & ball), Max	105°C	105°C	100°C	100°C
iii)	Solubility in CS ₂ , percent Min	60	60	99.5	60
iv)	Ash content (mineral matter), Max, percent by mass	30	30	0.5	30
v)	Loss on heating for 5h at 163°C, percent by mass, Max	2.0	2.0	2.0	2.0

TABLE 2 GRADING OF FINE AGGREGATES

S.I No.	Grading	Percentage By Weight*	
		Min	Max
(1)	(2)	(3)	(4)
i)	Passing 75-micron IS Sieve	45	55
ii)	Passing 212-micron IS Sieve and retained on 75-micron IS Sieve	10	30
iii)	Passing 600-micron IS Sieve and retained on 212-micron IS Sieve	10	30
iv)	Passing 2.36-mm IS Sieve and retained on 600-micron IS Sieve	5	20
v)	Retained on 2.36-mm IS Sieve	—	Nil

* Determined by the wet sieving method

TABLE 3 PERCENTAGE AND SIZE OF COARSE AGGREGATE FOR BITUMEN MASTIC FOR FLOORING AND COLOURED BITUMEN MASTIC FOR FLOORING

S.I No.	Grade	Aggregate Size and Type of Coarse	Percentage	Thickness
(1)	(2)		(3)	(4)
	I and II	Retained on 600-micron IS Sieve 85% Min Passing 4.75mm IS Sieve 100%	15-25	15-20
	III	Retained on 600-micron IS Sieve 85% Min Passing 4.75mm IS Sieve 100%	25-35	20-30
	IV	Retained on 600-micron IS Sieve 95% Min Passing 9.5mm IS Sieve 90%	30-50	30-50

4. Composition – See Table 4**TABLE 4 COMPOSITION OF BITUMEN MASTIC**

Requirement	Percentage By Mass	
	Min	Max
(1)	(2)	(3)
Soluble bitumen	12.0	18.0
Passing 75-micron IS Sieve	40.0	56.0
Passing 212-micron IS Sieve and retained on 75- micron IS Sieve	8.0	25.0
Passing 600-micron IS Sieve and retained on 212 micron IS Sieve	8.0	32.0

Note— Percentage by mass of bitumen mastic excluding the material retained on a 600-micron IS Sieve.**5. Hardness Number** — The hardness number of the bitumen mastic shall be as follows—**a) At the time of manufacture—**

Grade I	Not more than 15 at 45° C (after addition of specified coarse aggregates)	Grade IV	Not more than 40 at 35° C (before addition of specified COARSE aggregate)
Grade II & III	Not more than 12 at 35° C (after addition of specified coarse aggregates)	b) At the time of laying—	

Grade I	Not less than 2 nor more than 12 at 45°C
Grade II & III	Not less than 2 nor more than 12 at 35°C.

Note—For methods of tests for bitumen, refer to
 IS 1203:1978 Determination of penetration.
 IS 1205:1978 Determination of softening point.
 IS 1208:1978 Determination of ductility.
 IS 1212:1978 Determination of loss on heating.
 IS 1217:1978 Determination of mineral matter (ASH).

For detailed information refer to IS 1195 : 2002 Specification for bitumen mastic for flooring (third revision).

SUMMARY OF
IS 5317 : 2002 BITUMEN MASTIC FOR BRIDGE
DECKING AND ROADS
(Second Revision)

1. Scope — Requirements for bitumen mastic used as a surfacing material for bridge decks and roads.

2. Materials

2.1 Bitumen — See Table 1

TABLE 1 PHYSICAL PROPERTIES OF BITUMEN

SL. No. (1)	Characteristic (2)	Requirements (3)
i)	Softening point (ring and ball method)	50 to 90°C
ii)	Penetration at 25°C in 1/100 cm	10 to 40
iii)	Ductility at 27°C, <i>Min</i> in cm	3
iv)	Loss on heating, percent, <i>Max</i>	1
v)	Solubility in carbon disulphide, percent <i>Min</i>	99

2.2 Filler The filler shall be lime stone powder passing 75-micron IS Sieve and shall have a calcium carbonate content of not less than 80 percent by weight.

2.3 Aggregates

2.3.1 Fine Aggregate — Fine aggregate shall consist of naturally occurring sand or crushed lime stone or crushed hard-rock. The grading of the fine aggregates inclusive of the filler is given in Table 2 for guidance.

TABLE 2 GRADING OF FINE AGGREGATES

<i>S.l No.</i>	<i>Passing IS Sieve</i>	<i>Retained on IS Sieve</i>	<i>Percentage by mass</i>	
(1)	(2)	(3)	<i>Min</i>	<i>Max</i>
i)	75 - micron	—	0	5
ii)	212 - micron	75 micron	10	20
iii)	600 - micron	212 micron	5	35
iv)	2.36 mm	600 micron	0	25

Note— For methods of tests for bitumen, refer to
 IS 1203:1978 Determination of penetration.
 IS 1205:1978 Determination of softening point.
 IS 1208:1978 Determination of ductility.
 IS 1212:1978 Determination of loss on heating.
 IS 1216:1978 Determination of solubility in carbon disulphide trichloroethylene.

2.3.2 Coarse Aggregate — Coarse aggregate shall consist of hard durable crushed rock having aggregate impact value of not more than 20 and abrasion value not more than 40.

3. Hardness Number — The bitumen mastic whose composition is given at Table 3 before the addition of coarse aggregate, shall have hardness number of 60 to 80 at 25°C.

4. Composition — See Table 3

TABLE 3 COMPOSITION OF BITUMEN MASTIC (WITHOUT COARSE AGGREGATE)

<i>Requirement Mastic</i> (1)	<i>Percentage by Weight of Without Coarse Aggregate</i>	
	<i>Min</i> (2)	<i>Max</i> (3)
i) Bitumen	14	17
ii) Passing 75-micron IS Sieve	25	45
iii) Passing 212 micron IS Sieve 8 and retained on 75-micron IS Sieve		18
iv) Passing 600-micron IS Sieve 4 and retained on 212-micron IS Sieve		30
v) Passing 2.36mm IS Sieve and 0 retained on 600-micron IS Sieve		22

For detailed information refer to IS 5317 : 2002 Bitumen mastic for bridge decking and roads (second revision).

SUMMARY OF

IS 8374 : 1977 BITUMEN MASTIC, ANTI-STATIC AND ELECTRICALLY CONDUCTING GRADE

1. Scope — Requirements of bitumen mastic for anti-static and electrically conducting grade.

Note —In locations where it is necessary to take precautionary measures against the accumulation of static electricity, flooring should have uniform electrical conductance to a degree which will always ensure that under the fastest rate of generation of any charge that can possibly occur in practice, a dangerous potential can not exist.

2. Terminology

2.1 Electrically Conducting— Having a upper limit of resistance of 5×10^4 ohms.

2.2 Anti-static — Having a resistance of over 5×10^4 ohms and less than 10^8 ohms.

3. Materials

3.1 Bitumen — Requirements shall conform to as specified in Table 1.

TABLE 1 PHYSICAL PROPERTIES OF BITUMEN

Sl.No. (1)	Characteristic (2)	Requirement (3)
i)	Softening point (ring and ball method)	65 to 100°C
ii)	Penetration at 25°C in 1/100cm	5 to 20
iii)	Ductility at 27°C, <i>Min</i> , in cm	2
iv)	Loss on heating, percent, <i>Max</i>	0.3
v)	Solubility in CS ₂ , percent, <i>Min</i>	99

Note —Industrial bitumen of the grades 90/15 and 75/15 conforming to IS 702:1988 'Specification for industrial bitumen (second revision) are two typical examples of binder which will satisfy the requirements of this table.

3.2 Aggregates and Fillers—The aggregates and fillers used in preparing bitumen mastic should be of inert

Note— for methods of tests for bitumen, refer to:

IS 1203:1978	Determination of penetration.
IS 1205:1978	Determination of softening point.
IS 1208:1978	Determination of ductility.
IS 1212:1978	Determination of loss on heating.
IS 1216:1978	Determination of solubility in carbon disulphide trichloroethylene.

For detailed information, refer to IS 8374 : 1977 Specification for bitumen mastic, anti-static and electrically conducting grade.

nature and should have the grading as given below—

Sieve Designation		Percentage by Mass
Passing IS Sieve	Retained on IS Sieve	
75- micron	—	45 to 55 (filler)
212- micron	75- micron	10 to 30
600- micron	212- micron	10 to 30
2.36- mm	600- micron	5 to 20
—	2.36 mm	Nil

4. Composition

4.1 Bitumen mastic composition for electrical conducting and anti-static grade are made by incorporating bitumen in conjunction with other suitable materials like carbon black of the conductive grade like graphite.

4.1.1 The bitumen content shall be between 13 to 18 percent by mass of the total mastic.

Note — For method of preparation of bitumen mastic, refer to clause 4.2 of the standard.

5. Properties

5.1 Hardness number of bitumen mastic as laid shall be 4 to 12 at 35°C unless otherwise agreed to mutually.

5.2 Resistance of product after being manufactured shall have electrical conductance between 5×10^4 ohms and 2×10^6 ohms.

SUMMARY OF IS 9510 : 1980 BITUMEN MASTIC, ACID – RESISTING GRADE

1. Scope — Requirement for bitumen mastic of acid-resisting grade used as an underlay to acid-proof bricks, tiles or stones.

2. Materials

2.1 Bitumen— The physical properties of bitumen used shall conform to those specified in Table 1

**TABLE 1 PHYSICAL PROPERTIES OF
BITUMEN**

Sl. No. (1)	Characteristics (2)	Requirement (3)
i)	Softening point, °C	65 to 140
ii)	Penetration at 25°C in 0.01 cm	5 to 20
iii)	Loss on heating, percent by mass, <i>Max</i>	0.3
iv)	Solubility in carbon disulphide percent by mass, <i>Min</i>	99

2.2 Aggregates

2.2.1 Filler—The filler shall be the portion passing through 75-micron IS Sieve.

2.2.2 Fine Aggregates—The aggregates shall be siliceous in nature and shall have the grading as specified in Table 2.

2.2.3 Coarse Aggregates— Coarse aggregates when used shall conform to IS 383:1970* and shall consist of either crushed siliceous stones or any approved aggregates free from foreign material. These shall not be affected by acids. The size of coarse aggregates for various thicknesses of bitumen mastic shall be as specified in Table 3.

2.3.4 The coarse aggregates, fine aggregates and filler shall not contain matter soluble in hydrochloric acid more than 5 percent by mass.

* Coarse and fine aggregates from natural sources for concrete (second revision)

TABLE 2 GRADING OF FINE AGGREGATES

Sl. No. (1)	Grading (2)	Percent by Mass (3)
i)	Passing 75-micron IS Sieve	45 to 55 (filler)
ii)	Passing 212-micron IS Sieve and retained on 75-micron IS Sieve	10 to 30
iii)	Passing 600-micron IS Sieve and retained on 212-micron IS Sieve	10 to 30
iv)	Passing 2.36 mm IS Sieve and retained on 600 micron IS Sieve	5 to 20
v)	Retained on 2.36 mm IS Sieve	Nil

**TABLE 3 SIZE OF COARSE AGGREGATES
FOR USE IN BITUMEN MASTIC**

Thickness of Each Layer of the mastic (1)	Size of Aggregates (2)	Percentage by mass (3)
10mm	No coarse aggregates may be incorporated	—
15mm	Passing 4.75mm IS Sieve. Retained	100
20mm	on 600 micron IS Sieve Passing 4.75mm IS Sieve Retained	85Min 100
25mm	on 600-micron IS Sieve Passing 10mm IS Sieve retained on 2.36mm IS Sieve	95Min 100 95Min

3. Composition — See Tables 4 and 5

**TABLE 4 PERCENTAGE OF COARSE
AGGREGATES**

Sl No.	Thickness of Each Layer of the Mastic (2)	Percentage of Coarse Aggregates by Mass of Total Mastic (3)
i)	15 mm	15 to 30
ii)	20 to 25 mm	20 to 35
iii)	25 to 30 mm	30 to 45

TABLE 5 COMPOSITION OF BITUMEN MASTIC

<i>Sl No.</i>	<i>Requirement</i>	<i>Percentage by Mass of Bitumen Mastic Excluding the Coarse Aggregate</i>
(1)	(2)	(3)
i)	Soluble bitumen	13 to 18
ii)	Grading of aggregate	
	Passing 75-micron IS Sieve	45 to 55
	Passing 212 micron IS Sieve and retained on 75-micron IS Sieve	8 to 32
	Passing 600-micron IS Sieve and retained on 212 micron IS Sieve	8 to 30

Note 1— For guidance on performance and recommendation for use of bitumen mastic, refer to Table 6 of the standard.

Note 2— For methods of tests for bitumen, refer to:

IS 1203:1978 Determination of penetration.

IS 1205:1978 Determination of softening point.

IS 1212:1978 Determination of loss on heating.

IS 1216:1978 Determination of solubility in Carbon disulphide trichloroethylene.

4. Properties

4.1 Hardness Number— Unless otherwise agreed between the purchaser and the user, the hardness number of bitumen mastic as laid shall be 4 to 12 at 35°C

4.2 Acid-Resistance— The test specimens shall be subjected to acid-resistance test. The test specimen shall be observed for change of mass, surface cracks, loss of gloss, etching, pitting, and softening. The concentration of acid solutions to which the specimens to be are tested shall be as specified by the user.

4.2.1 The immersion medium shall be observed for discolouration and the formation of sediments.

For detailed information, refer to IS 9510 :1980 Specification for bitumen mastic, acid -resisting.

SUMMARY OF

IS 12583 : 1988 CORRUGATED BITUMEN ROOFING SHEETS

1. Scope—Requirements of corrugated bitumen roofing sheets used as light roofing material.

2. Material

2.1 The bitumen shall conform to IS 73:1992.*

2.2 The paper board used in the manufacture of bitumen roofing sheets shall conform to the requirements given in Table 1.

**TABLE 1 REQUIREMENTS OF
PAPER BOARD**

Sl. No. (1)	Characteristic (2)	Requirement (3)
i)	Thickness, mm	3 to 5
ii)	Weight, kg/m ² for 3 mm thick	1.50
	for 4 mm thick	2.00
	for 5 mm thick	2.50
iii)	Ash content, percent	7
iv)	Tensile strength, kg/cm ²	25
v)	Breaking load for 300 mm span, 750 mm width	60kg

3. Dimensions and Tolerances

3.1 The standard size of the sheets shall be as follows:

Length (mm)	Width (mm)	Thickness (mm)	Depth of Corrugation (mm)	Pitch of Corrugation (mm)
1 200	750	3 to 5	35	90
1 800	900	3 to 5	35	90

3.2 The permissible tolerances on dimensions specified in 3.1 shall be as follows :

Dimensions	Tolerances in mm
Length	±5
Width	±20
Thickness	±1

* Paving bitumen (second revision).

4. Mass — See Table 2

TABLE 2 WEIGHT OF SHEETS

Sl. No. (1)	Size (2) mm	Thickness (3) mm	Mass (4) kg
i)	1 200×750	3	3±0.2
		4	4±0.2
		5	5±0.2
ii)	1 800×900	3	5.4±0.2
		4	7.2±0.2
		5	9.0±0.2

5. Physical Requirements — See Table 3

TABLE 3 REQUIREMENTS OF CORRUGATED BITUMEN ROOFING SHEETS

Sr. No. (1)	Characteristic (2)	Requirement (3)
i)	Bitumen Content	Not to exceed 50 ± 5 percent
ii)	Uniformity of impregnation	Bitumen content in outer and central layers of the sheet shall not vary by more than 5 percent
iii)	Ash content	Shall not be more than 10 percent
iv)	Breaking load	100 kg (1000 N), minimum for all thickness
v)	Water absorption	Shall not be more than 8 percent
vi)	Impermeability	No water or moisture on the lower surface of the test specimen shall be visible or felt
vii)	Impact resistance	Shall not tear, break or crack
viii)	Wet load bearing capacity	The specimen shall not crack and sag and shall recover from the deflection, if any
ix)	Accelerated weathering (type test)	Shall be free from cracks, colour change or any other surface defects. there shall be no change in flexibility and overall appearance when compared to unexposed sheets
x)	Temperature	a) Shall be no softening or any apparent susceptibility change of colour, finish etc. b) Shall not crack or deform

6. Finish—The sheets shall have true shape, good appearance and shall be free from visible defects. The corrugations shall be true and regular. The edges of the sheets shall be straight and clean. External surface of

the sheets shall be painted with aluminium paint.

7. Packing—The sheets shall be packed in accordance with the usual trade practice to avoid damage, discoloration, deformation etc.

Note: For methods of tests, refer to Appendices A to K of the standard.

For detailed information, refer to IS 12583 :1988 Specification for corrugated bitumen roofing sheets.

SUMMARY OF

IS 13026 : 1991 BITUMEN MASTIC FOR FLOORING FOR INDUSTRIES HANDLING LPG AND OTHER LIGHT HYDROCARBON PRODUCTS

1. Scope

1.1 Requirements of bitumen mastic flooring for industries handling LPG and other light hydrocarbon products.

1.2 This standard is also applicable for explosive and crackers manufacturing factories, ordinance factories, ammonia depots, etc.

1.3 This standard is not applicable for less volatile materials such as kerosene, diesel and lubricating oil.

2. Materials

2.1 Bitumen — Properties of bitumen shall be as specified in Table 1.

TABLE 1 PHYSICAL PROPERTIES OF BITUMEN

Sl (1)	Characteristic (2)	Requirement (3)
i)	Softening point (ring and ball method)	65 to 100°C
ii)	Penetration at 27°C in 1/100 cm	10 to 40
iii)	Loss on heating, % <i>Max</i>	0.3
iv)	Solubility in CS ₂ , % <i>Min</i>	99
v)	Ductility at 27°C, <i>Min</i>	2

2.2 Aggregates and fillers — Aggregates and fillers used in preparing bitumen mastic should be lime stone

and other carbon black/graphite materials. The lime stone should have calcium carbonate content of maximum 75%. The combined grading of aggregates shall be as specified in Table 2.

TABLE 2 GRADING OF AGGREGATES AND FILLERS

Sieve Designation		Percentage by Mass
Passing IS Sieve	Retained on IS Sieve	
90 microns	—	45 to 55
212 microns	90 microns	10 to 30
600 microns	212 microns	10 to 30
2.36 mm	600 microns	5 to 20
—	2.36	Nil

3. Composition— Bitumen mastic composition is made by adding suitable materials like carbon black/graphite of conducting type. The bitumen content shall be between 13 and 18 percent by mass of the total mastics. Carbon black/graphite content shall be finer than 90 micron IS Sieve with carbon content more than 60 percent by mass.

4. Properties— The hardness number of bitumen mastic shall be 4 to 12 at 35°C. The resistance of products after being manufactured shall have electrical resistance between 5×10^{-4} ohms and 2×10^6 ohms

Note— For methods of tests for bitumen, refer to

IS 1203:1978 Determination of penetration.

IS 1205:1978 Determination of softening point.

IS 1208:1978 Determination of ductility.

IS 1212:1978 Determination of loss on heating.

IS 1216:1978 Determination of solubility in Carbon disulphide trichloroethylene.

For detailed information, refer to IS 13026 : 1991 Specification for bitumen mastic for flooring for industries handling LPG and other light hydrocarbon products.

SUMMARY OF
IS 653 : 1992 LINOLEUM SHEET AND TILES
(Third Revision)

1. Scope — Requirements of linoleum manufactured as sheets or tiles on a hessian backing and used as floor covering.

Note — This standard does not include jute canvas as backing material.

2. Materials

2.1 The wearing surface of the linoleum shall be made from the following material:

- a) Oxidized or polymerized linseed oil (conforming to IS 75 : 1973) * or other suitable drying oil, with necessary driers;
- b) Rosin or resin or their combination;
- c) Cork flour or wood flour or both;
- d) Mineral fillers; and
- e) Colouring material or pigments

Note — The material shall be mixed and pressed to a specially smooth surface on the backing (see 2.2). The backing material shall be securely bonded to the wearing surface.

2.2 The type of hessian used for backing is dependent on the type of conform method of manufacture and the machine and for manufacture.

3. Types

3.1 Plain Linoleum — The composition of plain linoleum shall be of uniform colour extending evenly throughout the full thickness from the wearing surface to the hessian backing.

3.2 Moire, Jaspe and Marble Linoleum — Linoleum other than plain shall be designed as in laid listum. They are composed of different columns extending from the wearing surface to the backing at random to form a variegated surface.

4. Dimensions and Tolerance

4.1 Linear Dimensions

4.1.1 Sheets — Unless otherwise specified the linoleum sheets of all thickness shall be supplied in rolls of lengths not less than 5.0 m. The standard width of the sheets shall be 2.0 m.

4.1.2 Tiles — The size of tiles shall be 225, 300 and 450 mm square.

4.2 Thickness — The standard overall thickness of the linoleum tiles shall be 4.5 mm, 3.2 mm, 2.5 mm and 20 mm.

4.3 Tolerances — The tolerances on the specified width of sheets, tiles sizes and thickness shall be as given in Table 1.

4.4 Cork Tiles — Cork tiles if supplied shall be of sizes and thickness as specified in 4.1.2 and 4.2 respectively. The permissible deviation in thickness shall be + 5 percent

5. Finish — The wearing surface of linoleum shall be smooth, uniform and shall be free from indentations, cracks and protruding particles.

6. Physical Requirement — See Table 1

7. Packing — The linoleum sheet shall be tightly wound on cores of mandrels of diameter not less than 75 mm. The rolls shall be wrapped in kraft paper (the weight of which shall not be less than 50 (g/m²) securely tied or otherwise fastened and finally packed in strong hessian or sacking. The ends of the rolls shall be suitably protected by means of cardboard or other suitable disc to avoid any damage.

* Linseed oil, raw and refined (*second revision*)

+ Indian Hessain Part 2-305 and 229 g/m² at 16 percent contact regain (*first revision*)

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**TABLE 1 REQUIREMENT OF
NOLEUM SHEETS, LINOLEUM
TILES AND CORK TILES**

Sl.No (1)	Characteristic (2)	Requirement (3)
i)	Width of sheet	Average value shall not vary by more than ± 3 mm
ii)	Tolerance to tile size	± 0.15 percent
iii)	Thickness	Average value shall not vary by more than $+0.15$ mm
iv)	Squareness (for tiles only)	Gap between the sides of tile and arms of the metal jig, shall not be greater than 0.25 mm at any point along the sides
v)	Seasoning (for plain linoleum only)	The cut surface shall show no difference in colour or grain, between the edges and the centre, 24 hours after the cut has been made.

vi)	Residual indentation	Shall not exceed 10 percent of the original overall thickness
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Sl.No (1)	Characteristic (2)	Requirement (3)
vii)	Flexibility	Shall not crack or break
viii)	Water Absorption	For Thickness mm Absorption Max Percent,
		4.5 5.5
		3.2 6.5
		2.0 9.0
		1.65 10.5

ix)	Colour fastness	Shall not be inferior to that of No. 5 of the standard patterns of the blue dyed wool cloth as specified in IS 686 : 1985*
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* Methods for determination of colour fastness of textile materials to day-lighting (*first revision*) day to light

Note — The tolerances on sizes are applicable at the time of actual cutting of the tiles.

Note — For methods of tests, refer to IS 9704:1980 Methods of tests for linoleum sheets and tiles.

For detailed information, refer to IS 653:1992 Specification for linoleum sheets and tiles (third revision).

SUMMARY OF
IS 3461 : 1980 PVC ASBESTOS FLOOR TILES
(First Revision)

1. Scope — Requirements for smooth surfaced homogeneous PVC asbestos floor tiles. Laminated floor tiles and floor tiles having embossed surface are not covered in this standard.

2. Materials — Blended composition of thermoplastic binder (vinyl chloride polymer and/ or vinyl chloride copolymers), asbestos fibre fillers, and pigments.

3. Dimensions and Tolerance

3.1 Size — 200 and 250 mm square.— Other size and shape as agreed to mutually. Tolerance, ± 0.4 mm on 200 mm size and ± 0.5 mm on 250 mm size. For larger size tolerance shall be ± 0.2 percent.

3.2 Thickness — 1.5, 2.0, 2.5 and 3.0 mm. Tolerance, ± 0.15 mm.

4. Colour and Finish — Tiles shall be plain or mottled. Plain tiles shall have colour uniformly distributed through tiles. Mottled tiles shall have colours distributed at random throughout thickness of tile.

5. Physical Requirements — See Table 1.

**TABLE 1 REQUIREMENTS OF PVC
ASBESTOS FLOOR TILES**

S.I.No.	Characteristic	Requirement
(1)	(2)	(3)
i)	Squareness	Gap between the sides of the tile and the arms of the metal jig shall not be greater than 0.15 mm for last 50 mm to wards the farther end from the junction of the arms.
ii)	Dimensional stability	Change in any linear dimension shall not exceed 0.25 percent.
iii)	Colour fastness	Shall not be inferior to that of No. 5 of daylight the 8 standard patterns of blue dyed woolen fabric specified in IS 686:1985*

* Methods for determination of colour, fastness of textiles materials to daylight (*first revision*).

† For detailed requirements of indentation limits at $27 \pm 2^\circ\text{C}$, refer to Table 2 of the standard.

iv) Volatile matter

v) Curling

vi) Indentation

a) At $27 \pm 2^\circ\text{C}$

b) At $46 \pm 2^\circ\text{C}$

vii) Residual indentation

viii) Resistance to various

ix) Deflection

x) Impact

xi) Abrasion resistance

Loss in weight shall not exceed 1 percent.

Shall not exceed 0.75 mm

Average indentation at the end of one minute shall not exceed 0.38 mm and no individual reading shall deviate from the average by more than 0.05 mm. In relation to the one minute indentation figures. The average indentation at the end of 10 minutes shall not exceed the value specified and no individual reading shall deviate from the average by more than 0.05 mm. Average indentation shall not exceed 0.82 mm and no individual reading shall deviate from the average by more than 0.05 mm.

Shall not exceed 0.15 mm

After immersion in various substances and when tested the width of the scratch on the surface shall not exceed 3 mm. The colour of the treated test piece shall show no significant change when compared with the untreated test piece.

Shall deflect at least 25 mm with out breaking.

Shall not suffer a fracture.

To be agreed between the purchaser and the supplier.

Note 1 : For methods of tests, refer to IS 3464:1980 Methods of test for plastic floor covering and wall tiles (*first revision*).

Note 2 : For categories of tests refer to 6 of the standard.

For detailed information, refer to IS 3461 : 1980 Specification for PVC asbestos floor tiles (first revision).

SUMMARY OF
IS 3462 : 1986 UNBACKED FLEXIBLE PVC FLOORING
(Second Revision)

1. Scope — Requirements of unbacked homogeneous flexible PVC flooring, including laminated PVC flooring in which the composition of each of the laminate is substantially the same.

The flooring may be supplied in continuous lengths or in tile form.

2. Materials — The flexible PVC flooring shall consist of a thoroughly blended composition of thermoplastic binder, fillers and pigments. The thermoplastic binder shall consist substantially of one or both of the following:

- a) Vinyl chloride polymer, and
- b) Vinyl chloride copolymer.

The polymeric material shall be compounded with suitable plasticizers and stabilizers.

3. Dimensions and Tolerances

3.1 Linear Dimensions

3.1.1 Sheets or rolls — The standard width of flooring sheets or rolls in continuous lengths shall be 1000, 1500, and 2000 mm.

3.1.2 Tiles — The tiles shall be 250 mm, 300 mm, 600 mm and 900 mm square.

3.2 Thickness — The standard thickness of floor covering shall be 1.5 mm, 2.0 mm, 2.5 mm and 3 mm.

3.3 Tolerances : The tolerance on the specified widths of sheets/rolls, tile sizes and thickness shall be as given in Table 1.

4. Colour and Surface Characteristics

4.1 The flooring shall have a uniform wearing surface. The colour and also the pattern, marbling or mottling, if present, shall extend through the full thickness of the flooring, when the flooring is not laminate. In case of laminated flooring it shall extend to the full thickness of the top layer. The colour and the pattern shall match the sample that is agreed upon by the purchaser and the supplier.

5. Requirement — See Table 1.

**TABLE 1 REQUIREMENTS OF
FLEXIBLE PVC FLOORING**

Sl.No.	Characteristic	Requirement
(1)	(2)	(3)
i)	Thickness	The mean thickness shall not differ by more than 0.13mm from that specified. The variation between any two measurements shall not exceed 0.20 mm
ii)	Width of sheet or roll	Width shall be not less than that specified and not more than 6 mm greater than that specified
iii)	Tile size	The dimensions shall not vary from the specified dimensions by more than 0.13% or +0.4mm whichever is less
iv)	Squareness (for tiles only)	Gap between the sides of the tiles and the arms of the metal jig shall not be greater than 0.15mm towards the farther end from the junction of the arms.
v)	Dimensional stability	Change in any linear dimensions shall not exceed 0.4 percent for sheet and 0.25 percent for tiles. After the test the specimen shall show no signs of curling.
vi)	Colour fastness to day night	Shall be rated not less than standard 4 when tested in accordance with IS 9766:1992*
vii)	Curling (for tiles)	Shall not exceed 0.75mm
viii)	Residual indentation	Shall not exceed 0.10 mm
ix)	Flexibility	Shall not break, crack or show any other signs of failure
x)	Resistance to various substances	The average scratch width obtained after immersion shall not exceed 2.0mm. The colour of the treated pieces shall show no significant change when compared with un-treated material

*IS 9766 : 1992 Flexible PVC compounds

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xi) Ply adhesion	Adhesion between plies in any test piece shall not be less than 1.05 kN/m.		not produce surface cracking.
xii) Moisture movement	Change in any linear dimensions shall not exceed 0.4 percent.	xiv) Elastic product	The mean product tensile strength and elongation shall be not less than 2 MJ/m ³ .
xiii) Heat ageing and	No exudation of plasticizer shall be apparent nor shall there be any change in appearance. The mandrel test shall		

Note— For methods of tests, refer to Appendix A to D of the standard and IS 3464:1986 Methods of test for plastic flooring and wall tiles (second revision).

For detailed information, refer to IS 3462 : 1986. Specification for unbacked flexible PVC flooring (second revision).

SUMMARY OF

IS 9197 : 1979 EPOXY RESIN, HARDENERS AND EPOXY RESIN COMPOSITIONS FOR FLOOR TOPPING

1. Scope — Lays down the requirements for epoxy resin, hardeners and other constituent materials to be used in the formulation of floor toppings.

2. Materials

2.1 Epoxy Resin — Shall be liquid epoxy resin containing no hardeners:

- a) Grade — Resins containing no diluents. See Table 1.
- b) Grade 2 — Resins modified with a reactive diluent. Each class of grade 2 resin can be made with grade 1 resin. See Table 1.

TABLE 1 REQUIREMENTS FOR GRADE 1 EPOXY RESIN

Class	Epoxy Content		Viscosity	Specific	Hydrolyz
	Equivalent/ 1000g, min	Weight per Epoxy Equivalent	at 27°C Pa.s	Gravity at 27°C	able Chlorine content %
(1)	(2)	(3)	(4)	(5)	Max (6)
1	5.0 to 5.88	200 to 170	3 to 20	1.05 <i>Min</i> 1.20 <i>Max</i>	0.6

TABLE 2 REQUIREMENTS FOR GRADE 2 EPOXY RESIN

Class	Epoxy Content		Viscosity	Specific	Hydrolyz
	Equivalent/ 1000g, min	Weight per Epoxy Equivalent	At 27°C Pa.s	Gravity at 27°C	able Chlorine content %, <i>Max</i>
(1)	(2)	(3)	(4)	(5)	(6)
I	5		0.5 to 0.9	1.05 <i>Min</i> 1.20 <i>Max</i>	0.6
II	5		0.9 to 4	do	0.6
III	5		4 to 10	do	0.6

2.2 Hardeners — Shall be liquid type, and shall react with epoxy resin at normal ambient temperature above 5° C. See Table 3

2.3 Accelerator — Liquids generally tertiary amines.

2.4 Plasticizers and Non-reactive Diluents —

May be incorporated in the resins and hardeners, provided the total quantity of these ingredients does not exceed 25 parts per hundred parts by weight of the resin, in the resin-hardener mixture.

2.5 Liquid Coal Tar — May be incorporated either in the resin or the hardener or both provided the quantity added shall not exceed 1:1 by weight of the epoxy resin hardener mixture and that the pot life, curing time and other physical and chemical properties of the mixture shall conform to those specified in the standard. See Table 4.

2.6 Aggregates — Aggregates shall be free from any reactive or deleterious substances. Fine aggregate shall conform to grading Zone III or Zone IV of IS 383:1970*. Coarse aggregate shall also conform to IS 383:1970.*

3. Properties of Epoxy Resin Compositions

3.1 Pot Life — Shall be at least 45 minutes at 27 ± 2°C and at 65 ± 5 percent relative humidity.

3.2 Chemical Resistance — Shall conform to the requirements of Table 1 of IS 4631:1986.+

3.3 Resistance to Wear — Permissible average wear and individual wear of specimen shall be as given in Table 5.

3.4 Other Requirements — The cured samples of epoxy resin-hardener-filler (including aggregates) when shall conform to the requirements specified in Table 5.

* Coarse and fine aggregates from natural sources for concrete (*second revision*)

** Code of practice for laying of epoxy resin floor toppings (*first revision*)

TABLE 3 HARDNESS FOR EPOXY RESIN

<i>SL No.</i>	<i>Type</i>	<i>Viscosity at 25°C MPa.s</i>	<i>Amine Value mg KOH/g</i>	<i>Specific Gravity at 25°C</i>	<i>Amount Recommended Per Equivalent Epoxy in Resin</i>	<i>REMARKS</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(a) Aliphatic Amine						
i)	A	10 to 20	1300 to 1700	0.97 to 0.99	16 to 25	High rate of reaction with strong exotherm. Curing sensitive to humidity.
ii)	B	20 to 40	450 to 500	--	50 to 55	Slow rate of curing with long pot-life and low exotherm
iii)	C	3000 to 6000	830 to 910	--	50 to 55	High rate of reaction and high exotherm
(b) Aromatic Amine Adduct						
i)	A	3800 to 6000	260 to 290	1.11 to 1.12	110 to 130	Permits curing at high atmospheric humidity and low temperature, medium rate of curing.
ii)	B	14000 to 22000	250 to 280	1.125 to 1.13	110 to 130	Permits curing at high atmospheric humidity and low temperature, Fast rate of curing
(c) Polyamionamide						
i)	A	12500 to 17500	350 to 410	0.96 to 0.98	110 to 190	Slow rate of curing with low exotherm
ii)	B	14000 to 15000	190 to 210	1.05 to 1.07	100 to 110	do
iii)	C	9000 to 13000	280 to 300	0.96 to 0.98	160 to 180	do
(d) Amino resin compound						
i)	A	17000 to 23000	300 to 360	--	100 to 110	Possibility of adjusting pot-life and exotherm

TABLE 4 GENERAL SPECIFICATION FOR LIQUID COAL TAR

<i>SL.</i>	<i>Characteristic</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Viscosity at 40°C, Pa.s	14 to 16
ii)	Specific gravity at 27°C	1.15 to 1.21
iii)	Residue (pitch), percent	60 to 70
iv)	Softening point of residual pitch	67°C
v)	Fractional distillation, percent by mass	
	170°-270°C	7.85
	270°-300°C	5.46
	300°-350°C	19.06
vi)	Phenol, cresols etc, Percent, <i>Max</i>	3
vii)	Naphthalene, percent, <i>Max</i>	2

TABLE 5 REQUIREMENTS OF EPOXY RESIN COMPOSITION FOR FLOOR TOPPING

<i>SL.</i>	<i>Characteristic</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Compressive strength, N/mm ²	80 <i>Min</i>
ii)	Bond strength, N/mm ²	2 <i>Min</i>
iii)	Flexural strength, N/mm ²	20 <i>Min</i>
iv)	Tensile strength, N/mm ²	15 <i>Min</i>
v)	Modulus of elasticity, N/mm ²	35x10 ⁻³ <i>Min</i>
vi)	Coefficient of linear thermal expansion, mm/mm°C	45x10 ⁻⁶ <i>Max</i>
vii)	Thermal conductivity (optional) W/mk	1 <i>Max</i>
viii)	Linear shrinkage, percent	0.10 <i>Max</i>
ix)	Water absorption, percent	0.50 <i>Max</i>
x)	Resistance to wear, Averagewear	2 <i>Max/mm</i>
	Individual	2.5 <i>Max</i>
xi)	Shear strength N/mm ²	3.2 <i>Min</i>

Note— For methods of tests, refer to IS 9162:1979 Methods of tests for epoxy resins, hardeners and epoxy resin compositions for floor topping.

For detailed information refer to IS 9197 : 1979 Specification for epoxy resin hardeners and epoxy resin compositions for floor topping.

SUMMARY OF

IS 12866 : 1989 PLASTIC TRANSLUCENT SHEET MADE FROM THERMOSETTING POLYESTER RESIN (GLASS FIBRE REINFORCED)

1. Scope — Specifies dimensions, tolerances, strength and light transmission of glass fibre reinforced translucent plastic sheeting of the profiles specified in IS 277 : 1992*, IS 459:1992** and IS 1254:1991⁺ for use in roofs.”

Recommended temperature range is from —20 to 60°C

2. Materials — Shall be composed of a thermosetting styranated or acrylated polyester resin system reinforced with glass fibre which may include curing agents, catalysts and light stabilizers. Glassfibre shall be in the form of chopped strand mat having a highly soluble modified polyester binder in accordance with IS 11551:1996[@] having a density of 450 g/m² and minimum width of 500 mm.

Special grade of unsaturated polyester resin having a refractive index matching that of the glassfibre (that

is 1.53) and conforming to the broad specifications given below shall be used.

a)	Viscosity at 25°C, in cps (Brooke –field LVF spindle 2/12 rev 1 min)	:	400 to 500
b)	Specific gravity at 20°C	:	1.11
c)	Acid number, in mg KOH/g	:	25 to 30
d)	Solids, in percent	:	65

3. Profiles, Dimensions and Tolerances

3.1 Profiles— The profile of the sheet shall match the profiles specified in the appropriate Indian Standards for the particular material. *See* Table 1.

4. Workmanship and finish

4.1 The sheets shall have a smooth surface finish on both sides. A resin rich surface on the exposed part of the sheet is necessary to ensure that the sheet has good weathering properties. The moulded sheets shall be reasonably free from visible defects, such as, fibre pattern, foreign inclusions, cracks, crazing, die-lines, pin holes, striations, and bubbles over 1.3 mm in diameter.

* Galvanized steel sheet (plain and corrugated (*fifth revision*))

** Corrugated and semi-corrugated asbestos cementsheets
(*third revision*)

+ Corrugated aluminium sheet (*third revision*)

@ Glass fibre chopped strand mat for the reinforcement of epoxy, phenolic and polyester resin systems (*first revision*)

**TABLE 1 DIMENSION AND TOLERANCES OF GLASSFIBRE
REINFORCED CORRUGATED TRANSLUCENT ROOFLIGHT SHEETS**

All dimensions in millimetres.													
Sl. No.	Type of Sheet	Profile No.	Depth of Corrugation		Pitch of Corrugation		Overall Width		Effective Width	Minimum Thickness		Length of Sheet	
(1)	(2)	(3)	D	Tolerance	P	Tolerance	B	Tolerance	(10)	T	Tolerance	A	Tolerance
(4)	(5)	(6)	(7)	(8)	(9)	(11)	(12)	(13)	(14)				
i)	Corrugated asbestos cement, profile in accordance with IS 459:1992	1	48	+3 -5	146	+6 -9	1050	+10 -5	+10 -5	1.1	+0.15	1 750 2 000 2 500 3 000	0.5% of length
ii)	Corrugated steel profile in accordance with IS 277 : 1992	3	17.5	±2.5	75	+5	660				+0.15	1 800 2 200 2 500 2 800 3 000	0.5% of length
		4	12.5	±2.5			810 910 680 830						
iii)	Corrugated aluminum sheets profile in accordance with	5	19	—	75	+5	650 800	±25 ±25		1.1	+0.15	1 800 2 400 3 000	0.5% of length
		6	38	—	125	±5	795	+25					

4.2 Special Finishes – A clear tissue of fibreglass surface mat or polyester mat may be applied to the sheet surface(on the side exposed to weathering) during manufacture to improve resistance to weathering. Alternatively, PVF and polyester cladding films can be bonded to the sheet surface (on the side exposed to weathering).

5. Performance Requirements:

5.1 Density —The nominal weight of 1.10 + 0.15 mm thick plain sheet shall be 1.85 kg/sq m.

5.2 Glass Content—Shall not be less than 30 percent

5.3 Water Absorption — Shall not absorb water in excess of 0.3 percent

5.4 Hardness (Barcol) – Barcol hardness shall not increase by more than 30 percent of its initial value.

5.5 Bolt Shear Test – Arithmetic mean of the loads at which the first tear appears, shall be not less than 375 N. The load at which the first tear appears while testing any one of the specimens, shall be not less than 250 N.

5.6 Load Deflection Test – Applicable only to corrugated sheets and flats of curved sheets. When three sheets of 1.10+0.15 mm thickness are tested none of the sheets shall rupture although minor cracking around the areas of support or loading shall be permitted. The total load as shown in Table 2 shall produce a deflection of not more than 15mm (that is, span/70) on any of the sheets.

TABLE 2 DEFLECTION UNDER TEST LOAD

Profile No. in Accordance With Table	Total Load N
(1)	(2)
1	1 100
2	1 100
3	190
4	190
5	190
6	850
7	750

Note— for methods of tests, refer to Appendices A to G of the standard.

For detailed information, refer to IS 12866 : 1989 specification for plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced).

5.7 Light Diffusion — The gradient constant shall be as per Table 3

**TABLE 3 LIGHT DIFFUSION
GRADIENT CONSTANT G**

<i>Diffusion Classification</i> (1)	<i>Description</i> (2)	<i>Gradient Constant G</i> (3)
I	Clear	Above 0.80
II	Moderately diffusing	0.32 to 0.80
III	Heavily diffusing	0.10 to 0.32
IV	Very heavily diffusing	Below 0.10

5.8 Transmission— The gradient constant shall lie within the limits set out in Table 4 for the appropriate class of sheet.

**TABLE 4 MINIMUM TOTAL LIGHT
TRANSMISSION**

<i>Diffusion Classification</i> (1)	<i>Minimum Total Transmission</i> (2)
I	80
II	75
III	70
IV	60

SUMMARY OF
IS 638 : 1979 SHEET RUBBER JOINTING AND RUBBER
INSERTION JOINTING
(Second Revision)

1. Scope — Requirements and the methods of sampling and test for sheet rubber jointing and rubber insertion jointing for use between flanges and similar joints subjected to water pressure, air pressure or low pressure steam.

Note — The recommended low pressure steam is up to 350 kN/m² (approximately 3.5 kgf/cm²)

2. Types:

- a) *Type A* — 50 to 65 Hardness in IRHD, and
- b) *Type B* — 66 to 80 Hardness in IRHD.

3. Grades — Grade 1 and 2

4. Requirements

4.1 Material

4.1.1 Jointing Material — Shall be made of one of the following materials:

- a) Sheet rubber, or
- b) Sheet rubber reinforced with fabric rubber insertion jointing.

4.1.2 Composition of Rubber Compound — Shall be natural or synthetic rubber or a blend thereof, suitably compounded and vulcanized having the degree of hardness as specified in 2.

4.1.3 Fabric reinforcement for rubber insertion jointing — Shall have a minimum breaking load of 120 N/cm (approx 12 kgf/cm) width for both warp and weft direction.

4.2 Construction and Workmanship

4.2.1 Shall be free from surface defects, such as pitting, blemishes and other irregularities and the rubber used in both shall be homogeneous and be free from porosity and grit as judged visually on surface or any cut-surface of the test sample.

4.2.2 Thickness and number of plies — See Table 1.

Table 1 Thickness and Number of Fabric plies

<i>Thickness of Sheet Rubber Jointing or Rubber Insertion</i>	<i>Tolerance on Thickness</i>	<i>Number of Plies in Rubber Insertion Jointing</i>
(1)	(2)	(3)
mm	mm	
0.8	± 0.2	1
1.5	± 0.2	1
3	± 0.3	2
5	± 0.5	2
6	± 0.6	3
8 and above	± 0.7	4

4.2.2.1 Position of plies — In the case of three or more plies of fabric, they shall be so placed within the thickness of the jointing that the rubber layers between the plies are of approximately same thickness.

4.2.2.2 Each outer layer of rubber shall be not less than 0.8 mm thick in all insertions containing two or more plies of fabric. The outer layers of rubber shall in all cases be of equal thickness.

4.3 Size — Sizes up to 6 mm thickness shall be supplied in one piece of 1 × 10 metres and sizes above 6 mm thickness the minimum length shall be as agreed to between the purchaser and the supplier.

4.4 Tensile Strength and Elongation at Break — see Table 2

4.5 Accelerated Ageing

4.5.1 Jointing to be used for joints subjected to water and air pressure — After ageing at 70 ± 1°C for a period of 72 hours shall not vary by more than $\begin{smallmatrix} +10 \\ -15 \end{smallmatrix}$ percent for tensile strength and $\begin{smallmatrix} +5 \\ -15 \end{smallmatrix}$ percent for elongation at break of the corresponding values obtained before ageing.

4.5.2 Jointing to be used for joints subjected to steam pressure — The ageing shall be done at 100 ± 1°C for 72 hours and shall not vary by more than $\begin{smallmatrix} +10 \\ -25 \end{smallmatrix}$ percent for tensile strength and $\begin{smallmatrix} +10 \\ -35 \end{smallmatrix}$ percent for elongation at break of the corresponding values obtained before ageing

4.6 Compression Set

4.6.1 Jointing to be used for joints subjected to water and air pressure: The compression set at $27 \pm 1^\circ\text{C}$ for 24 ± 2 hours shall not exceed 35 percent.

4.6.2 Jointing to be used for joints subjected to steam pressure: The compression set at $100 \pm 1^\circ\text{C}$ for 24 ± 2 hours shall not exceed 35 percent.

4.7 Resistance to bending— There shall be no visible signs of cracking of the surfaces or separation of rubber from the fabric (in case of rubber insertion jointing) when subjected to bending test.

4.8 Adhesion— Rate of separation shall not exceed 25 mm per minute under a load of 4kg.,

4.9 Hardness— See Table 2.

TABLE 2 TENSILE STRENGTH AND ELONGATION AT BREAK OF SHEET RUBBER JOINTING AND RUBBER USED IN INSERTION JOINTING

Sl.	Type	Joints Subjected to water and Air Pressure				Joints subjected to steam pressure			
		Tensile Strength MN/m^2		Elongation at Break		Tensile Strength MN/m^2		Elongation at Break	
		(approx kgf/cm^2)		Percent		(Approx kgf/cm^2)		Percent	
		Min		Min		Min		Min	
		Grade 1	Grade 2	Grade 1	Grade 2	Grade 1	Grade 2	Grade 1	Grade 2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	A	8.5(85)	6(60)	400	350	12(120)	7(70)	450	400
ii)	B	8.5(85)	6(60)	300	250	12(120)	7(70)	350	300

Note— For methods of tests, refer to the standard, and IS 3400: Methods of tests for vulcanized rubbers

Part 1 : 1987 Tensile stress-strain properties (*second revision*)

Part 2 : 1995 Hardness (*second revision*)

Part 4 : 1987 Accelerated ageing (*second revision*)

Part 5 : 1986 Adhesion of rubber to textile fabrics (*second revision*)

Part 10 : 1977 Compression set at constant strain (*first revision*)

Note — This standard is also applicable to Section 10 on Sanitary Appliances and Water Fittings.

For detailed information, refer to IS 638 : 1979 Sheet rubber jointing and rubber insertion jointing (second revision).

SUMMARY OF
IS 809 : 1992 RUBBER FLOORING MATERIALS
FOR GENERAL PURPOSE
(First Revision)

1. Scope — Lays down the composition, minimum requirements, workmanship and prescribes tests for rubber flooring material suitable for covering floors of domestic and public buildings, cinemas, hospitals, large stores, ships, transport vehicles, etc. This standard does not cover the requirements for special types of rubber flooring used for electrical insulating purposes, conductive or antistatic flooring or rubber flooring having chemical and oil-resistant properties.

2. Composition

2.1 Shall be made from a compound of natural or synthetic rubber which may also contain reclaim rubber and suitable fillers. All colouring matter shall be of good quality, insoluble in water, resistant to alkalies and direct sunlight or artificial light.

2.2 Suitable cotton sheeting shall be used as backing, impregnated with a high grade rubber compound. The hessian used shall conform to Type II hessian as specified in IS 2818 (Part 2) : 1971.* The hessian shall be impregnated with a high grade rubber compound.

3. Workmanship

3.1 Appearance — Shall be of first class workmanship, satisfactorily vulcanized, free from sulphur bloom and objectionable odour and blisters, cracks and embedded foreign matter. There shall be no porosity on the surface or throughout the thickness of the sheet. The surface finish of the flooring shall be either glossy or mat. The underside of the floor covering shall be either furnished with a cloth impression or be buffed smooth. The edges and ends shall be cut true and square.

3.2 Colour — The colour of the flooring shall not be permanently affected by cleaning with water and a washing soap or by treatment with a suitable floor polish.

4. Dimension

4.1 Thickness — 3 mm, 4 mm, 5 mm, 6 mm

4.2 Overall thickness shall not differ from the declared nominal value by more than 0.3 mm at any of the twenty measuring points.

4.3 Tile Sizes and Squareness — Rubber flooring, when supplied in the form of tiles, shall be of any thickness (in the case of ribbed or fluted rubber flooring, the thickness refers to the thickness of the base) specified in 4.1 and of the following sizes:

200 mm × 200 mm
 300 mm × 300 mm
 500 mm × 500 mm

4.4 The length of side shall not vary from the nominal value by more than 0.15 percent.

4.5 Sheet Width — 0.9 m, 1.2 m, 1.5 m, 1.8 m, 2.0 m, 2.1 m. The width of the sheet at any point shall not be less than the nominal value, and shall not exceed the nominal value by more than 6 mm. The sponge-backed rubber flooring shall have a wearing surface of solid rubber at least 3 mm thick on a sponge rubber base of 3 mm thickness.

5. Performance

5.1 Hardness — Shall be neither less than 65 IRHD nor greater than 96 IRHD.

TABLE 1 TOLERANCE IN HARDNESS

<i>Nominal Hardness</i>	<i>Tolerances on Hardness</i>
IRHD	IRHD
65 to 76	± 5
Over 76 to 86	± 4
Over 86 to 96	± 3

5.2 Water Absorption — Shall not absorb water by weight more than 0.5 percent of the original weight

5.3 Compression Set — Shall not exceed 15 percent conditional for 24 hours and 27±1°C

5.3.1 The test pieces shall show no signs of cracking after the test is conducted.

5.4 Resistance to Abrasion — Shall be as agreed between purchaser and supplier.

* Indian Hessian, Part 2-305 and 229g/m² at 16 percent contact regain (*first revision*)

Note: For methods of tests refer to Appendices B to F of the standard and IS 3400. Methods of test for vulcanized rubbers
Part 2 : 1995 Hardness (*first revision*)
Part 3 : 1987 Abrasion resistance using rotating cylindrical drum device (*first revision*)
Part 10 : 1977 Compression set at constant strain (*first revision*)

For detailed information, refer to IS 809 : 1992 Specification for rubber flooring materials for general purposes (second revision).

SECTION 9

**WATERPROOFING AND DAMP - PROOFING
MATERIALS**

CONTENTS

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SUMMARY OF
IS 1322 : 1993 BITUMEN FELTS FOR WATER-PROOFING
AND DAMP-PROOFING
(Fourth Revision)

1. Scope—Requirements for saturated bitumen felts (underlay) and self-finished bitumen felts used for water proofing and damp-proofing.

2. Classification

2.1 Fibre Base

Type 1 — Saturated felt for underlay

Type 2 — Self finished felt (for water-proofing)

2.2 Hessian Base

Type 3— [Self-finished felt (for water-proofing)
Grade 1]

[Self-finished felt (for damp-proofing)
Grade 2]

3. Weight — Weight of ingredients of bitumen felt for 10 m shall not be less than those specified in Table 1.

4. Dimensions — It shall be in width of 90 cm or 100 cm and generally on lengths of 10 m or 20 m

5. Other Requirement

5.1 The finished material shall be free from visible external defects, such as holes, oil patches, ragged or untrue edges, breaks, cracks, tears, protuberances and indentations.

5.2 Tests — See Table 2.

TABLE 1 MINIMUM WEIGHT OF BITUMEN FELT (IN KG)

Sl	Type of Felt	For 10m ²			
		Untreated Base (see Note)	Saturant	Coatant	Total Weight of the Finished Bitumen Felt in Dry with Condition Mica Dusting Powder Min (see Notes 2 and 3)
(1)	(2)	(3)	(4)	(5)	(6)
a)	Fibre Base				(7)
	i) Type 1 Underlay	4.0	4.5	--	3.6
	ii) Type 2 Self finished felt	5.0	5.7	12.9	12.0
b)	Hessian Base				
	i) Type 3 Self finished felt Grade 1	2.3	1.8	17.7	12.1
	iii) Type 3 self finished felt Grade 2	2.3	1.8	31.8	20.2

Notes—1. The weight of the untreated base shall be taken as in dry condition for fibre base felts. In the case of hessian base the weight of untreated base shall conform to IS 2818 (Part2) : 1971.*

2. Include allowance for 1.2kg minimum mica dusting powder in dry condition except for Type 1.

3. When other type of mineral powders are used, the weights shown in the last column shall be changed on the basis of 4.4.2 of the standard.

* Indian hessian: Part 2 : 305 and 229 g/m at 16 percent
contract regain (first revision)

TABLE 2 REQUIREMENTS OF BITUMEN FELTS

Type of Felt	Breaking Strength, Min, Kg		Pliability Test		Storage Sticking Test	Heat Resistance Test	Pressure Head Test	Water Absorption Test, Max
(1)	Warpway (2)	Weftway (3)	(4)		(5)	(6)	(7)	(8)
Type 1	72	24	i) The roll shall not show cracks on unrolling		—	—	—	—
			ii) Consider any surface rupture exceeding 5mm in length as failure					
Type 2	95	60	i) The roll shall not show crack on unrolling		The test pieces shall be examined after cooling	The test pieces shall show no sign of melting of the bitumen compound	The test pieces shall show no sign of leakage	5.0%
			ii) Consider any surface rupture exceeding 5 mm in lengt as failure		After release of the load the layers felt shall be capable of being separated withoutdamaging the coatant, in any way	—	—	—
Type 3 (all grades)	135	90	i) The roll shallnot show cracks on unrolling		The test pieces shall be examined after cooling	The test pieces shall show no sign of melting of the bitumen compound	The test piecesshall show no sign of leakage	2.0%
			ii) Consider any surface rupture exceeding 5mm in length as failure		After release of the load the layers of felt shall be capable of being separated without damaging the coatant in any way	--	--	--
* Diameter of Mandrel for pliability test shall be as follows :								
Type 1	}		50 mm					
Type 2								
Type 3, Grade 1								
Type 3, Grade 2								

Notes — 1. The tests shall be carried out not earlier than two days from the date of manufacture
 2. See Fig. 1 of the standard for cutting test pieces from the roll

Note— For test procedures refer to IS 13826 Methods of test for bitumen based felt:

IS (Part 1) : 1993 Breaking strength test.

IS (Part 2) : 1993 Pliability test.

IS (Part 3) : 1993 Storage sticking test.

IS (Part 4) : 1993 Pressure head test.

IS (Part 5) : 1993 Heat resistance test.

IS (Part 6) : 1993 Water absorption test.

For detailed information, refer to IS 1322 :1993 Specification for bitumen felts for water-proofing and damp-proofing (fourth revision).

SUMMARY OF
IS 1580 : 1991 BITUMINOUS COMPOUNDS FOR
WATER-PROOFING AND CAULKING PURPOSES
(Second Revision)

1. Scope — Requirements and methods of sampling and tests for bituminous compound, applied cold and used for stopping leaks through cracks of roofs, floors, walls, etc; as sealant for plate joints of wagons, coaches and buses; as caulking agent for crevices and vertical joints between steel plates, folded sections, wood joints, precast concrete cladding, etc; and as adhesives for rainguards for rubber trees.

2. Grades

a) *Grade 1* — Shall be semistiff, smooth and homogenous paste suitable for application by spreading with hand, trowel, spatula or gun.

b) *Grade 2* — Shall be of light consistency and homogenous paste suitable for application by putty knife.

3. Composition — The material shall consist of bitumen and flus oils with or without addition of vegetable or resinous oils, cut back with volatile thinners and intimately mixed with non-gritty absorbent, inorganic fibrous material (with or without powder) in suitable proportions as to comply with the requirements of this standard. (see Table 1).

4. Keeping Quality — When stored under cover in a dry place in the original sealed container under normal temperature the material shall retain the specified properties for a period of not less than six months from the date of manufacture as declared on container.

TABLE 1 REQUIREMENTS FOR BITUMINOUS COMPOUNDS

Sl. No.	Characteristic	Requirements	
		Grade 1	Grade 2
(1)	(2)	(3)	(4)
i)	Water content, percent by mass, <i>Max</i>	0.5	0.5
ii)	Ash content, percent by mass, <i>Max</i>	40	30
iii)	Flow	Shall satisfy the requirement	Shall satisfy the requirement
iv)	Flash point °C, <i>Min</i>	35	35
v)	Flexibility and adhesion	Shall satisfy the requirement	Shall satisfy the requirement
vi)	Consistency		
	a) Before setting (test after 1h) <i>Min</i>	100	225
	b) After setting (test after 24 h) <i>Min</i>	80	200

Note— For test procedures, refer to Annex A to C of the standard and
 IS 1209 : 1978 Determination of flash point and fire point (*first revision*).
 IS 1211 : 1978 Determination of water content (Dean and Stark method) (*first revision*).
 IS 1217 : 1978 Determination of mineral matter (Ash) (*first revision*).

For detailed information, refer to IS 1580 : 1991 Specification for bituminous compound for water proofing and caulking purposes (second revision).

SUMMARY OF
IS 2645 : 2003 INTEGRAL CEMENT WATER-PROOFING
COMPOUNDS
(Second Revision)

1. Scope — Requirements for integral cement water-proofing compounds, which shall be assessed by:

- a) Permeability to water, and
- b) Physical tests of setting time and compressive strengths of cement mixed with the water-proofing compounds.

Note — Proportions as recommended by manufacturers, but not exceeding 3 percent by weight of cement.

2. Requirements

2.1 Permeability to water of specimens prepared with the recommended proportion of the compound shall be less than half the permeability of similar specimens prepared without the addition of the compound.

2.2 *Setting time of cement mixed with water-proofing*— Initial – not less than 30 minutes; final – not more than 600 minutes.

2.3 Compressive Strengths – of mortar cubes using the recommended proportion of waterproofing compound shall be as follows :

At 3 days — Not less than the minimum specified 3 days compressive strength of the grade of ordinary Portland cement used nor less than 90 percent of the 3 days compressive strength of mortar cubes made with the same cement and sand only.

At 7 days — Not less than the minimum specified 7 days compressive strength of the grade of ordinary Portland cement used nor less than 90 percent of the 7 days compressive strength of mortar cubes made with the same cement and sand only.

2.4 The chloride content and sulphate content in the product shall be declared by the manufacturer.

Note— For methods of tests, refer to Appendix B of the standard,

IS 4031 Methods of physical tests for hydraulic cement

IS 6925 Methods of test for determination of water soluble chlorides in concrete and admixtures.

For detailed information, refer to IS 2645 : 2003 Specification of integral cement water proofing compounds (second revision).

SUMMARY OF
IS 3037 : 1986 BITUMEN MASTIC FOR USE IN
WATER—PROOFING OF ROOFS
(First Revision)

1. Scope — Requirements for bitumen mastic suitable for water proofing of roofs. This bitumen mastic is not intended to be used as a paving material or to withstand exceptional conditions, such as acid or alkali actions.

2. General Characteristic — It shall consist of a mixture of bitumen, aggregates and mineral filler in such suitable proportions as to give it a semi fluid consistency when heated to about 180°C. The mastic at this temperature shall be easily compressible by trowels into a compact and uniform layer, not less than 10 mm in thickness.

3. Materials

3.1 Bitumen — See Table 1.

Note—For methods of tests, refer to IS 1203:1978*, IS 1205 : 1978 **, IS 1208 : 1978#, IS 1212 : 1978 ^, IS 1216:1978`.

3.2 Aggregate — Aggregates shall be crushed rock or gravel of silicious, granite or limestone origin with mineral fillers, such as, limestone dust or cement. Aggregates used shall be clean and free of all foreign matter. Shall conform to gradings as given in Table 2.

Methods for testing tar and bituminous materials—

- * Determination of penetration
- † Determination of softening point
- ‡ Determination of ductility
- § Determination of loss on heating
- * Determination of solubility in Carbon disulphide trichloroethylene.

TABLE 1 PHYSICAL PROPERTIES OF BITUMEN

Sl No.	Characteristics	Requirements
(1)	(2)	(3)
i)	Softening point (R&D)	55 to 90°C
ii)	Penetration	10 to 30
iii)	Ductility	3 to 30
iv)	Loss on heating, percent, <i>Max</i>	2.0
v)	Solubility in carbon disulphide, carbon tetrachloride or trichloroethylene, <i>Min</i>	99%

TABLE 2 GRADING OF AGGREGATES

<i>Type of Sieve used</i>	<i>Percentage by Weight of</i>
Passing 75-micron IS Sieve	40 to 45
Retained on 75-micron IS Sieve and passing 425-micron IS Sieve	15 to 20
Retained on 425-micron IS Sieve and passing 2.00-mm IS Sieve	15 to 20
Retained on 2.00-mm IS Sieve and passing 4.75-mm IS Sieve	20 to 30
Retained on 10-mm IS Sieve	Nil

4. Composition — See Table 3

5. Hardness Number — The hardness number of the bitumen mastic at the time of laying shall be between 2 to 8 at 25°C, and 10 to 65 at 45°C.

TABLE 3 COMPOSITION OF BITUMEN MASTIC BY ANALYSIS

<i>Sl No.</i>	<i>Requirement</i>	<i>Percentage by weight of Total Mastic</i>
(1)	(2)	(3)
i)	Bitumen	15 to 20
	<i>Aggregate passing</i>	
ii)	4-75 mm IS Sieve and retained on 2.00 mm	18 to 20
iii)	2.00 mm IS Sieve and retained on 425-micron IS Sieve	12 to 18
iv)	425 – micron IS Sieve and retained on 75-micron IS Sieve	12 to 18
v)	75 – micron IS Sieve (mineral filler)	35 to 40

For detailed information, refer to IS 3037 : 1986 Specification for bitumen mastic for use in water-proofing of roofs (first revision).

SUMMARY OF
IS 3384 : 1986 BITUMEN PRIMER FOR USE IN
WATER-PROOFING AND DAMP-PROOFING
(First Revision)

1. Scope—Covers the requirements for bitumen primer for application to concrete and masonry surfaces and to be used with bitumen in damp-proofing and waterproofing below or above ground level.

2. Requirements—See Table 1

TABLE 1 REQUIREMENTS OF PRIMER

Sl.No.	Characteristic	Requirement
(1)	(2)	(3)
i)	Viscosity by standard tar viscometer, 4-mm orifice, in sec, at 25°C	4 to 24
ii)	Distillation fractions, percent by volume of the primer—	
	a) Up to 225°C, <i>Min</i>	35
	b) Up to 360°C, <i>Max</i>	65
iii)	Flash point, Pensky Martens closed type, <i>Min</i>	40
iv)	Water content, percent, <i>Max</i>	0.2
v)	Tests on residue from distillation up to 360°C	
	a) Ductility, 27°C, <i>Min</i>	3
	b) Penetration at 25°C, 100g, 5 sec in 1/100 cm	20 to 50
	c) Matter soluble in carbon disulphide or carbon tetrachloride or trichloroethylene, percent by weight, <i>Min</i>	99.0

Note— For test procedures, refer to Methods of testing tar and bituminous materials;
IS 1203 : 1978 Determination of penetration
IS 1206 (Part 1): 1978 Determination of viscosity: Part 1 Industrial viscosity.
IS 1208 : 1978 Determination of ductility.
IS 1209 : 1978 Determination of flash point and fire point.
IS 1211 : 1978 Determination of water content (Dean and Stark Method).
IS 1213 : 1978 Distillation test
IS 1216 : 1978 Determination of solubility in carbon disulphide trichloroethylene

For detailed information, refer to IS 3384 : 1986 Specification for bitumen primer for use in water-proofing and damp-proofing.

SUMMARY OF
IS 5871 : 1987 BITUMEN MASTIC FOR
TANKING AND DAMP-PROOFING
(First Revision)

1. Scope — Requirements for bitumen mastic used as covering material for damp-proofing of underground tanks, basements of building, water reservoirs, swimming pools, irrigation canals, etc.

2. General Characteristics — It shall consist of a mixture of bitumen, aggregates and mineral filler in suitable proportions so as to give it a semi fluid consistency when heated to about 180°C. The mastic at this temperature shall be easily compressible by trowels into a compact and uniform layer.

3. Materials

3.1 Bitumen — Physical Properties

i) Softening point (ring and ball method)	50 to 90°C
ii) Penetration at 25°C in 1/100cm	20 to 40
iii) Ductility at 27°C (<i>Min</i>) in cm	3
iv) Loss on heating, percent <i>Max</i>	1
v) Solubility in CS ₂ , percent <i>Min</i>	99
or	
Carbon tetrachloride or trichloroethylene	

Note— For methods of tests, refer to IS 1203 : 1978*, IS 1205 : 1978⁺, IS 1208 : 1978[‡], IS 1212 : 1978[§], IS 1216 : 1978^{//}.

Methods for testing tar and bituminous materials:

- * Determination of penetration (*first revision*).
- + Determination of softening point (*first revision*).
- ‡ Determination of ductility (*first revision*).
- § Determination of loss heating (*first revision*).
- // Determination of solubility in Carbon disulphide trichloroethylene. (*first revision*).

3.2 Filler — The filler shall be lime-stone powder

passing 75-micron IS Sieve and shall have a calcium carbonate content of not less than 80 percent by weight.

3.3 Aggregates — Fine aggregate shall only be used. Fine aggregate shall consist of naturally occurring sand or crushed lime-stone or crushed hard rock. The grading of the aggregate is given below for guidance.

GRADING OF FINE AGGREGATES

<i>Type of Sieve Used</i>	<i>Percentage of Weight</i>
Passing 75 micron IS Sieve	0 to 10
Retained on 75 micron IS sieve and passing 215 micron IS Sieve	10 to 18
Retained on 212 micron IS Sieve and passing 600 micr on IS Sieve	40 to 54
Retained on 600 micron IS Sieve and passing 2.36 mm IS Sieve	24 to 40
Retained on 2.36 mm IS Sieve	Nil

4. Composition — See Table 1.

TABLE 1 COMPOSITION OF BITUMEN MASTIC BY ANALYSIS

Sl.No.	Requirements	Percentage by Total Mastic
i)	Soluble bitumen	15 to 17
ii)	Aggregate passing 75-micron IS Sieve	42 to 52
iii)	Aggregate passing 212-micron IS Sieve and retained on 75-micron IS Sieve	3 to 10
iv)	Aggregate passing 600 micron IS Sieve and retained on 212-micron IS Sieve	15 to 25
v)	Aggregate passing 2.36 mm IS Sieve and retained on 600-micron IS Sieve	7 to 20
vi)	Aggregate retained on 2.36 mm IS Sieve	Nil

5. Hardness Number— The hardness number of the bitumen mastic shall be between 20 and 50 at 25°C.

For detailed information, refer to IS 5871 : 1987 Specification for bitumen mastic for tanking and damp – proofing (first revision).

SUMMARY OF
IS 7193 : 1974 GLASS FIBRE BASE BITUMEN FELTS
(First Revision)

1. Scope — Requirements for self finished glass fibre bitumen felts used for waterproofing and damp proofing.

Note — Glass fibre base bitumen felts are suitable for water-proofing and damp-proofing in buildings and other situations where penetration of moisture is to be stopped.

2. Classification

- a) *Grade 1* — Talcum, mica or sand surface glass fibre base bitumen felts for water-proofing
- b) *Grade 2* — Talcum, mica or sand surfaced glass

fibre base bitumen felts for damp-proofing.

3. Dimensions — Bitumen felts in width of one metre and generally in lengths of 1, 10 and 20m.

4. Weight — The weight of ingredients used in manufacture of glass fibre felts for 10 m² shall be not less than those specified in Table 1

5. Other Requirements — See Table 2.

TABLE 1 MINIMUM WEIGHT OF GLASS FIBRE BASE BITUMEN FELTS FOR 10 m²

<i>Sl. No.</i>	<i>Type of Felt</i>	<i>Untreated Base</i>	<i>Coatant</i>	<i>Total Weight in Dry Condition Including Surfacing</i>
(1)	(2)	(3)	(4)	(5)
		kg	kg	kg
ii)	Grade I	0.4	15.3	18.0
iii)	Grade II	0.4	22.0	25.0

TABLE 2 REQUIREMENTS OF GLASS FIBRE FELTS

<i>Sl. No.</i>	<i>Properties</i>	<i>Requirements</i>
i)	Breaking strength, <i>Min kg.</i>	a) Warp 50 b) Weft 30
ii)	Pliability test	a) Roll shall not cracks on unrolling b) Consider any surface rupture exceeding 5 mm in length as failure
iii)	Storage	The test pieces shall be examined after cooling. After release of load, the layers of felt be capable of being separated without damaging
iv)	Pressure head	The test pieces shall show no sign of leakage
v)	Heat resistance	The test pieces shall show no sign of melting of bitumen compound
vi)	Water absorption	2 percent

Note— For test procedures, refer to IS 13826 : 1993 Methods of test for bitumen based felts:

- (Part 1) Breaking strength test.
- (Part 2) Pliability test.
- (Part 3) Storage sticking test.
- (Part 4) Pressure head test.
- (Part 5) Heat resistance test.
- (Part 6) Water absorption test.

For detailed information, refer to IS 7193 : 1974 Specification for glass fibre base bitumen felts.

SUMMARY OF

IS 12027 : 1987 SILICONE-BASED WATER REPELLENTS

1. Scope — Requirements for silicone - based water repellents. These water repellents can be applied to masonry generally free from cracks exceeding 0.10 mm in width, to confer water repellency without appreciable change of colour or appearance other than that imparted by fugitive dye.

2. Classification

- Class A — Silicone formulations for clay brickwork, hydraulic cement-based materials, and natural and cast stone masonry of a predominantly siliceous nature.
- Class B — Silicone formulations for natural and cast stone masonry of a predominantly calcareous nature and calcium silicate brick-work.
- Class C — Aqueous siliconate solution for natural and cast stone masonry of a predominantly calcareous nature.

3. Consistency — The water repellent shall be of such consistency that it can be readily applicable to masonry by brushing or spraying.

4. Performance Requirement

4.1 Early Water Repellency — Water repellency shall be such that no pool of water shall be completely absorbed within 10 minutes.

4.2 Absorption of Water — The relative absorption of water through treated and untreated faces shall not be more than 10 percent for any one of three test specimens.

4.3 Evaporation of Water — The evaporation ratio of water as determined in Appendix E of the standard shall be not less than 10 percent.

4.4 Durability — When the water repellent is tested as described in Appendix F of the standard it shall meet the requirements of **4.1, 4.2** and **4.3** after a period of 12 months weathering.

Note— For test procedures refer to Appendices A to G of the standard.

For detailed information, refer to IS 12027 : 1987 Specification for silicone-based water repellents.

SUMMARY OF
IS 14695 : 1999 GLASS FIBRE BASE COAL
TAR PITCH OUTER WRAP

1. Scope — Covers the requirement for glass fibre base coal tar pitch outerwrap used for corrosion protection of buried mild steel pipelines.

2. Dimensions and Weight

2.1 Dimensions— Glass fibre base outerwrap shall be supplied in width of one metre and in lengths of 100m.

3.2 Weight — See Table 1.

**TABLE 1 MINIMUM WEIGHT OF
GLASS FIBRE BASE OUTERWRAPS
FOR 10 m²**

<i>Untreated Base kg</i>	<i>Treated Base kg</i>	<i>Total Weight in Dry condition Including Surfacing Material. kg</i>
(1)	(2)	(3)
0.4	4.5	5.5

3. Other Requirements — See Table 2

**TABLE 2 REQUIREMENTS OF
GLASS FIBRE OUTER WRAPS**

<i>Sl.No.</i>	<i>Properties</i>	<i>Requirement</i>
(1)	(2)	(3)
i)	Breaking strength in Kg, <i>min</i>	a) Wrap 30 b) Weft 15
ii)	Pliability after conditioning the sample for 3 h at 5°C.	a) Roll shall not show cracks on unrolling b) Consider any surface repture exceeding 5 mm in length as fracture.

Note— For test procedure, refer to IS 13826 : 1993 Methods of test for bitumen based felts:

(Part 1) Breaking strength test.

(Part 2) Pliability test.

For detailed information, refer to IS 14695 : 1999 Specification for glass fibre base coal tar pitch outer wrap.

SECTION 10

SANITARY APPLIANCES AND WATER FITTINGS

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Note— IS 638 : 1979 Sheet rubber jointing and rubber insertion jointing (*second revision*) is covered in Section 8 Floor Covering and Finishing.

SUMMARY OF
IS 775 : 1970 CAST IRON BRACKETS AND SUPPORTS
FOR WASH-BASINS AND SINKS
(Second Revision)

1. Scope—Requirements regarding material, construction, workmanship dimensions, weights and finish of cast iron brackets and supports for wash basins and sinks.

2. Type and Weights

<i>Type</i>	<i>Weight</i>
a) Cantilever support for sink	1.8
b) Recessed cantilever support for sink	1.8
c) Wall fixing bracket for sink	2.7
d) Wall fixing bracket with resses for sink	2.7
e) Strap and leg support for sink	1.8
f) Strap and leg support with recess for sink	1.8
g) Bracket and leg support for sink	1.8
h) Bracket and leg support with recess for sink	2.0
j) Built-in-single rail type bracket for wash basin	1.5
k) Built-in cantilever type bracke for wash basin	1.5

- m) Wall fixing single rail type bracket for wash basin 1.2
- n) Wall fixing cantilever type bracket for wash basin 1.0
- p) Strap and leg support with As utually front towel rail for wash basin agreed

3. Construction and Workmanship

- a) Brackets for building into wall shall include a lugged portion, and a flange at bottom to indicate wall line. Lugged portion shall be slotted.
- b) Brackets for screwing to wall shall have back fixing plate
- c) Supports with horizontal strap and supporting leg, or cast iron brackets with supporting leg shall be arranged for wall fixing. Leg support shall be 15 mm bore steel tube or casting and shall terminate in a flange for fixing to floor.
- d) Strap or bracket and supporting leg shall be made separately.

4. Finish - Painted, galvanized or porcelain enamelled. For hospital use, chromium plated or porcelain enamelled.

Note—For dimensions and figures refer to the standard

For detailed information, refer to IS 775 : 1970 Specification for cast iron brackets and supports for wash-basins and sinks (second revision).

SUMMARY OF
IS 782 : 1978 CAULKING LEAD
(Third Revision)

1. Scope — Requirements for different types of caulking lead suitable for use in water supply and sanitary installations.

2. Type

- a) *Pig Lead* — Used in caulking joints in gas, water and sewer lines, where it is possible to use cast lead caulking.
- b) *Lead Wool and Lead Yarn* — Used in caulking joints in gas, water and sewer lines where it is impracticable to use cast lead (such as inverted joints, under water joints, etc.) Such joints will withst and greater displacement than cast lead joints.

3. Material and Quality

- a) *Pig Lead* — Shall be of uniform softness and capable of being easily caulked.

- b) *Lead Wool* — Free from sulphur. Shall consist of fine strands or plaited ribbons. Section not less than 0.13 mm and not more than 0.9 mm.

- c) *Lead Yarn* — Free from sulphur. Shall consist of fine strands of plaited ribbons. Cross section of individual strands shall be triangular. Section not less than 0.13 mm and not more than 0.9 mm.

4. Packing

- a) Pig lead in pigs of 35 kg + 10 percent, each or linked ingots.
- b) Lead wool and lead yarn, in the form of ropers packed in wax paper or polythene sheets and finally put in polythene lined hessian bags to prevent oxidation of lead.

For detailed information, refer to IS 782 : 1978 Specification for caulking lead (third revision).

SUMMARY OF
IS 804 : 1967 RECTANGULAR PRESSED STEEL TANKS
(First Revision)

1. Scope— Requirements for the materials, fabrication, erection and supply for rectangular pressed steel tanks used for the storage of cold and hot water and certain other liquids under pressure not greater than the static head corresponding to the depth of the tank.

This specification does not cover the requirements of tanks storing liquids having temperature higher than 100°C, or those tanks subject to earth or other external pressure besides wind pressure.

2. Types

- | | |
|--------|--|
| Type 1 | Tanks with all flanges external. |
| Type 2 | Tanks with all flanges internal. |
| Type 3 | Tanks with bottom flanges internal and side flanges external. Each of the above types may be either with open top or with covered top. |

3. General

3.1 Pressed steel tanks are not recommended for depths greater than 5 m.

3.2 Type 1 tanks are normally used where plain internal surface is necessary or where there are no restrictions as to external access or where the exterior of the tank is to be lagged.

3.3 Type 2 tanks are normally used at a location where access to the exterior for erection is precluded due to insufficient space inside a building.

3.4 Type 2 and type 3 tanks are suitable for use where they are to be erected on a solid level floor.

4. Material

4.1 Mild steel plates and components used in pressed steel tanks shall conform to the prescribed standards.

4.2 Bolts and Nuts— Bolts and nuts used shall be of mild steel. They shall be hexagonal and finished black.

4.3 Jointing Material— The material used for jointing shall be insoluble in the liquid to be stored and shall be capable of withstanding the temperature variation in the liquid to be stored in the tank.

5. Dimensions

5.1 The nominal size of unit plates shall be 1.25 m square. The size of tanks shall be specified as multiples of the nominal dimensions of 125 m. The nominal capacity shall be based upon the nominal dimensions of the tank, for example, $1.25 \times 1.25 \times 1.25$ m equals 1950 litres.

5.2 Pressed mild steel tanks shall be either 1.25 m, 2.50 m, 3.75 m or 5.00 m deep. Typical sizes, approximate weights and nominal capacity of Type 1 tanks with open tops for the depths mentioned above are given respectively in Tables 1, 2, 3 and 4 of the standard.

5.3 The minimum nominal thickness of plates used for different depths of tanks used for storage of cold liquids with specific gravity not exceeding 1.0 shall be as given in Table 5 of the standard.

In the case of hot liquids with specific gravity not exceeding 1.0, the thickness of plates for different depths of tanks shall conform to that laid down in Table 5 of the standard, except that no plate of the tank shall be less than 6.0 mm thick.

6. Tests— Each tank shall be tested at site after erection for leakage under full static head.

Note — 1. For fabrication and erection, refer to the standard.

2. Refer to Fig 1 of the standard for details of fabrication.

3. For sizes, weights and nominal capacities of tanks and plate thickness refer to Tables 1 to 5 of the standard.

For detailed information, refer to IS 804 : 1967 Specification for rectangular pressed steel tanks (first revised).

SUMMARY OF
IS 1700 : 1973 DRINKING FOUNTAINS
(First Revision)

1. Scope— Covers the material, construction, essential hygienic and performance requirements and finish of drinking fountains used in schools, parks and other public places.

2. Materials

<i>Sl. No</i>	<i>Component Part</i>	<i>Material</i>
i)	Basin or receptacle	a) Glazed earthenware b) Vitreousware c) Enamelled cast iron d) Cement concrete with smooth finish e) Stoneware f) Stainless steel
ii)	Pipe work for jet mechanism	a) Brass b) Copper, Solid drawn c) Stainless steel
iii)	Fittings	a) Brass, cast or hot pressed b) Stainless steel
iv)	Nozzle	a) Bronze b) Any other non-oxidizing copper alloy

3. Construction

3.1 Basin or Receptacle— Shall be fixed at such a height that the drinking level is most convenient to persons utilizing the fountain.

3.2 Jet Mechanism — With nozzle mouth not greater than 10 mm diameter or one square centimetre in area, the nozzles shall be placed so that the lower edge of the nozzle mouth is at an elevation not less than 20 mm above the floor level rim of the receptable.

3.3 The water supply to the jet shall be controlled by a self closing tap of nominal size, 15 mm, fixed at the right hand side of the connecting inlet pipe when viewed from the front.

3.4 Waste Water Fitting— The drain shall be provided with a trap and shall terminate in a tail piece suitable for connecting to waste pipe.

4. Finish— All metal work shall be chromium plated over a base of nickel plating.

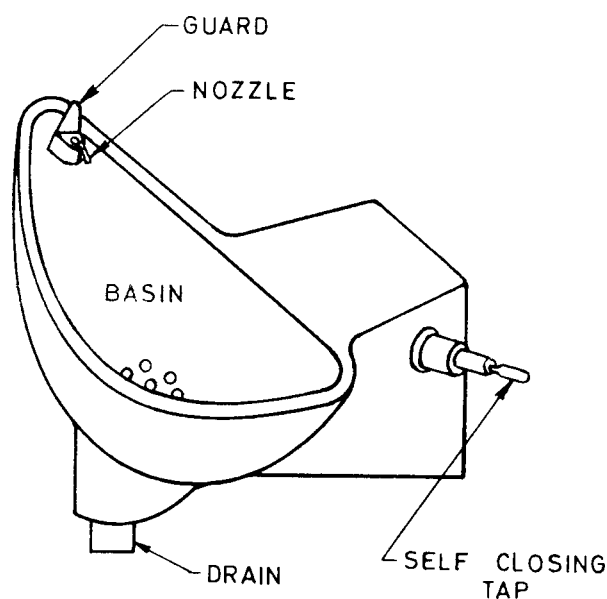


Fig. 1 TYPICAL ILLUSTRATION OF DRINKING FOUNTAIN

For detailed information, refer to IS 1700 : 1973 Specification for Drinking fountains (first revision).

SUMMARY OF
IS 2963 : 1979 COPPER ALLOY WASTE FITTINGS FOR
WASH-BASINS AND SINKS
(First Revision)

1. Scope— Requirements for materials, manufacture and workmanship, nominal sizes, dimensions and finish of copper alloy waste fittings used in wash-basins and sinks complying with the prescribed standards.

2. Requirements

2.1 Materials

Body — Brass or leaded tin bronze

Nut — Brass rod

2.2 Nominal Sizes — 32 mm for wash basins.

50 mm for sinks

Note—For detailed dimensions refer to the figures in the standard.

2.3 Finish — Nickel chromium plated.

For detailed information, refer to IS 2963 : 1979 Specification for copper alloy waste fittings for wash-basins and sinks (first revision).

SUMMARY OF
IS 3489 : 1985 ENAMELLED STEEL BATH TUBS
(First Revision)

1. Scope—Requirements for material, construction and workmanship, patterns, dimensions, tolerances and maintenance for vitreous enamelled steel bath tubs.

2. Pattens— See Fig 1 and Fig. 2.

3. Material— Mild Steel sheet conforming to the prescribed standard and having a minimum thickness of 1.60 mm shall be free from lamination and surface cracks.

4. Dimensions— See Table 1.

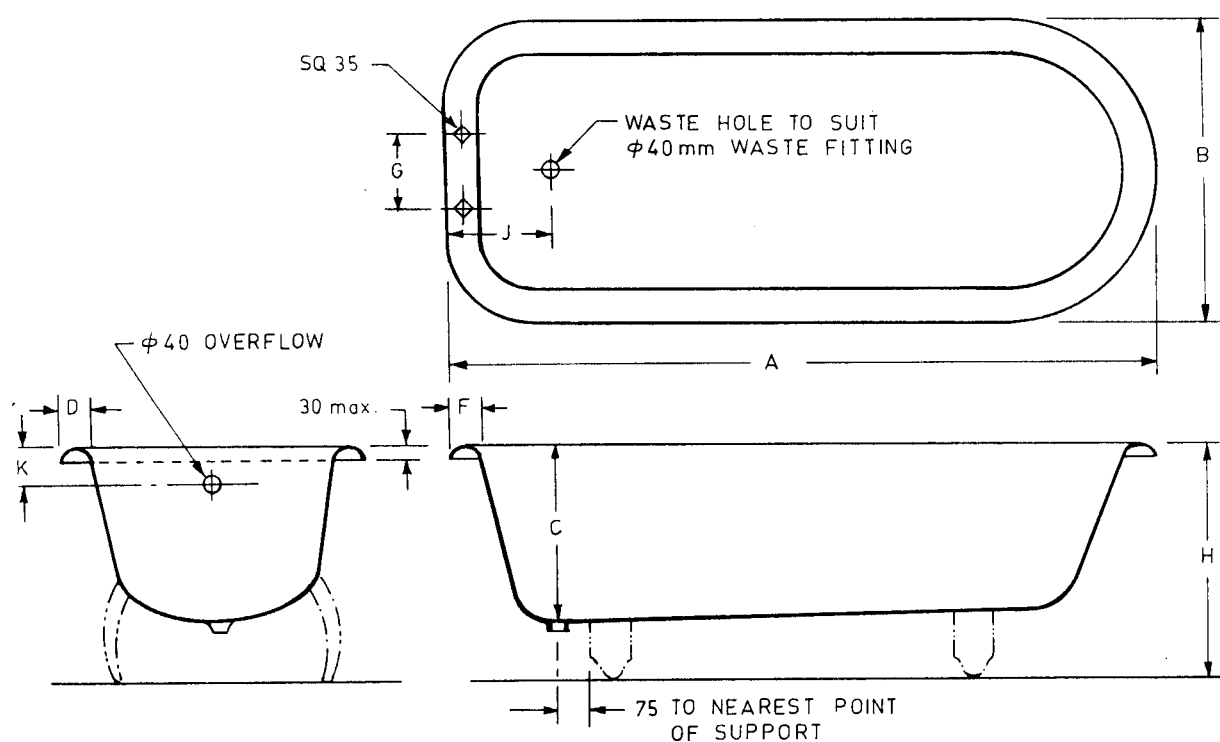


Fig. 1 Bath Tub – Pattern 1

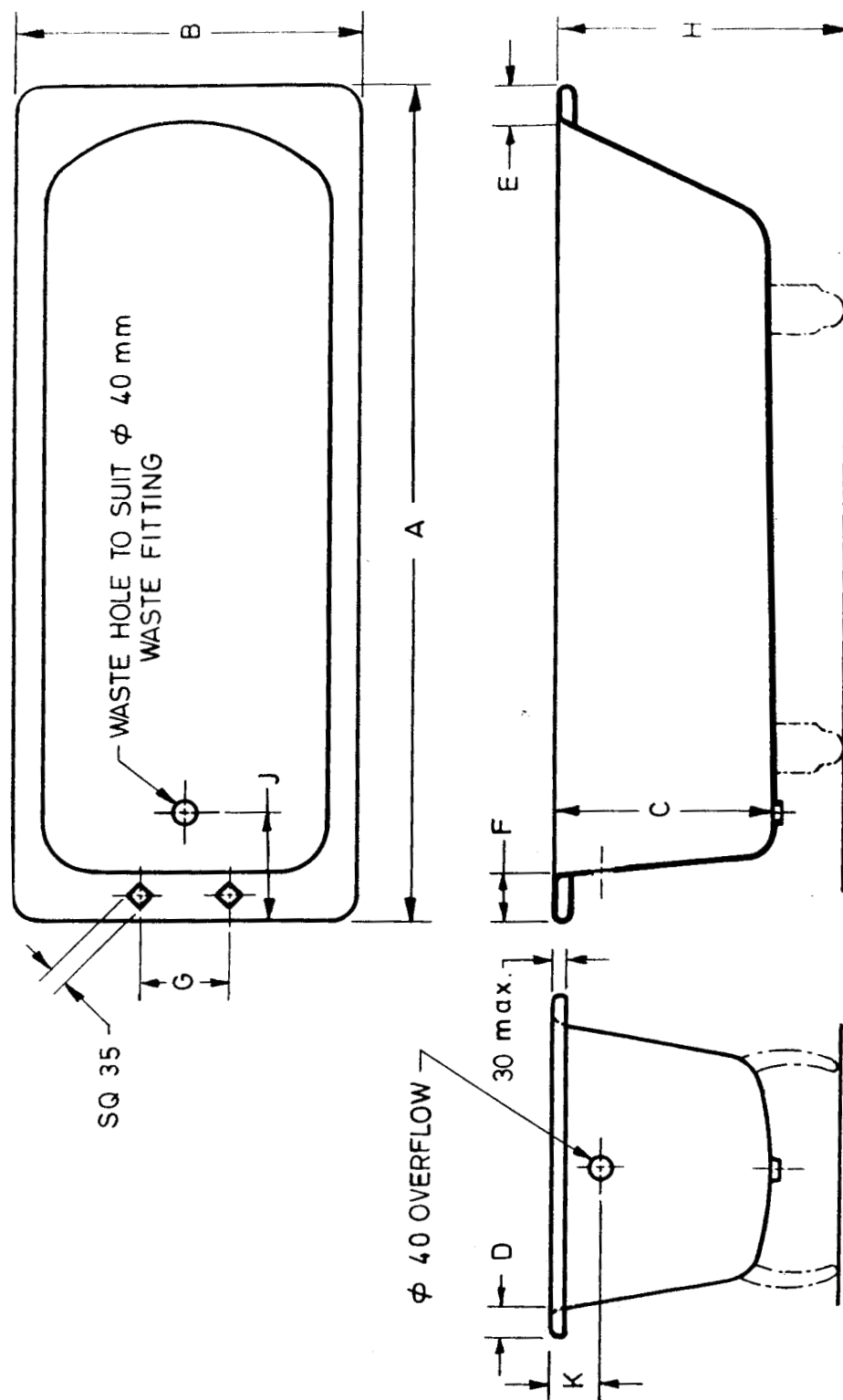


Fig. 2 Bath Tub – Pattern 2

TABLE 1 DIMENSIONS OF BATH TUBS

Particulars	Dimension of Tubs			
	Pattern 1			Pattern 2
	Size 1	Size 2	Size 3	
Length overall, A	1525	1700	1850	1700
Width overall, B	700	700	700	730
Depth inside (at waste hole), C	440	440	440	430
Roll (at sides), D (<i>see</i> Note)	60-80	60-80	60-80	60-80
Roll (at tap end), E	60-80	60-80	60-80	60-80
Roll (at tap end), F	75-100	75-100	75-100	75-100
Distance of tap holes, centre to centre, G	180 <i>Min</i>	180 <i>Min</i>	180 <i>Min</i>	180 <i>Min</i>
Height Overall, H				
with 35 mm <i>Min</i> seal trap	580	580	580	570
with 70 mm <i>Min</i> seal trap	620	620	620	610
Waste hole - horizontal distance from outside edge of roll at tap end to centre of waste hole, J	250 <i>Min</i>	250 <i>Min</i>	250 <i>Min</i>	250 <i>Min</i>
Overflow centre- vertical distance below top edge, K	90-105	90-105	90-105	90-105

Note— In case of bath tubs pressed from one sheet the dimension may be increased to 100 mm maximum, whilst the slope of the sides and ends will be steeper than that shown in Fig. and 2.

5. Tolerances

5.1 Overall width and length ± 1 percent.

5.2 For other values specified in Table 1, ± 4 percent

6. Surface Coating

6.1 *Finish*—Gloss, colour and opacity shall be uniform and visually satisfactory.

6.2 *Chemical resistance*—

- Alkali resistance test*—There shall be no loss in weight after the prescribed test
- Acid resistance test*— There shall be no loss in weight after the prescribed test.

6.3 *Defects* — shall be liable to rejection if the finish shows any of the following defects:

- Crazing
- Dimples, rundown, sagging
- Blisters
- Pinholes
- Specks

6.4 *Thickness of Enamel*— shall be between 0.2 mm to 0.5 mm.

6.5 *Warpage*— Shall not exceed 5 mm/m for edges set against wall or floor and shall not exceed 1.5 mm/m for other edges.

Note: For method of tests refer to the standard.

For detailed information, refer to IS 3489 : 1985 Specification for enamelled steel bath tubs (first revision).

SUMMARY OF
IS 5219 : 1969 CAST COPPER ALLOYS TRAPS
PART 1 P AND S TRAPS

1. Scope – Covers copper alloy cast traps P and S types and their associated components of nominal sizes 32 mm, 40 mm and 50 mm for use in wash-basins, sinks, bath tubs and similar waste appliances.

2. Materials–

Castings – Shall be of brass with copper content not less than 56 percent.

Pressing – Pressings where used for associated Components shall be forgeable brass with the following composition:

	<i>Min</i>	<i>Max</i>
Copper	56.5	60.0
Lead	1.0	2.5
Zinc	—	Remainder

Note— Total impurities not more than 0.75 percent

3. Workmanship and Finish

3.1 Casting shall be sound in all respects, free from blow holes, laps and sand pittings. Both the external and internal surface shall be clean, smooth and free from sand. No casting shall be plugged, stoped or patched.

3.2 The external surface of traps and associated components shall have one of the following finishes—

- a) Self-colour, free from grease and tool marks;
- b) Polished; and
- c) Nickel or chromium plated.

4. Design and Construction

Note—Typical illustrations of traps are shown in Tables 1 to 8 of the standard.

4.1 Inlet — Inlet of every trap shall have internal threads conforming to the basic profile of ISO metric screw threads and shall be provided with a tail pipe and a coupling nut. the tail pipe shall be screwed on to the inlet with a minimum engagement of 8 mm and secured in position by soldering.

4.2 Outlet — The outlet of ‘P’ and ‘S’ trap shall be

either with plain ends suitable for conection to lead pipe or with external parallel pipe threads of fastening type.

4.3 Tail Pipes — Tail pipes shall be of any of the following types:

- a) *Screwed inlet straight tail pipes*— shall conform to Table 6 of the standard and shall be threaded externally to a length sufficient to have a minimum engagement of 8mm into trap inlet. Collar shall be integral with the tail pipe.
- b) *Bent rail pipe* — when used for bathtrap,overflow connections shall conform to Table 7 of the standard and shall have an integral collar. It may also be used for converting a ‘P’ trap to an ‘S’ trap.

4.4 Coupling Nuts — The dimensions of coupling nuts for trail pipes shall coform to Table 8 of the standard.

4.5 Blank Nuts —Blank nuts for bath traps shall be of 25 mm nominal size conforming to Table 8 of the standard except that the flange shall be without hole.

4.6 Access for Inspection and Cleaning — Every trap of the type shown in Tables 1 and 2 of the standard shall be provided with a clean out in the position shown in the figures and shall be fitted with the clean out plugs (see Table 5 of the standard).

4.7 Lower Flow Openings – Bath traps shall be provided with branches in4 positions shown in Tables 3 and 4 of the standard and shall be screwed externall with 25 mm (P-1) parallel pipe theads conforming to IS 2643 : 1975 with a minimum thread lenght of 10 mm.

4.7.1 One branch shall be fitted with a blank cap, complete with washer.

5. Dimensions

5.1 The traps and associated components shall conform to the dimensions given in Tables 1 to 8 of the standard.

5.2 Thickness of Wall — The average thickness of the wall of the traps shall be not less than 2.3 mm and at no point shall be the thickness less than 1.6 mm.

5.3 Depth of Seal — The minimum depth of the seal shall be either 35 mm or 75 mm as ordered.

5.4 Rake of Outlet — In “P” traps, the outlet shall be in possession of a rake of 1 1/40 Min and 50° Max below the horizontal when the access of the inlet is vertical. Variation shall be permissible when so ordered.

For detailed information, refer to IS 5219 (Part 1) : 1969 Specification for cast copper alloys traps Part 1: ‘P’ and ‘S’ traps.

SUMMARY OF
IS : 6411-1985 GEL-COATED GLASS FIBRE REINFORCED
POLYESTER RESIN BATH TUBS
(First Revision)

1. Scope—Requirements for materials, construction, workmanship, finish, performance and testing for gel-coated glass fibre reinforced polyester resin bath tubs.

2. Materials

2.1 Glass Fibre—The fibre glass used shall be low alkali glass (for example, E-glass) compatible with polyester resin.

2.1.1 The glass content of the laminate shall be minimum 30 percent by weight.

2.2 Polyester resin—Unsaturated polyester resin used in the manufacture of bath tubs should be resistant to hot water and weathering. A ratio of not less than 1: 2 of glass fibre to polyester is recommended.

2.3 Fillers and Colouring Materials—When filler and colouring materials are used, their quality and proportion should be compatible to the polyester and the materials should not have any harmful effect on the quality and performance of bath tubs.

2.4 Gel-coat—The bath tub should possess a uniform gel-coat on the working surface. The gel-coat used shall be based on isophthalic grade of polyester, or epoxy resin or any equally suitable chemical resistant grade of resin.

3. Workmanship and Finish

3.1 The bath tubs shall be free from cracks, crazing, pinholes, blisters or chipped areas or moulding defects that may affect their appearance and serviceability. There shall be no readily visible wrinkles in any area when viewed with lighting. The gel-coat shall be free from voids and no voids between the gel-coat and the back-up resin shall be closer than 0.5 mm to the inner face.

3.2 Non-permissible defects

Sl.No Part Non-permissible.

(1)	(2)	(3)
i)	Upper rim, inner wall, bottom, apron, other readily visible faces.	Small pores, wrinkle, craze, bubbles, defective impregnation, superficial defects injuries, aggregate defects
ii)	Obscure faces.	Defective impregnation, superficial defects.

3.3 Permissible Range of Defects

Sl. No	Defects	Upper Rim	Inner Wall	Apron	Bottom	Other/ Readily Visible Parts
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Traces of mending	2	2	2	2	Not conspicuous
ii)	Impurities	2	3	2	3	" "
iii)	Pin Holes	2	3	2	3	" "
iv)	Colour bolts	Should not be conspicuous				
v)	Unevenness	Should not be conspicuous				
vi)	Deformity	The horizontal section of the upper rim should drain off water readily. The bend of the section in contact with wall should be less than 5 mm. Deformities of the other sections of the bath tubs should not be conspicuous.				

4. Dimensions

All dimensions in millimetres

Length overall at top	1680 to 1700
Width overall at top	730 to 760
Height overall	500 to 570
Depth inside, at waste	440
Roll (at head end and sides)	60 Min to 85 Max
Roll (at tap end)	75 Min to 100 Max
Distance of tap holes centre-to-center	180
Waste hole- horizontal distance from outside edge of roll at tap end to centre of waste hole	250
Overflow centre-vertical distance below top edge	100

5. Requirements

5.1 Each bath tub shall be one piece unit with an opening for waste out let. An overflow shall normally be provided. Apron (side panel) may be provided integrally or seperately.

5.2 Thickness of laminbase including gel coal shall not be less than 2 mm for apron, 3 mm for inner wall and bottom and 4 mm tor bottom bend.

6. Performance Requirements

6.1 Impact Resistance : Shall not show cracks in the gel-coat when subjected to impact test.

6.2 Hardness —Shall show a minimum reading of 40 points on a bareolimpessor or any other equally suitable apparatus.

6.3 Cracking or Crazing—Shall not show on visual inspection any signs of cracking or crazing after the oven test.

6.4 Water Absorption — Shall not absorb water in excess of 0.5 percent in 24 hours.

6.5 Gel-Coat— Shall not be less than 0.25 mm thickness nor more than 1.00 mm thickness.

6.6 Resistance to Boiling Water— There shall be no crazing , bubbless,dis-colouration when test pieces are subjected to boiling water.

6.7 Resistasnce to Hydrochloric Acid— There shall be no crazing, discolouration, exposure of glass fiber, etc, .when subjected to the test for hydrochloric acid.

6.8 Tensile Strength Test for Laminates — The tensile strength of the laminate at any point shall not be less than 6.5 MPa.

6.9 Washability — Shall withstands 40 000 cycles in the scrub test and only slight brush marks at the completion of the test shall be permitted.

Note: For Methods of tests, refer to 8 of the standard

For detailed information, refer to IS 6411 : 1985 Specification for Gel-coated glass fibre reinforced polyester resin bath tub (first revision).

SUMMARY OF

IS 8718 : 1978 VITREOUS ENAMELLED STEEL KITCHEN SINKS

1. Scope : Requirements regarding material construction and workmanship, patterns and sizes, dimensions and tolerance and marking for vitreous enamelled steel kitchen sinks.

2. Material : Mild steel sheet minimum 1 mm thick.

3. Patterns and Sizes:

Sl. No.	Pattern	Overall length mm	Overall Width mm	Overall Depth (in mm)	
				Min mm	Max mm
i)	Flat-rim	750	450	150	200
		600	450	150	200
		500	400	150	200
		450	400	150	200
		400	400	150	200
ii)	Flat-rim-ledge	750	500	150	200
		600	500	150	200
iii)	Flat-rim- ledge, with double compartment	1050	500	150	200
		800	500	150	200

4. Tolerances — Overall length and width shall not vary by more than +2 percent.

Note — Kitchen sinks may be made in other patterns and sizes where mutually agreed.

5. Surface Coating — Interiors of sinks shall be adequately and evenly coated with vitreous enamel of quality complying with requirements given 4.1 to 4.5 of the standard. At least one ground or primer coating preferably white, or coloured enamel coating preferably white or coloured enamel coating shall be applied on the outer surface.

5.1 Finish — Gloss, colour and opacity shall be uniform and visually satisfactory.

5.2 Abrasion — shall withstand resistance to scratching.

5.3 Alkali Resistance — There shall be no loss in weight after the test.

5.4 Acid Resistance

5.4.1 White enamelled sinks — There shall be no loss in weight.

5.4.2 Coloured enamelled sinks — Shall conform to classes AA, a and B.

5.5 Defects — Shall be liable to rejection if finish shows any of the following defects:

- Crazing
- Dimples, rundown and sagging.
- Bisters — not more than two in number on the interior surface shall be permitted provided they can not be broken by pressure of a finger nail.
- Pin holes — maximum 2 for coloured sinks and 4 for white enamelled sinks. There shall be no grouping and they shall not penetrate to the metal.
- Specks — shall be less than 1 mm in size and maximum 5 in number and there shall be maximum 0.5 mm.

5.6 Thickness of Enamel — Minimum 0.2 mm, and maximum 0.5 mm.

5.7 Warpage of edges set against wall and edged of roll rims shall not exceed 5 mm/m. Warpage of all other edges shall not exceed 7.5 mm/m.

Note — For test procedures refer to IS 772 : 1973 General requirements for enamelled cast iron sanitary appliances (second revision) and IS 3972 Methods of test for vitreous enamel ware.

For detailed information, refer to IS 8718 : 1978 Specification for vitreous enamelled steel kitchen sinks.

SUMMARY OF

IS 8727 : 1978 VITREOUS ENAMELLED STEEL WASH-BASINS

1. Scope—Requirements regarding material, construction and workmanship, patterns and sizes, dimensions and tolerances and marking for vitreous enamelled steel wash basins.

2. Material — Mild steel sheet of thickness 1 mm. min.

3. Patterns and Sizes

Pattern	Nominal Size (Overall Length × Overall Width)		
	mm	×	mm
i) Flat-back (Type 1)	480	×	430
	500	×	450
	500	×	450
Flat-back (Type 2)	600	×	500
	480	×	430
	500	×	400
ii) Flat-rim	510	×	450
	530	×	430
	450	×	400
iii) Overall	450	×	400
iv) Round	450 Dia		

3.1 Tolerance — On overall dimension + 2 percent.

Note 1— Wash basins may be made in other patterns and sizes where mutually agreed.

Note 2 — For detailed dimensions and figures refer to the standard.

4. Requirement

4.1 Basin shall have in integral soap holder recess or recesses which shall drain into the bowl.

4.2 A slot type of overflow having an area of not less than 500 mm² shall be provided in the front or back facilitate cleaning of the overflow. The cross-sectional area of passageway of overflow shall be 400 mm², minimum.

5. Surface Coating— Interiors of wash basins shall be adequately and evenly coated with vitreous enamel of quality in 5.1 to 5.5. At least one ground or primer coating preferably white, or coloured enamel coating

shall be applied on the outer surface.

5.1 Finish — Gloss, colour and opacity shall be uniform and visually satisfactory.

5.2 Abrasion — Shall withstand resistance to scratching.

5.3 Alkali Resistance — There shall be no loss in weight.

5.4 Acid Resistance

5.4.1 White enamelled wash basins — There shall be no loss in weight.

5.4.2 Coloured enamelled wash basins — Shall conform to classes AA, A and B.

5.5 Defects — Shall be liable to rejection if finish shows any of the following defects :

- Crazing
- Dimples, rundown and sagging
- Blisters** — Not more than two in number on interior surface shall be permitted provided they cannot be broken by a pressure of a finger nail.
- Pinholes** — maximum 2 for coloured wash basins and maximum 4 for white enamelled wash basins permissible. There shall be no grouping of pinholes and they shall not penetrate to the metal.
- Specks** — shall be less than 1 mm in size and maximum 5 in number and there shall be no grouping.

5.6 Thickness of Enamel — Minimum 0.2 mm, and maximum 0.5 mm.

5.7 Warpage of edges set against wall and edges of rims shall not exceed 5 mm/m warpage of all other edges shall not exceed 7.5 mm/m.

Note — For test procedures refer to IS 772 : 1973 General requirements for enamelled cast iron sanitary appliances (second revision), and IS 3972. Methods of test for vitreous enamel ware.

For detailed information, refer to IS 8727 : 1978 Specification for vitreous enamelled steel wash-basins.

SUMMARY OF
IS 12701 : 1996 ROTATIONAL MOULDED POLYETHYLENE
WATER STORAGE TANKS
(First Revision)

1. Scope

1.1 Requirements of materials, dimensions, construction, shape workmanship, performance requirements and inspection and testing of rotational moulded polyethylene water storage tanks with a nominal service temperature +1°C to +50°C.

1.1.1 These tanks are not meant for underground applications.

1.2. This standard is applicable tanks subjected to the following conditions :

- a) Own hydrostatic head of water, and
- b) Tank with uniform flat base support .

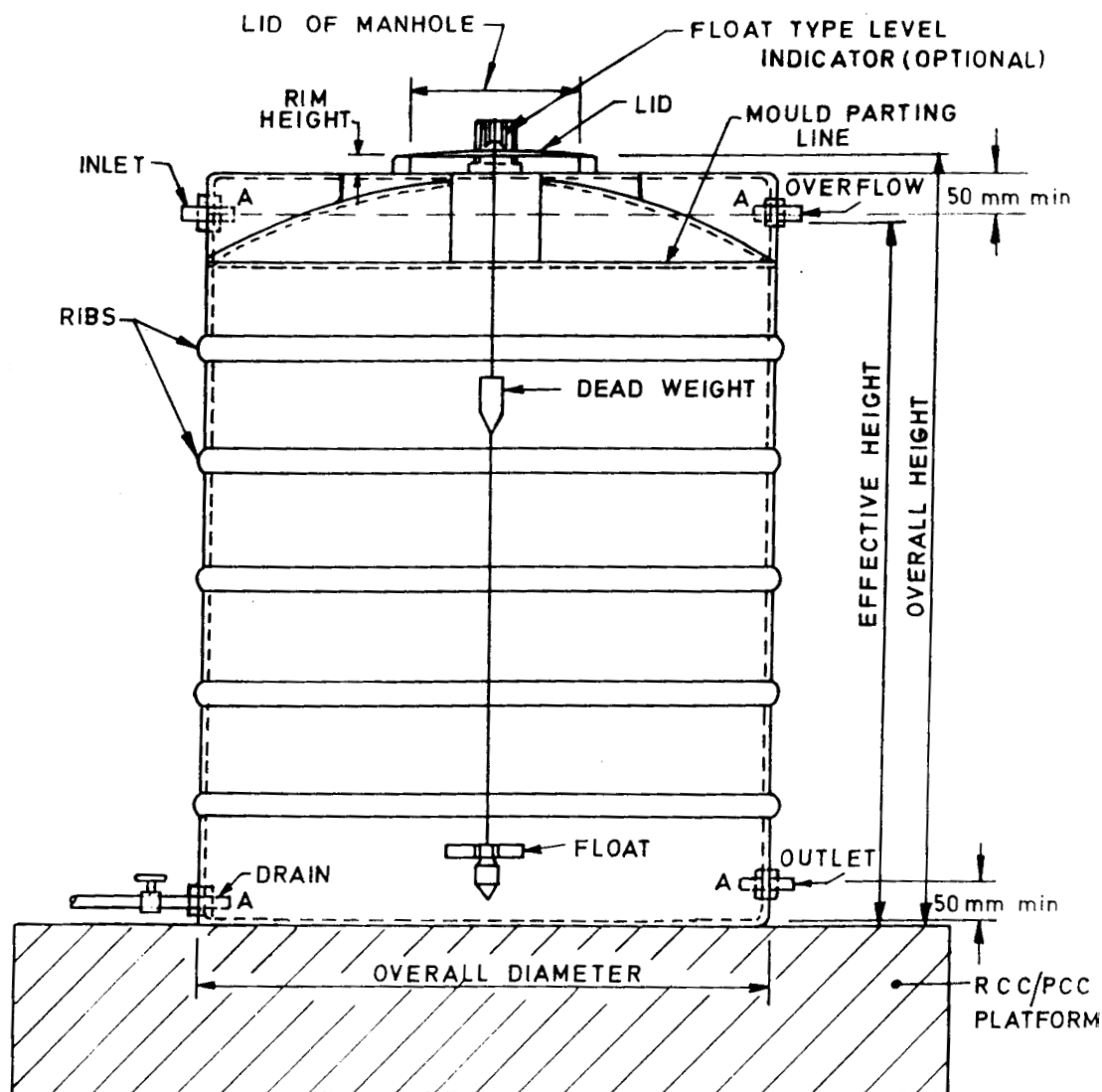


FIG. 1 TYPICAL DETAILS OF CYLINDRICAL VERTICAL TANK

1.3 This standard does not cover mobile and horizontal cylindrical water tanks

2. Material

2.1 Shall be such that it does not impart any taste, colour or odour to water, nor have any toxic effect, and it shall not contaminate water thereby making it unpotable.

2.2 Polyethylene resin to be used should be of rotational moulded grade and duly stabilized with anti-oxidants. The anti oxidants used, not exceeding 0.3% by mass of finished resin, should be physiologically harmless and should be selected from the list given in IS 10141: 1982. Positive list of constituents of polyethylene in contact with food stuffs, pharmaceuticals and drinking water.

2.3 The density of resin (base material) at 23 °C shall be within 932 to 943 kg/m³.

2.4 The melt flow rate (MFR) of the resin under (Temperature 190° C and nominal load of 2.16 kg) shall be within 2.0 to 6.0 g/10 minutes.

2.5 The water tanks meant for out door use shall be manufactured from carbon black compounded polyethylene and shall meet the following requirements:

- The percentage of carbon black content in the materials shall be within 2.0 and 3.0, and
- The dispersion of carbon black shall be satisfactory.

2.6 The addition of not more than 10 percent of the manufacturers own reworked material resulting from the manufacture of tanks only according to this standard is permissible.

3 Types and Features

- Cylindrical vertical tanks
- Rectangles tanks

TABLE 1 DIMENSION OF CYLINDERICAL VERTICAL TANK

<i>Sl. Minimum Net Range</i>		<i>Overall Diameter Range (mm)</i>	<i>Overall Height Range (mm)</i>	<i>Minimum Internal Dia of Man-Hole/ Hand-Hole (mm)</i>	<i>Minimum Wall and Bottom Thickness (kg)</i>	<i>Minimum Weight of Tank (Without Lid)</i>
<i>No.</i>	<i>Up to Effective Height (mm)</i>					
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	200	650-850	490-690	265	3.0	7.8
ii)	300	650-850	700-900	265	3.0	9.0
iii)	400	700-980	700-950	265	3.5	15.0
iv)	500	800-1140	625-1025	370	4.0	18.0
v)	700	900-1140	800-1100	370	4.4	23.0
vi)	1000	1000-1200	1050-1350	370	4.5	33.0
vii)	1500	1080-1450	1150-1590	370	4.5	47.0
viii)	1700	1300-1500	1260-1650	370	4.5	54.0
ix)	2000	1365-1500	1400-1700	450	5.4	64.0
x)	2500	1380-1610	1400-1810	450	7.7	81.0
xi)	3000	1410-1800	1640-2150	450	8.1	96.0
xii)	4000	1450-1920	1750-2400	450	10.4	147.0
xiii)	5000	1800-2110	1800-2100	450	10.7	180.0
xiv)	6000	1800-2200	2065-2800	450	10.72	05.0
xv)	7500	1890-2250	2100-2930	450	10.72	39.0
xvi)	10000	1900-2680	2400-3740	450	11.53	19.0
xvii)	15000	2100-2680	2100-4000	450	11.5	408.0
xviii)	20000	2100-3150	3190-5000	450	13.2	566.0

Note— The gross capacity of the tanks shall be at least 5 percent in excess of the minimum net capacity.

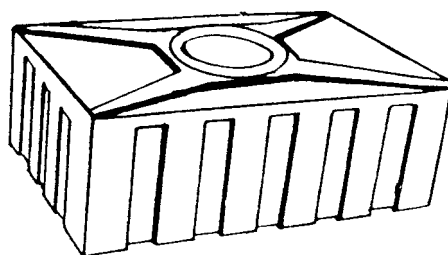


FIG. 2 RECTANGULAR LOFT TANK

TABLE 2 DIMENSIONS OF RECTANGULAR LOFT TANKS

Sl. No	Minimum Net Capacity	Overall Length	Overall Width	Over all Height	Minimum Internal dia of Handhole	Minimum wall Thickness (Measured on) Rectangular Vertical Port and Bottom Thickness	Minimum Weight of Tank (Without Lid)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	150	620-820	620-820	285-485	300	2.75	6.6
ii)	200	930-1130	620-820	285-485	300	2.75	7.7
iii)	300	995-1200	620-820	285-485	300	2.75	11.0
iv)	400	1150-1350	855-1150	335-535	300	2.75	13.0
v)	500	1150-1500	900-1250	335-535	300	2.75	17.5

4. Finish — The internal and external surface of the water storage tank shall be smooth, clean and free from other hidden internal defects, such as air bubbles, pits and metallic or other foreign material inclusions.

5. Performance Requirement

5.1 Resistance to deformation — The difference between the circumferential measurement shall not be greater than 2 percent of the original measurements for cylindrical vertical tanks. The difference between the longitudinal measurements shall not be greater than 3 percent of the original measurements, for rectangular loft tanks.

5.2 Resistance to Impact — The impact shall neither result into cracking nor puncture of the tank.

5.3 Test for Load Resistance — After removal of the load the test specimen shall be inspected for deformation or crack on the surface and after 4 hours of the removal of the load the flat surface shall return to position. This test shall be applied to tanks with capacity 1500 litres and more.

5.4 Tensile Strength — Shall not be less than 12 N/mm^2

5.5 Flexural Modulus — Shall not be less than 300 N/mm^2 .

5.6 Overall Migration — As specified in IS 10146 : 1982*

6. Man-Hole, Hand-Hole Lids

6.1 Man-hole hand-hole lids shall be moulded from polyolefins of minimum thickness 3 mm and shall have sufficient ribs to provide adequate stiffness. It shall be stabilized with 2 to 7 percent of carbon black having satisfactory dispersions.

6.2 The lid shall fit securely over the top rim of the tank and it shall rest evenly on it in order to prevent the ingress of foreign matter such as insects, mosquitoes or dust through the top of the tank. The lid shall also be provided with suitable locking arrangement.

6.3 To test the lid being fit securely to the manhole, no clearance in it should permit a 1.6 mm diameter wire to pass through.

*Polyethylene for its safe use in contact with Food stuffs, pharmaceuticals and drinking water.

For detailed information, refer to IS 12701 : 1996 Specification for rotational moulded polyethylene water storage tanks (first revision).

SUMMARY OF

IS 13983 : 1994 STAINLESS STEEL SINKS FOR DOMESTIC PURPOSES

1. Scope — Requirements regarding material dimensions, construction and workmanship for sit-in and inset type stainless steel sinks for domestic purposes. Options are specified for sinks with or without overflow holes, tap holes or selected waste facilities. The standard does not specify methods of supporting or methods of fixing and sealing sinks.

2. Types

Type A1 or A2 –	Single bowl without drainer.
Type B1 or B2 –	Double bowl without drainer
Type C –	Single bowl without drainer right or lefthand.
Type D –	Single bowl double drainer
Type E1, E2 or E3 –	Double bowl single drainer, right or left hand.
Type F –	Double bowl double drainer.

3. Materials – Austenitic stainless steel of specified grade.

4. Dimensions and Tolerances

4.1 Nominal Thickness of Sheet— not less than 1 mm.

4.2 Thickness at any point of sink, after forming, shall not be less than 0.75 mm.

4.3 The depth of the sink bowl shall be 150 mm minimum, when measured from the top edge of the bowl to the base of the sink.

4.4 The minimum internal dimensions, when measured on the bowl centre lines across the top of the bowl, shall be 380 mm × 340 mm for rectangular bowls and 360 mm for round bowls

4.5

- The distance between the edge of the sink bowl and the end of the sink shall be 15 mm, minimum for sit-on type sinks and 30 mm, minimum for inset type sinks. Depth of the collar provided for inset sinks shall be 10+2 mm.
- For sinks designed for use with a 600 mm wide worktop, the distance between the edge of the sink bowl and the front of the sink shall be 50 mm minimum and in the case of sinks designed for use with 500 mm wide worktop, the distance shall be 45 mm minimum.
- Both single and double bowl sink shall be set a minimum of 10 mm from gridline.

4.6 The dimensions of the sink shall comply with Table 1 read with Fig. 1 of the standard.

5. Construction and workmanship

5.1 Sinks shall be constructed of the lowest practical numbers of sections compatible with the manufacturing practice to ensure a smooth surface.

5.2 Drainers shall be fluted or grooved and shall be inclined towards the sink bowl.

5.3 Waste Outlet—Sink bowls shall be designed/constructed with a fall to the waste outlet. The waste outlet fitting shall be recessed type.

5.4 Tap Holes—Sinks shall be provided, in one of the following conditions :

- Without tap holes;
- With two tap holes of 30+2 mm diameter with a distance of 180+2 mm between centres, or 300+2 mm between centre for round bowled sinks only, for nominal size 1/2 outlet pillar or high level combination taps.

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- c) with single tap hole of 35 ± 2 mm diameter for high outlet mixer tap. The centres of tap holes shall be more than 60 mm from the nearest back edge of the bowl and not less than 50 mm to the front face of the upstand.

5.5 Overflows— Sinks shall be provided in either of the following conditions :

- a) Without an overflow hole;
- b) With an overflow hole having a horizontal dimension not less than 64 mm, and a vertical height not less than 15 mm giving an area of not less than 6430 mm², and located completely below the spillover level of the sink.

6. Finish—Sinks may be supplied with a bright or dull finish.

For detailed information, refer to IS 13983 : 1994 Specification for stainless steel sinks for domestic purposes.

SUMMARY OF

IS 14399 (PART 1 AND 2) : 1996 HOT PRESS MOULDED THERMOSETTING GLASS FIBRE REINFORCED POLYESTER RESIN (GRP) SECTIONAL WATER STORAGE TANKS.

1. Scope — Requirements for the panels of glass fibre reinforced polyester resin (GRP) sectional tanks meant for storing potable water under pressure not exceeding the static head corresponding to the depth of the tanks and temperature of exceeding 50°C.

GRP panels used in manufacturing tanks as covered in this standard are not compression moulded, using sheet moulding compound (SMC).

2. Materials — Shall be composed of unsaturated thermosetting polyester resin (food grade) reinforced with glassfibre. This system will include catalysts and may include pigments (compatible with unsaturated polyester resin) and ultra violet stabilizers.

2.1 Polyester Resin—Shall meet the following characteristics:

- | | | | |
|----|------------------|---|------------------------|
| a) | Specific gravity | = | 1,13+0.01 at 27°C |
| b) | Acid value | = | 16+4 mg. KOH/g, |
| c) | Volatile content | = | 30 percent +3 percent, |
| d) | Gel time at 25°C | = | 20 to 30 minutes. |

Cured resin shall also be met with:

- | | | | |
|----|-----------------------------|---|--------------------------------------|
| a) | Barcol hardness | = | 40 BHU min; |
| b) | Heat deflection temperature | = | 80°C to 90°C |
| c) | Elongation at break | = | 1.9 percent, -0+ 25°C |
| d) | Water absorption | = | 1 percent, after 7 day sat 25°C max. |

2.1.1 Hydrolysis Test — There shall be no evidence of weight loss (due to break down of the polymer) when tasted as prescribed.

2.2 Glass Fibre Reinforcements — Shall be of commercial grade E type and shall conform to the prescribed standards.

2.3 Fillers — Inert inorganic fillers (with particle size below 0.05 mm) shall only be used, if required.

2.4 Additives may be incorporated for modifying the properties to the resin.

2.5 Colour — Colour of the panel shall be a shade of grey or cream. Any other colour (pastel shade) may be used.

3. Panel Dimensions

3.1 The nominal external size of the unit panels shall be 1 m² square or 1 m x 0.5 or 0.5 x 0.5 m

3.2 Tolerance in the external dimensions of each panel shall be within or +0.2 percent of the external dimensions. Tolerance on the angles shall be within ±0.3°

4. Type/Thickness of panel

Type of panel	Min Thickness, mm
A	3
B	4
C	5

5 Visual Inspection of Panels

5.1 The internal and external surfaces of the panels when visually inspected shall be free from the following defects

- Small pits appearing on the surface.
- Poor impregnation of fibreglass with resin.
- Cuts, cracks and scratches exposing the glass reinforcement.
- Sharp projections, exposed fibres or glass reinforcements too close to the surface.
- Surface and non-structural repair marks.
- Blister on the surface caused by air pockets.

6. Mechanical and Physical Properties Panels:

6.1 Mechanical/Physical Properties, Acceptance Criteria:

- | | | |
|------|-----------------------------------|-------------------|
| i) | Tensile strength | 70 MPa (Min) |
| ii) | Bending strength (cross-breaking) | 100 MPa (Min) |
| iii) | Elastic modulus in bend | 6000 MPa (Min) |
| iv) | Glass content | 25 percent (Min) |
| v) | Barcol hardness | 50 BHU (Min) |
| vi) | Water absorption | 0.5 percent (Max) |

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6.2 Hydrostatic Test—Shall withstand following hydrostatic pressure without bursting, cracking or leakage:

Type of Panel	Hydrostatic Pressure MPa
A	0.04
B	0.08
C	0.12

6.3 Deflection shall not exceed 10 mm.

7. Test for Establishing Polability of Water—see 11 of the standard.

Note— Part 2 deals with assembly, installation and leakage test.

For detailed information, refer to IS 14399 (Parts 1 and 2): 1996. Specification for hop press moulded thermosetting glass fibre reinforced polyester resin (GRP) sectional waterstorage tanks.

SUMMARY OF
IS 407 : 1981 BRASS TUBES FOR GENERAL PURPOSES
(Third revision)

1. Scope

1.1 Requirement of solid drawn brass tubes for general purposes. Specifies the method of designating tubes by their outside diameter and lays down the permitted tolerances on outside diameter, thickness and length of tubes.

2. Freedom from Defects

2.1 Shall be reasonably round, straight, clean smooth, uniform in diameter and free from cracks, seams, silver, scale, etc.

3. Condition

3.1 May be supplied in one of the following conditions:

- a) As drawn and stress relieved-hard temper (HD).
- b) Temper annealed (TA) (tubes heat treated over their full length to an intermediate temper), and.
- c) Annealed (O).

4. Sizes and Tolerances**4.1 Sizes :**

<i>Outside Dia in Preferred No. Series</i>	<i>Wall Thickness (mm)</i>
2	0.5
2.5	0.5, 0.6
4	0.5 to 1.0
5	0.5 to 1.2
8	0.6 to 1.5
10	0.6 to 1.5
12	0.6 to 1.5
14	1
16	0.6 to 1.5
18	1
20	0.8 to 2
22	1 to 1.5
25	1 to 2.5
28	1 to 1.5
32	1.2 to 3
35.5	1.2 to 1.5
40	1.5 to 4
50	1.5 to 4
63	1.5 to 6
80	1.5 to 8
100	1.5 to 8

<i>Outside Dia in Preferred No. Series</i>	<i>Wall Thickness (mm)</i>
125	2 to 12
160	2.5 to 12
200	8 to 12
250	8 to 12
315	8 to 20

Note— Wall thickness shall be 0.5, 0.6, 0.8, 1, 1.2, 1.5, 1, 2.5, 3, 4, 5, 6, 8, 10, 12, 16 and 20 mm.

4.1.1 Length — Up to 6 mm.

4.2 Tolerances—For tolerances refer to IS 5493 : 1981*.

5. Pressure Tests — (if required by purchaser)

5.1 Hydraulic Test — When tested, tubes shall show no sign of weeping, leaking or permanent increase in diameter at any point

5.2 Pneumatic Test — Tubes shall show no sign of leaking when tested to an air pressure of 0.42 MPa while immersed in water.

6. Physical Test**6.1 Tensile Strength and Hardness Requirements:**

<i>Grade</i>	<i>Temper</i>	<i>Tensile Strength MPa</i>	<i>Hardness Vickers HV</i>
CuZn 37As	Annealed (o)	285 Min	75 Max
	Temper		
	annealed (TA)	300 Min	80-110
CuZn37	Hard (HD)	400 Min	135 Min
	Annealed (o)	285 Min	80 Max
	Temper		
	annealed (TA)	320 Min	80-110
	Hard (HD)	400 Min	130 Min

6.2 Drifting Test— Tubes up to 100 mm nominal outside diameter shall not show crack or flaw, until the diameter of the drifted end measures at least 30 percent more than the original diameter.

* Dimensions for wrought copper and copper alloy tubes
(first revision).

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6.3 Flattening (*for tubes not exceeding 100 mm Outside Diameter*) — Test piece shall not crack.

6.4 Double Bend Test (*for Round Tubes over 100 mm Outside Diameter*) — Test piece shall not crack on the outside of either bend.

6.5 Mercurous Nitrate Test —As drawn and stress relieved (after the final draw) tubes shall withstand the prescribed test without showing any sign of cracking.

For detailed information, refer to IS 407: 1981. Specification for brass tubes for general purposes (third revision).

SUMMARY OF
IS 2501 : 1995 SOLID DRAWN COPPER TUBES
FOR GENERAL ENGINEERING PURPOSES
(Third Revision)

1. Scope

1.1 Requirements of solid drawn (seamless) copper tubes for general engineering purposes.

2. Grades

2.1 *Types*—Cu-ETP, Cu-DHP, Cu-FRTP,
 Cu-DPA, Cu-ATP.

3. Supply Condition:

- a) As Drawn (HD)—Tubes in half hard condition produced by cold drawing.
- b) Half Hard (HB) — Tubes in half hard condition produced by cold drawing.
- c) Annealed (O)

4. Freedom from Defects

4.1 Shall be reasonable clean, smooth and free from cracks, seams, silver, scales and other defects detrimental to the intended applications.

5. Dimension and Tolerances

5.1 *Dimensions* — Shall be designated by the outside diameter and the wall thickness. See IS 5493 :1981 for rationalised sizes.

5.2 *Tolerances* — As per IS 5493:1981. No tolerance on ovality shall be specified for tubes if wall thickness up to and including 0.4 mm.

6. Chemical Composition— Shall comply with relevant grade of copper as specified in IS 191 (Parts 1 to 10):1980*

++ Dimensions for wrought copper and copper alloy tubes
 (first revision)

7. Physical Properties**7.1 Tensile test**

**TENSILE STRENGTH AND CONSTANT FOR
 HYDROSTATIC TEST. K**

<i>Condition</i>	<i>Tensile Strength, MPa</i>	<i>Percentage Elongation on Gauge Length</i>	<i>K</i>
		$5.65 \sqrt{S_0}$	
	<i>Min</i>	<i>Min</i>	
(1)	(2)	(3)	(4)
As drawn (HD)	—	—	113
i) As such	280	—	—
ii) Strip cut from tube	250	—	—
Half Hard (HB)	—	—	99
i) As such	235	25	—
ii) Strip cut from tube	225	25	—
Annealed (O)	—	—	85
i) As such	205	40	—
ii) Strip cut from tube	195	45	—

The tubes shall also satisfy the following prescribed tests.

7.2 Flattening and Doubling Over test**7.3 Drift Expanding Test****7.4 Non-Destructive testing:**

- a) Eddy-current test
- b) Hydrostatic test
- c) Pneumatic test

7.5 Microscopic Examination (for 0 condition only)**7.6 Hydrogen Embrittlement test (for Cu-DHP and Cu-DPA Grades).**

For detailed information, refer to IS 2501: 1995 Specification for solid drawn copper tubes for general engineering purposes. (third revision).

SUMMARY OF

IS 1230 : 1979 CAST IRON RAINWATER PIPES AND FITTINGS

(Second Revision)

1. Scope

1.1 Requirements for cast iron rainwater pipes, half-round gutters, their fittings and accessories.

1.2 The requirements of O.G. gutters and fittings are covered in Appendix A of the standard.

2. Dimensions and Mass

2.1 Pipes and Fittings

		Length, mm	1800	1800	1800	1800
		Minimum weight for 1800 mm length, kg.	5	5.9	7.5	9.1
Pipes	Nominal Size, mm	50	75	100	125	150
	External dia, mm	53	79	104	130	156
	Thickness, mm	3	3	3	3	4
	Projection of spigot bead, mm	1	1	1	1	1
	Width of spigot bead, mm	20	20	20	20	20
Sockets	Length of Width of spigot bead, mm 1 800	1 800	1 800	1 800	1 800	1 800
	Internal dia, mm	63	89	114	139	167
	Thickness, <i>Min</i> , mm	4	4	4	4	4
	Internal depth, mm	60	65	65	75	75
	Thickness of beads, mm	7	7	7	9	9
Mass	Nominal mass of 1800 mm pipe without ears, kg.	7.5	11	14	20	26

Note — Unless otherwise specified, pipes and fittings shall be supplied without ears. For details refer to the standard.

3. Freedom from Defects — Pipes and fittings shall be sound and free from surface and other defects.

2.1.1. Tolerances

External dia of barrel	: ± 3 mm for 50 and 75 mm pipes ± 3.5 mm for 100 and 125 mm pipes ± 4 mm for 150 mm pipes
Internal dia of socket	: ±3mm
Depth of socket	: ±10mm
Thickness	: ±1mm
Thickness of gutters/fittings	: - 1.0 mm
Length of pipe	: ±13.0 mm
Length of fittings	: ± 3 mm
Mass	: -10 percent

4. Tests

4.1 Brinell Hardness Test — The hardness of external unmachined surface shall not exceed 230 HB.

4.2 Hydrostatic Test — Shall withstand pressure test without showing any leakage, sweating or other defect of any kind.

4.3 Hammer Test — When tested for soundness pipe shall emit a clear ringing sound.

2.2. Half-round Gutters and Fittings:

Nominal size, mm	75	100	125	150
Width, mm	75	100	125	150
Radius, mm	40	50	65	75
Thickness, mm	3	3	3	3
Length of gutters	: +13.0 mm			
Length of gutter fittings	: + 3.0 mm			
Mass	: 10 percent			

Note 1 — For dimens of bends, shoes, branches, offsets, union sockets, holderbats, rainwater heads, refer to the standard.

Note 2 — For test details, refer to the standard and IS 1500:1983 Methods for brinell hardness test for mettallc materials (second revision).

For detailed information, refer to IS 1230 : 1979 Specification for cast iron rainwater pipes and fittings (second revision).

SUMMARY OF
IS 1536 : 2001 CENTRIFUGALLY CAST (SPUN) IRON PRESSURE
PIPES FOR WATER, GAS AND SEWAGE
(Fourth Revision)

1. Scope

1.1 Requirements for centrifugally cast (spun iron pipes for pressure main lines for water, gas and sewage, manufactured in metal (lined or unlined) or sand lined moulds.

1.2 This standard is applicable to cast iron pipes having socket/spigot (both lead caulked or push on flexible) or flanges as specified in this standard. On cast of push-on joints the inner profile of socket end and spigot end of the pipe shall depend on the type of rubber gasket ensuring that the overall dimensions are maintained for reasons of safety and interchangeability.

2. Classification

2.1 Classified as LA and B according to their thickness. Class LA pipes have been taken as the basis for evolving the series of pipes. Class A allows a 10 percent increase in thickness over class LA. Class B allows a 20 percent increase in thickness over Class LA.

2.2 For special uses, Classes, C, D or E may be derived after allowing corresponding increases of thickness of 30, 40 or 50 percent respectively.

3. Mechanical tests:

- a) *Ring Test (for pipes centrifugally cast in metal moulds)*

Nominal Diameter	Modulus of Rupture, Min MPa
------------------	-----------------------------------

Upto and including 300 mm 390

- b) *Tensile Test for pipes over 300 mm*

Type of Moulding	Nominal Diameter	Tensile Strength Min, MPa
---------------------	---------------------	---------------------------------

i) For pipes centrifugally Over 300 mm
cast in metal moulds and up to and
including 600 mm 200
over 600 mm 180

ii) For pipes centrifugally All diameters 180

cast in sand lined moulds.

c) *Brinell Hardness*— shall not exceed 230

4. Hydrostatic Test —Hydrostatic test pressure for Centrifugally Cast Socket and Spigot Pipes

Class	Hydrostatic Test Pressure at Works, MPa	
	Upto 600 DN*	Above 600 DN*
(1)	(2)	(3)
LA	3.5	1.5
A	3.5	2.0
B	3.5	2.5

Note— *DN : Nominal diameter.

Hydrostatic Test Pressure for Centrifugally Cast Screwed on flanges

Class	Hydrostatic Test pressure at Works, MPa	
	Upto 300 DN*	350 to 600 DN*
(1)	(2)	(3)
B	2.5	1.6

Note— *DN : Nominal Diameter.

5. Sizes and Mass

5.1 Nominal Diameter 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 1000 and 1050 mm.

5.2 Working Length

a) Socket and spigot pipes — 3.0, 3.5, 3.66, 4, 4.5, 5.5, and 6.0 m.

b) Flanged pipes—2.75, 3, 4, 4.5, 5, 5.25 and 5.5 m.

Note — For dimensions of sockets spigots and flanges etc and for mass refer to the standard.

6. Tolerances

6.1 Tolerances on barrel diameter and socket dimensions (lead joint) (refer to Table below) and Fig. of the standard.

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<i>Dimensions</i>	<i>Nominal Diameter DN</i>	<i>Tolerances mm</i>
a) External diameter of barrel (DE)	All diameters	$\pm \frac{1}{2} f = \pm(4.5+0.0015 \text{ DN})$
b) Internal diameter of socket (DI)	All diameters	$\pm \frac{1}{3} f = \pm(3+0.001 \text{ DN})$
c) Depth of socket (P)	Up to and including DN 600	± 5
	Over DN 600 upto and including 1050	± 10

Note — “f” is the caulking sace of the joint in mm and us equal to (9+0.003 DN).

6.2 Tolerance on ovality (push-on-joint).

<i>Nominal diameter DN</i>	<i>Allowable Difference Between Mionor Axis and DE, Min mm</i>
80 - 300	1.0
350 - 600	1.75
700	2.00
750 - 800	2.4
900-1050	3.5

Note— For tolerance on barrel diameter and socket dimensions for push-on - joint refer to the standard.

6.3 Tolerance on Thickness

<i>Dimensions</i>	<i>Tolerance in mm</i>
a) Wall thickness	-- (1+0.05 e)
b) Flange thickness	$\pm(2+0.05$

Where e is the thickness of the wall in mm and b is the thickness of the flange in mm.

6.4 Tolerance on Length:

<i>Typing of Casting</i>	<i>Tolerance in mm</i>
a) Socket and spigot and plain ended pipes.	± 100
b) Flanged pipes	± 10

6.5 Deviation from a Stright Line — The maximum deviation from a straight line in mm shall not be greater than 1.25 times the length *L* in meters of standard.

6.6 Tolerance on Dimensions of Flanges — See **11.6** of the standard.

6.7 Tolerance on Mass — ± 5 percent.

7. Coating

7.1 All pipes shall be coated externally and internally with the same material by dip ping in a tar or suitable base bath. The pipes may be either preheated before dipping or the bath may be uniformly heated. The coating material shall set rapidly with good adherence and shall not scale.

Note— For methods of test refer to the standard and IS 1500 : 1983 Method for Brinell hardness test for smetallic materials (second revision).

For detailed information, refer to IS 1536 : 1989 Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage (third revision).

SUMMARY OF
IS 1537 : 1976 VERTICALLY CAST IRON PRESSURE PIPES
FOR WATER, GAS AND SEWAGE

(*First Revision*)

1. Scope

1.1 Requirements for cast iron pipes for pressure main lines of water gas and sewage manufactured by vertical casing in sand moulds.

1.2 Applicable to pipes with sockets (for lead joints) or flanges. Standard may also be made applicable to other types of joints specially rubber joints, where overall measurements shall be adhered to, to ensure interchangeability.

2. Requirements

2.1 Hardness — shall not exceed 210 HB.

2.2 Tensile Strength — shall not be lower than 15 kgf/mm²

2.3 Hydrostatic Test — Pipes shall with stand following test pressures kgf/cm².

Diameter	Socket and Spigot Pipes		Flanged Pipe	
	Class A	Class B	Class A	Class B
1) Up to 300 mm	20	25	20	25
2) Over 300 and up to 600 mm	20	25	15	20
3) Over 600 and up to 1000 mm	15	20	10	15
4) Over 1000 and up to 1500 mm	10	15	10	10

3. Sizes

a) Working length of socket and spigot pipes 3.66, 4, 4.88, 5 and 5.5 m.

b) Working length of flanged pipes 2 to 3 m for 80 mm nominal diameter pipe and 2 to 4 m for others.

c) Nominal diameter of socket and spigot pipes and flanged pipes 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1 000, 1 100, 1 200, 1 500.

d) Tolerances

1) Length (socket and spigot, and plain ended pipes)

2) Length (flanged pipes) ± 10 mm.

3) Maximum deviation from straight line shall not exceed (1.2 L) mm where l is length in meters.

Note — For dimensions of sockets, spigots, flanges, etc, refer to the standard.

4. Mass — Density of cast iron is taken as 7.15 kg/dm³.

4.1 Tolerance on standard mass ± 5 percent.

For detailed information, refer to IS 1537 : 1976 Specification for vertically cast iron pressure pipes for water, gas and sewage (first revision).

SUMMARY OF
IS 1538 : 1993 CAST IRON FITTINGS FOR PRESSURE PIPES
FOR WATER, GAS AND SEWAGE
(Third Revision)

1. Scope

1.1 General requirements for cast iron fittings for pressure pipes for water, gas and sewage.

1.2 Applicable to all cast iron fittings having spigots, sockets or flanges as specified in this standard and also to fittings with other type of joints, the general dimensions of which, except those relating to the joints, conform to this standard.

2. General Requirements

2.1 Material —The metal used for the manufacture of pipes shall be of a quality not less than that of the specified standard.

2.2 Tensile Strength — minimum of 150 MPa (N/mm²).

2.3 Brinell Hardness — Less than 210 HBS.

2.4 Hydrostatic Test — Shall withstand the pressure shown below:

HYDROSTATIC TEST
PRESSURE FOR FITTINGS

<i>Nominal Diameter</i>	<i>Test Pressure</i>	
	<i>Fittings without Branches or with Branches not Greater than Half the Principal Diameter</i>	<i>Fittings with Branches Greater than Half the Principal Diameter</i>
	MPa (N/mm ²)	MPa (N/mm ²)
Up to and including 300	2.5 (25)	2.5 (25)
Over 300 and upto and including 600	2.0 (20)	2.0 (20)
Over 600 and upto and including 1500	1.5 (15)	1.0 (10)

3. Tolerances

3.1 Diameter —

<i>Dimension</i>	<i>Nature of Joint</i>	<i>Nominal Diameter (DN)</i>	<i>Tolerance mm</i>
External diameter of spigot (DE)	Lead joints	All diameters	$\pm 1/2 f$ or $\pm (4.5+0.0015 \text{ DN})$
Internal diameter of socket (DI)	Lead joints	All diameters	$\pm 1/3 f$ or $\pm (3+0.001 \text{ DN})$
Depth of socket (P)	Lead joints	Up to and including 600	± 5
		Over 600 up to and including 1000	± 10
		Over 1000 upto and including 1500	± 15

Note— 'f' is the caulking space of the joint in mm ($=9+0.003 \text{ DN}$).

3.2 Thickness

<i>Dimension</i>	<i>Tolerance, mm</i>
Wall thickness	- (2+0.05 e)
Flange thickness	+ (3+0.05 b)
where	
e =	the standard thickness of the wall in millimetres, and
b =	the standard thickness of the flange in millimetres.

3.3 Length —

<i>Type of Fitting</i>	<i>Nominal Dia</i>	<i>Tolerance mm</i>
Socket fittings and flange and spigot pieces	Upto and including 450	+ 20
	Over 450	+ 20 - 30
Flanged fittings	All diameters	± 10

4. Mass

- a) The masses have been calculated by taking the density of iron as 7.5 kg/ dm³
- b) The permissible tolerances on standard mass of fittings shall be ± 8 percent except for bends, fittings with more than one branch and non-standard fittings, in which case the tolerance shall be ± 12 percent.

Note— Standard masses shall conform to those given in Tables 7 to 28 of the standard.

5. Coating — Where coating material has tar or similar base, it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 65°C but not so brittle at a temperature of 0°C as to chip off when scribed lightly with a pen knife.

6. Dimensions**6.1 Sockets and Spigots of Pipes (Lead Joints)**

Nominal Diameter	Barrel Diameter	Internal Dia of Socket
(DN)	(DE)	(DI)
(mm)	(mm)	(mm)
80	98	116
100	118	137
125	114	163
150	170	189
200	222	241
250	274	294
300	326	346
350	378	398
400	429	449
450	480	501
500	532	553
600	635	657
700	738	760
750	790	813
800	842	865
900	945	968
1000	1048	1072
1050	1124	1143
1100	1152	1177
1200	1256	1281
1500	1567	1594

Note — Internal diameter of sockets (DI) given above is applicable to sockets of fittings (lead joint) also.

6.2 Flanges of pipes and fitting including Raised Flanges

Nominal Diameter	Flange Diameter
(DN)	(D)
(mm)	(mm)
(1)	(2)
80	200
100	220
125	250
150	285
200	340
250	395
300	445
350	505
400	565
450	615
500	670
600	780
700	895
750	960
800	1015
900	1115
1000	1230
1050	1258
1100	1340
1200	1455
1500	1800

6.3 Flanged Sockets, Flanged Spigots, Collars, Double Sockets – 1/4, 1/8, 1/16 and 1/32 bends.

Nominal Diameter – 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1 000, 1 050, 1 100, 1 200, and 1 500 mm.

6.4 All flanged tees— All sockets, all flanges.

Nominal Diameter	Nominal Diameter of Branch	Nominal Diameter	Nominal Diameter of Branch
(DN)	(dn)	(DN)	(dn)
mm	mm	mm	mm
80	80	300	80
100	80	—	100
—	100	—	125
125	80	—	150
—	100	—	200
150	80	—	250
—	125	—	300
—	150	350	200
200	80	—	250
—	100	—	300
—	125	—	350
—	150	400	200
—	200	—	250
250	80	—	300
—	100	—	350
—	125	—	400
—	150		
—	200		
—	250		

Nominal Diameter	Nominal Diameter of Branch	Nominal Diameter	Nominal Diameter
(DN)	(dn)		of Branch
mm	mm	(DN)	(dn)
450	250	mm	mm
—	300		
—	350	900	450
—	400	—	500
—	450	—	600
500	250	—	700
—	300	—	800
—	350	—	900
—	400	1000	500
—	450	—	600
—	500	—	700
600	300	—	750
—	350	—	800
—	400	—	900
—	450	1100	1050
—	500	—	600
700	300	—	700
—	350	—	750
—	400	—	800
—	450	—	900
—	500	—	1000
—	600	—	1100
800	350	—	1200
—	400	1200	600
—	450	—	700
—	500	—	800
—	600	—	900
—	700	—	1000
—	750	—	1100
800	400	—	1200
—	450	1500	750
—	500	—	800
—	600	—	900
—	700	—	1000
—	750	—	1100
—	800	—	1200
—	—	—	1500

6.5 Double Scocket Tee with Flanged Branch— (for Air Valves and Hydrant Tees)

Nominal Diameter	Nominal Diameter of Branch	Nominal Diameter	Nominal Diameter
(DN)	(dn)		of Branch
mm	mm	(DN)	(dn)
80	80	mm	mm
100	80		
125	80	1000	200
150	80	1050	200
200	80	1100	250
250	80	1200	250
300	80	1500	250
300	100	—	—
350	80	—	—
350	100		
400	80		
400	100		
450	100		
500	150		
600	150		
700	150		
750	150		
800	200		
900	200		

6.6 All Crosses, All Sockets –

Nominal Diameter—80, 100, 125, 200, 250, and 300 mm

6.7 Double Scocket Tapers and Double flanged Tapers

Nominal Diameter	Nominal Diameter of Branch	Nominal Diameter	Nominal Diameter of Branch
(DN)	(dn)	(DN)	(dn)
mm	mm	mm	mm
100	80	750	600
125	80	800	700
150	80	800	600
200	100	900	700
250	100	900	750
300	125	1000	700
350	150	1000	750
400	150	1000	800
450	200	1050	800
500	250	1100	900
550	300	1200	900
600	350	1500	1000
650	400	1500	1100
700	450	1500	1200
750	500	1500	1000
800	550	1500	1100
850	600	1500	1200
900	650	1500	1000
950	700	1500	1100
1000	750	1500	1200

6.8 Caps and Plugs

Nominal Diameter 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1 000, 1 050, 1 100, 1 200 and 1 500 mm

* For double socket

+ For double flanged.

6.9 Bell Mouth Pieces

<i>Nominal Diameter (DN)</i>	<i>Big End Diameter (DI)</i>
mm	mm
80	125
100	150
125	175
150	200
200	285
250	350
300	450
350	525
400	600
450	650
500	750
600	900
700	1050
800	1200
900	1350
1000	1500
1050	1550
1100	1650
1200	1800
1500	2250

6.10 Double flanged 1/4 and 1/8 Bends

Nominal diameter — 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1 000, 1 050, 1 100, 1 200 and 1 500 mm.

6.11 Double flanged 1/4 Duckfoot Bends

Nominal Diameter — 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500 and 600 mm.

6.12 All flanged Radial Tees

Nominal Diameters— 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900 and 1000 mm.

6.13 Blank Flanges

Nominal Diameters— 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1 000, 1 050, 1 100, 1 200 and 1 500 mm.

Note – For detailed dimensions and sketches refer to the standard.

For detailed information, refer to IS 1538 : 1993 Specification for cast Iron Fittings for pressure pipes for water, gas and sewage (third revision).

SUMMARY OF

IS 2002 : 1979 SAND CAST IRON SPIGOT AND SOCKET SOIL,
WASTE AND VENTILATING PIPES, FITTINGS AND ACCESSORIES

(Second Revision)

1. Scope

1.1 Requirements for sand cast iron spigot and socket soil, waste and ventilating pipes together with details of fittings and accessories. These pipes and fittings are accessories. These pipes and fittings are suitable for use above ground only.

2. Requirements

2.1 Shall be free from defects, other than any unavoidable surface imperfections and shall be such that they could be cut. Shall emit clear ringing sound when struck with light hand hammer.

2.2 Shall emit clear ringing sound when struck with light hand hammer.

2.3 Hydraulic Test— Pipes and fittings shall withstand a hydrostatic pressure of 0.07 N/mm² for minimum 15 seconds without showing any signs of leakage. These tests shall be carried out after an internal or external coating.

2.4 Ears shall be provided only if specifically required. When provided, they shall have following projections:

50 and 75 mm dia	32 mm
100 and 150 mm dia	38 mm

3. Dimensions (in mm)**3.1 Straight Pipes and Sockets—**

50 Pipe	{ 75 External diameter Thickness	100 60 5	150 85 5	110 5	160 5
Socket	{ Internal diameter Thickness	76 6	101 6	129 6	181 6
Nominal mass of pipe(kg) excluding ears	{ 1500 mm length 1800 mm length 2000 mm length	9.56 11.41 12.65	13.86 16.52 18.37	18.14 21.67 24.15	26.70 31.92 35.66

3.2 Short Radius Bends with and without Access Doors

Nominal Size	{ θ (Bend)
50, 75, 100, 150,	92½°, 95°, 100°, 112½°, 120°, 135°, 104°
100	

3.3 Large Radius Bends

Nominal Size	{ θ (Bend)
50, 75, 100, 150,	92½°, 95°, 100°, 112½°, 120°, 135°, 104°

3.4 Off Sets

Nominal	Size	{ Projection
50, 75, 100, 150		76, 114, 152, 229, and 305

3.5 Equal Branches with and without oval Access Doors

Nominal	{ θ (Bend)
50, 75, 100, 150,	92½°, 95°, 100°, 12½°, 120°, 135°, 104°
100	

3.6 Unequal Branches with and without Oval Access Doors

	Nominal	{ (Bend)
Main pipe	50, 75, 100, 150	92½°, 95°, 100°, 112½°, 120°, 135°
Branch pipe	50, 50, 75, 100	

3.7 Parallel Branches, Singles, Equal and

Unequal	—
Main Pipe	Branch Pipe
100	100
100	50

3.8 Inverted Branches, Socket and Spigot Type— Nominal Size θ Bend

Main Pipe	50	100	100	}	95°, 112½°, 180°
Branch Pipe	50	100	50		

3.9 Trap

Nominal Size	50	75	100	150
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3.10 Oval Access Doors

Nominal Size	50	75	100	150
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3.11 Diminishing Pieces

Large Diameter	50	75	100	100
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3.12 Straight Inspection Pieces

Nominal Size	50	75	100	150
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3.13 Loose Sockets and Collars

Nominal Size	50	75	100	150
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3.14 Cast Iron Holderbats

Nominal Size	50	75	100	150
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3.15 Ware Balloons Galvanised Steel or Copper

Nominal Size	50	75	100	150
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3.16 Sanitary connection

3.16.1 Socket to Fit WC Outlet Nominal Size

Dimension—	100
Pipe — Internal dia, Min	100
Socket— Internal dia, Min	150

3.16.2 S and P Branches and Bends—

Nominal Size	100
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3.16.3 Bends

Nominal Size	100
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3.16.4 Short Connection Pipe

Nominal Size	Length
100	150, 225, 450, 600

3.17 Bossed Pipes and Connections for One Pipe Systems.

Nominal size of basin and bath connector (single and double) = 100 mm

Note — For dimensions of rectangular access doors (for straight pipes and large radius bends, roof outlet square grating, circular grating, “D” grating, bent), straight inspection pieces with rectangular access door, vent pipe, roof connectors, floor trap, floor trap (Nahani), 90 and 100 mm WC connectors with anti-syphon socket, refer to the standard.

4. Tolerances

Wall thickness	± 1.0 mm
External dia of barrel	± 3 mm for 50 and 75 mm dia ± 3.5 mm for 100 mm dia ± 4 mm for 150 mm dia
Internal dia of socket	± 3 mm for all dia
Depth of socket	± 10 mm for all dia
Length	± 20 mm for pipes and ± 10 mm for fittings

5. Weight — Density of cast iron taken as 7.15 kg/dm³ Tolerance : 10 percent.

6. Coating — Where coating material has tar or similar base, it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77°C but not so brittle at 0°C as to chip off when scribed lightly with a penknife.

For detailed information refer to IS 1729:2002. Specification for sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories (first revision).

SUMMARY OF
IS 1879 : 1987 MALLEABLE CAST IRON PIPE FITTINGS
(Second Revision)

1. Topic

1.1 Requirements for following types of malleablecast iron pipe fittings threaded in accordance with IS 554:1985 for general purposes for the transmission of fluid and gas upto the limit of pressure and temperature specified in 1.3 :

- a) Elbows including twin elbows, union elbows and side outlet elbows,
- b) Tees including pitcher tees and side outlet tees,
- c) Crosses,
- d) Bends including long sweep bends and return bends,
- e) Sockets,
- f) Bushing and hexagon nipples,
- g) Backnuts,
- h) Caps and plugs, and
- j) Unions

1.2 Dimensions which are not included in the standard are left to the discretion of the manufacturer depending on the end use of the fittings.

1.3 These fittings shall be suitable for working pressure of up to 1.4 MPa in the case of water and up to 0.7 MPa in the case of steam, air, gas and oil at a temperature not exceeding 100°C.

Note—Relationship between nominal size (in inch) of the thread at the outlet of the fitting and the corresponding nominal diameter DN in mm is given in Appendix A of the standard.

2. Designation

2.1 Malleable cast iron fittings shall be designated giving the following particulars in the sequence shown:

- a) Type of fitting
- b) Size designation
- c) Right and left-hand thread where applicable,
- d) Code number

3. Material

3.1 Shall conform to— IS 14329:1995⁺

4. Galvanising

4.1 Shall be galvanised to meet the standard.

5. Threads

5.1 Outlets of fittings shall be threaded to dimensions and tolerances as per the prescribed standard.

6. Dimensions

6.1 *Wall Thickness and Reinforcement Shall be as Follows:*

Size Designation	Wall-Thickness		Reinforcement	
	Basic size	Tolerance *	Projection	width
(1)	(2)	(3)	(4)	(5)
<i>m m</i>	<i>m m</i>	<i>m m</i>	<i>m m</i>	<i>m m</i>
1/8	2.0	-0.5	1.0	3.0
1/4	2.5	-0.5	1.3	3.6
3/8	2.5	-0.5	1.3	4.0
1/2	2.5	-0.5	1.5	4.6
3/4	3.0	-0.7	1.5	4.6
1	3.0	-0.7	1.8	5.1
1¼	3.5	-0.7	1.8	5.1
1½	3.5	-0.7	2.0	5.6
2	4.0	-0.7	2.3	6.1
2½	4.5	-1.0	2.5	6.1
3	5.0	-1.0	2.8	6.1
4	6.0	-1.0	3.3	7.1
5	6.5	-1.0	4.0	8.1
6	7.5	-1.0	4.6	8.9

* No limit for plus tolerance.

6.2 *Tolerances on Dimensions*— Where maximum and minimum dimensions are not specified shall be as follows:

⁺ Malleable Iron Castings

Designations Above	Upto and Including	Tolerances
(1) mm	(2) mm	(3) mm
—	30	+1.5
30	50	+ 2.0
50	75	± 2.5
75	100	+ 3.0
100	150	+ 3.5
150	200	+ 4.0
200	—	+ 5.0

6.3 Size Designation of Elbows, Reducing A1, and Male and Female Elbows, Reducing A4.

a) Elbows, reducing A1— $3/8 \times 1/4$, $1/2 \times 3/8$, $3/4 \times 3/8$, $3/4 \times 1/2$, $1 \times 1/2$, $1 \times 3/4$, $1\frac{1}{4} \times \frac{1}{2}$, $1\frac{1}{4} \times 3/4$, $1\frac{1}{4} \times 1$, $1\frac{1}{2} \times \frac{1}{2}$, $1\frac{1}{2} \times 3/4$, $1\frac{1}{2} \times 1$, $1\frac{1}{2} \times 1\frac{1}{4}$, $2 \times \frac{1}{2}$, $2 \times 3/4$, 2×1 , $2 \times 1\frac{1}{4}$, $2 \times 1\frac{1}{2}$ and $2\frac{1}{2} \times 2$.

b) Male and female elbows, reducing A4— $\frac{1}{2} \times 3/8$, $3/4 \times \frac{1}{2}$, $1 \times 3/4$ and $1\frac{1}{4} \times 1$.

6.4 Size Designation of 45° Elbows A1/45° and 45° Male and Female Elbows A4/45°

$3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$ and 2 .

6.5 Size Designation of Twin Elbows E2

$3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$ and 2 .

6.6 Size Designation of Elbows, Reducing E2

$3/4 \times \frac{1}{2} \times \frac{1}{2}$, $1 \times \frac{1}{2} \times \frac{1}{2}$, $1 \times 3/4 \times 3/4$, $1\frac{1}{4} \times 3/4 \times 3/4$, $1\frac{1}{4} \times 1 \times 1$, $1\frac{1}{2} \times 1 \times 1$, $1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{4}$, $2 \times 1\frac{1}{4} \times 1\frac{1}{4}$ and $2 \times 1\frac{1}{2} \times 1\frac{1}{2}$.

6.7 Size Designation of Union Elbows, Flat Seat UA1; Male and Female Union Elbows, Flat Seat UA2; Union Elbows, Taper Seat UA11; and Male and Female Union Elbows, Taper Seat UA12—

Size Designation			
UA1	UA2	UA11	UA12
—	—	$\frac{1}{4}$	$\frac{1}{4}$
*	*	*	*
$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$
1	1	1	1
$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$
$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
2	2	2	2

6.8 Size Designation of Tees B1 and Side Outlet Tees, Za2—

Tees B1— $1/8$, $1/4$, $3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$, 2 , $2\frac{1}{2}$, 3 , $3\frac{1}{2}$, 4 , 5 and 6 .

Side Outlet Tees, Za2 — $3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$

6.9 Size Designation of Tees – Reducing or Increasing on the Branch B1—

$3/8 \times 1/4 \times 3/8$	$1 \times 3/8 \times 1$	$1\frac{1}{2} \times 2 \times 1\frac{1}{2}$
$3/8 \times 1/2 \times 3/8$	$1 \times 1/2 \times 1$	$2 \times \frac{1}{2} \times 2$
$1/2 \times 1/4 \times 1/2$	$1 \times 3/4 \times 1$	$2 \times \frac{3}{4} \times 2$
$1/2 \times 3/8 \times 1/2$	$1 \times 1\frac{1}{4} \times 1$	$2 \times 1 \times 2$
$1/2 \times 3/4 \times 1/2$	$1 \times 1\frac{1}{2} \times 1$	$2 \times 1\frac{1}{4} \times 2$
$1/2 \times 1 \times 1/2$	$1\frac{1}{4} \times 3/8 \times 1\frac{1}{4}$	$2 \times 1\frac{1}{2} \times 2$
$3/4 \times 1/4 \times 3/4$	$1\frac{1}{4} \times \frac{1}{2} \times 1\frac{1}{4}$	$2\frac{1}{2} \times 1 \times 2\frac{1}{2}$
$3/4 \times 3/8 \times 3/4$	$1\frac{1}{4} \times 3/4 \times 1\frac{1}{4}$	$2\frac{1}{2} \times 1\frac{1}{4} \times 2\frac{1}{2}$
$3/4 \times 1/2 \times 3/4$	$1\frac{1}{4} \times 1 \times 1\frac{1}{4}$	$2\frac{1}{2} \times 1\frac{1}{2} \times 2\frac{1}{2}$
$3/4 \times 1 \times 3/4$	$1\frac{1}{4} \times 1\frac{1}{2} \times 1\frac{1}{4}$	$2\frac{1}{2} \times 2 \times 2\frac{1}{2}$
$3/4 \times 1\frac{1}{4} \times 3/4$	$1\frac{1}{4} \times 2 \times 1\frac{1}{4}$	$3 \times 3/4 \times 3$
$1 \times 1\frac{1}{4} \times 1$	$1\frac{1}{2} \times \frac{1}{2} \times 1\frac{1}{2}$	$3 \times 1 \times 3$
	$1\frac{1}{2} \times 3/4 \times 1\frac{1}{2}$	$3 \times 1\frac{1}{4} \times 3$
	$1\frac{1}{2} \times 1 \times 1\frac{1}{2}$	$3 \times 1\frac{1}{2} \times 3$
	$1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{2}$	$3 \times 2 \times 3$
		$3 \times 2\frac{1}{2} \times 3$
		$4 \times 2 \times 4$
		$4 \times 3 \times 4$

6.10 Size Designation of Tees —

Reducing on the Run, Reducing Equal to or Increasing on the Branch B1 —

$1/2 \times 3/8 \times 3/8$	$1 \times 3/8 \times 3/4$	$1\frac{1}{4} \times \frac{1}{2} \times 1$	$1\frac{1}{2} \times \frac{1}{2} \times 1\frac{1}{4}$	$2 \times 1\frac{1}{2} \times 1\frac{1}{2}$
$1/2 \times 1/2 \times 1/2$	$1\frac{1}{4} \times \frac{3}{4} \times \frac{3}{4}$	$1\frac{1}{4} \times 1 \times 1\frac{1}{4}$	$1\frac{1}{2} \times \frac{3}{4} \times 1\frac{3}{4}$	$2 \times 2 \times \frac{3}{4}$
	$1 \times 1/2 \times 3/4$	$1\frac{1}{4} \times \frac{3}{4} \times 1$	$1\frac{1}{2} \times 1\frac{1}{4} \times \frac{3}{4}$	$2 \times 2 \times 1$
$3/4 \times 3/8 \times 3/8$	$1 \times 3/4 \times 3/8$	$1\frac{1}{4} \times 1 \times \frac{1}{2}$	$1\frac{1}{2} \times 1\frac{1}{4} \times 1$	$2 \times 2 \times 1\frac{1}{4}$
$3/4 \times 3/8 \times 1/2$	$1 \times 3/4 \times 1/2$	$1\frac{1}{4} \times 1 \times \frac{3}{4}$	$1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{4}$	$2 \times 2 \times 1\frac{1}{2}$
$3/4 \times 1/2 \times 3/8$	$1 \times 3/4 \times 3/4$	$1\frac{1}{4} \times 1 \times 1$	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$	
$3/4 \times 1/2 \times 1/2$	$1 \times 1 \times 3/8$	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{2}$	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$	
$3/4 \times 3/4 \times 3/8$	$1 \times 1 \times 1/2$	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4}$	$1\frac{1}{2} \times 1\frac{1}{2} \times 1$	
$3/4 \times 3/4 \times 1/2$	$1 \times 1 \times 3/4$	$1\frac{1}{4} \times 1\frac{1}{4} \times 1$	$1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{4}$	
$3/4 \times 1 \times 1/2$	$1 \times 1\frac{1}{4} \times 3/4$	$1\frac{1}{4} \times 1\frac{1}{2} \times 1$	$1\frac{1}{2} \times \frac{3}{4} \times 1\frac{1}{4}$	
			$2 \times \frac{3}{4} \times 1\frac{1}{2}$	
			$2 \times 1 \times 1\frac{1}{2}$	
			$2 \times 1\frac{1}{4} \times 1\frac{1}{4}$	
			$2 \times 1\frac{1}{4} \times 1\frac{1}{2}$	
			$2 \times 1\frac{1}{2} \times 1\frac{1}{4}$	

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6.11 Size Designation of Pitcher Tees EI

3/8, 1/2, 3/4, 1, 1¼, 1½ and 2.

Reducing on the Branch, Reducing the Run, and Reducing on Branch and Run EI.

$\frac{3}{4} \times \frac{1}{2} \times \frac{1}{2}$	$1\frac{1}{4} \times \frac{1}{2} \times 1\frac{1}{4}$	$1\frac{1}{2} \times \frac{3}{4} \times 1\frac{1}{2}$	$2 \times 1 \times 2$	$2 \times 1\frac{1}{4} \times 2$
$\frac{3}{4} \times \frac{1}{2} \times \frac{3}{4}$	$1\frac{1}{4} \times \frac{3}{4} \times 1$	$1\frac{1}{2} \times 1 \times 1\frac{1}{4}$	$2 \times 1\frac{1}{4} \times 1\frac{1}{2}$	$2 \times 1\frac{1}{2} \times 1\frac{1}{4}$
$\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2}$	$1\frac{1}{4} \times \frac{3}{4} \times 1\frac{1}{4}$	$1\frac{1}{2} \times 1 \times 1\frac{1}{2}$		$2 \times 1\frac{1}{2} \times 1\frac{1}{2}$
$1 \times \frac{1}{2} \times \frac{3}{4}$	$1\frac{1}{4} \times 1 \times \frac{3}{4}$	$1\frac{1}{2} \times 1\frac{1}{4} \times 1$		$2 \times 1\frac{1}{2} \times 2$
$1 \times \frac{1}{2} \times 1$	$1\frac{1}{4} \times 1 \times 1$	$1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{4}$		
$1 \times \frac{3}{4} \times \frac{1}{2}$	$1\frac{1}{4} \times 1 \times 1\frac{1}{4}$	$1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{2}$		
$1 \times \frac{3}{4} \times \frac{3}{4}$	$1\frac{1}{4} \times 1\frac{1}{4} \times 1$			
$1 \times \frac{3}{4} \times 1$				
$1 \times 1 \times \frac{3}{4}$				

6.13 Size Designation of Crosses CI

1/4, 3/8, 1/2, 3/4, 1, 1¼, 1½, 2, 2½, 3 and 4.

6.14 Size Designation of Crosses — Reducing CI.

$3/8 \times \frac{1}{2} \times 3/8$	$1\frac{1}{4} \times \frac{1}{2} \times 1\frac{1}{4} \times \frac{1}{2}$
$1/4 \times 3/8 \times \frac{3}{4} \times 3/8$	$1\frac{1}{4} \times \frac{3}{4} \times 1\frac{1}{4} \times \frac{3}{4}$
$3/8 \times 1 \times 3/8$	$1\frac{1}{4} \times 1 \times 1\frac{1}{4} \times 1$
$1 \times \frac{1}{2} \times 1 \times \frac{1}{2}$	$1\frac{1}{2} \times \frac{3}{4} \times 1\frac{1}{2} \times \frac{3}{4}$
$1 \times \frac{1}{2} \times 1 \times \frac{1}{2}$	$1\frac{1}{2} \times 1 \times 1\frac{1}{2} \times 1$
$1 \times \frac{3}{4} \times 1 \times \frac{3}{4}$	$1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{2} \times 1\frac{1}{4}$
	$2 \times 1 \times 2 \times 1$
	$2 \times 1\frac{1}{4} \times 2 \times 1\frac{1}{4}$
	$2 \times 1\frac{1}{2} \times 2 \times 1\frac{1}{2}$

6.15 Size Designation of Bends D1 and Male and Female Bends D4

¼, 3/8, ½, ¾, 1¼, 1½ and 2.

6.16 Size Designation of Long Sweep Bends G1, Male and Female Long Sweep Bends G4, and Male Long Sweep Bends G8.

a) Long sweep bends G1, and male and female long sweep bends G4

1/8, 1/4, 3/8, 1/2, 3/4, 1, 1¼, 1½, 2, 2½, 3, 3½ and 4.

b) Male long sweep bend G8:

3/8, 1/2, 3/4, 1, 1¼, 1½ and 2.

6.17 Size Designation of 45° Long Sweep Bends G1/ 45° and Male and Female Long Sweep Bends G4/45°:

¼, 3/8, ½, ¾, 1, 1¼, 1½, 2, 2½ and 3.

6.18 Size designation of Return Bends Kb1 :

½, ¾, 1, 1¼, 1½ and 2.

6.19 Size Designation of Sockets M2; Sockets, Right and Left Hand Thread M2R-L; Sockets, Reducing M2; and Eccentric Sockets, Reducing M3:

a) Sockets M2 — 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1¼, 1½, 2, 2½, 3, 3½, 4, 5 and 6.

b) Sockets, right and left hand thread M2R-L:

6.12 Size Designation of Pitcher Tees

1/4, 3/8, 1/2, 3/4, 1, 1¼, 1½, 2, 2½ and 3.

c) Sockets, reducing M2 :

1/4 × 1/8, 3/8 × 1/8,
3/8 × 1/4, 1/2 × 1/4,
1/2 × 3/8, 3/4 × 1/4,
3/4 × 3/8, 3/4 × 1/2,
1 × 3/8, 1 × 1/2, 1 × 3/4,
1¼ × 3/8, 1¼ × 1/2,
1¼ × 3/4, 1¼ × 1,
1½ × ½, 1½ × ¾,
1½ × 1, 1½ × 1¼,
2 × ½, 2 × ¾, 2 × 1,
2 × 1¼, 2 × 1½, 2½ × ½,
2½ × ¾, 2½ × 1,
2½ × 1¼, 2½ × 1½,
2½ × 2, 3 × ½, 3 × ¾,
3 × 1, 3 × 1¼, 3 × 1½,
3 × 2, 3 × 2½, 4 × 2,
4 × 2½ and 4 × 3.

d) Eccentric sockets, reducing M3

¾ × ½, 1 × 1½, 1 × ¾, 1¼ × ½,
1¼ × ¾, 1¼ × 1, 1½ × ½, 1½ × ¾,
1½ × 1, 1½ × 1¼, 2 × ¾,
2 × 1, 2 × 1¼ and 2 × 1½.

6.20 Size Designation of Male and Female Sockets M4, and Male and Female Sockets, Reducing M4

a) Equal Socket size designation M4

3/8, ½, ¾, 1 and 1¼.

b) Reducing socket size designation M4

3/8 × ¼, ½ × ¼, ½ × 3/8 × ¾ × 3/8, ¾ × ½, 1 × ½,
1 × ¾, 1¼ × ¾, 1¼ × 1, 1½ × 1, 1½ × 1¼, 2 × 1¼
and 2 × 1½.

6.21 Size Designation of Bushings N4

$1/4 \times 1/8$, $3/8 \times 1/8$, $3/8 \times 1/4$, $1/2 \times 1/8$, $1/2 \times 1/4$,
 $1/2 \times 3/8$, $3/4 \times 1/4$, $3/4 \times 3/8$, $3/4 \times 1/2$, $1 \times 1/4$,
 $1 \times 3/8$, $1 \times 1/2$, $1 \times 3/4$, $1\frac{1}{4} \times 3/8$, $1\frac{1}{4} \times \frac{1}{2}$, $1\frac{1}{4} \times \frac{3}{4}$,
 $1\frac{1}{4} \times 1$, $1\frac{1}{2} \times 3/8$, $1\frac{1}{2} \times \frac{1}{2}$, $1\frac{1}{2} \times \frac{3}{4}$, $1\frac{1}{2} \times 1$,
 $1\frac{1}{2} \times 1\frac{1}{4}$, $2 \times \frac{1}{2}$, $2 \times \frac{3}{4}$, 2×1 , $2 \times 1\frac{1}{4}$, $2 \times 1\frac{1}{2}$,
 $2\frac{1}{2} \times 1$, $2\frac{1}{2} \times 1\frac{1}{4}$, $2\frac{1}{2} \times 1\frac{1}{2}$, $2\frac{1}{2} \times 2$, 3×1 , $3 \times 1\frac{1}{4}$,
 $3 \times 1\frac{1}{2}$, 3×2 , $3 \times 2\frac{1}{2}$, $3\frac{1}{2} \times 3$, $4 \times 2\frac{1}{2}$, 4×3 and $4 \times 3\frac{1}{2}$.

6.22 Size Designation of Hexagon Nipples N8; Hexagon Nipples, Right - and Left- Hand Thread N8, R-L ; and Hexagon Nipples, Reducing N8:**a) Equal nipple size designation N8 :**

$1/8$, $1/4$, $3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$, 2 , $2\frac{1}{2}$, 3 , $3\frac{1}{2}$ and 4 .

b) Equal nipple size designation N8 R-L :

$3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$ and 2 .

c) Reducing nipple size reducing N8 :

$3/8 \times 1/4$	$1\frac{1}{4} \times \frac{1}{2}$	$2 \times \frac{1}{2}$
	$1\frac{1}{4} \times \frac{3}{4}$	$2 \times \frac{3}{4}$
$\frac{1}{2} \times \frac{1}{4}$	$1\frac{1}{4} \times 1$	2×1
$\frac{1}{2} \times 3/8$		$2 \times 1\frac{1}{4}$
	$1\frac{1}{2} \times \frac{1}{2}$	$2 \times \frac{1}{2}$
$\frac{3}{4} \times 3/8$	$1\frac{1}{2} \times \frac{3}{4}$	
$\frac{3}{4} \times \frac{1}{2}$	$1\frac{1}{2} \times 1$	$2\frac{1}{2} \times 1\frac{1}{2}$
	$1\frac{1}{2} \times 1$	$2\frac{1}{2} \times 2$
$1 \times \frac{1}{2}$		
$1 \times \frac{3}{4}$		3×2
		$3 \times 2\frac{1}{2}$

6.23 Size Designation of Back Nuts P4

$1/4$, $3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$, 2 , $2\frac{1}{2}$ and 3 .

6.24 Size Designation of Hexagon Caps T1, Round Caps T2, Plain Plugs T8, Beaded Plugs T9 and Countersunk Plugs T11.**Size Designation**

T 1	T 2	T 8	T 9	T 11
—	$1/8$	$1/8$	$1/8$	—
$1/4$	$1/4$	$1/4$	$1/4$	—
$3/8$	$3/8$	$3/8$	$3/8$	$3/8$
$1/2$	$1/2$	$1/2$	$1/2$	$1/2$
$3/4$	$3/4$	$3/4$	$3/4$	$3/4$
1	1	1	1	1
$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	—
$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	—
2	2	2	2	—
$2\frac{1}{2}$	—	$2\frac{1}{2}$	$2\frac{1}{2}$	—
3	—	3	3	—
—	—	—	$3\frac{1}{2}$	—
4	—	4	4	—

6.25 Size Designation of Unions, Flat Seat U1; Male and Female Unions, Flat Seat U2; Unions, Taper Seat U11; and Male and Female Unions, Raper SEat U12**Size Designation**

U1	U2	U11	U12
$1/8$	—	$1/8$	—
$1/4$	$1/4$	$1/4$	$1/4$
$3/8$	$3/8$	$3/8$	$3/8$
$1/2$	$1/2$	$1/2$	$1/2$
$3/4$	$3/4$	$3/4$	$3/4$
1	1	1	1
$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$
$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
2	2	2	2
$2\frac{1}{2}$	—	$2\frac{1}{2}$	$2\frac{1}{2}$
3	—	3	3
4	—	4	—
5	—	—	—
6	—	—	—

6.26 Gasket for Unions,

Flat seat — U_1 , U_2 , UA_1 and UA_2

Fitting Sizes of Unions — $1/8$, $1/4$, $3/8$, $1/2$, $3/4$, 1 , $1\frac{1}{4}$, $1\frac{1}{2}$, 2 , $2\frac{1}{2}$, 3 and 4 .

6.27 Nominal Sizes of Pipe Threads and corresponding Nominal diameter DN

Nominal Size of Pipe Threads (Size Designation)	Corresponding Bore mm
$1/8$	6
$1/4$	8
$3/8$	10
$1/2$	15
$3/4$	20
1	25
$1\frac{1}{4}$	32
$1\frac{1}{2}$	40
2	50
$2\frac{1}{2}$	65
3	80
4	100
5	125
6	150

7. Pressure Test**7.1 Shall be subjected to either of the two following pressure tests**

- a) Internal hydraulic pressure of not less than 2.1 MPa, or
- b) Internal air pressure of 1.05 MPa whilst the fitting is completely immersed in water or light oil.

8. Compression Test — Shall satisfy the prescribed test.

For detailed information, refer to IS 1879 : 1987 Specification for malleable cast iron pipe fittings (second revision).

SUMMARY OF
IS 3989 :1984 CENTRIFUGALLY CAST (SPUN) IRON SPIGOT AND
SOCKET SOIL WASTE AND VENTILATING PIPES
FITTINGS AND ACCESSORIES
(Second Revision)

1. Scope—Requirements for centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes together with the details of the fittings and accessories. These pipes and fittings are suitable for use above ground only.

2. General Requirements

2.1 *Shall be capable of being cut with the tools normally used for installation.*

3. Tests

3.1 Hardness — not greater than 230 HBS.

3.2 Soundness — When tested for soundness by striking with a light hand hammer, shall emit a clear ringing sound.

3.3 Hydrostatic Test— When hydrostatically tested at a pressure of 0.07 MPa (N/mm²) for 15 seconds the pipes and fittings shall not show any sign of leakage, sweating or other defects of any kind. The test shall be conducted after surface coating.

4. Sizes (in mm)— Nominal Diameter DN, of pipes and fittings are 50, 75, 100 and 150.

4.1 Socket and Spigot Pipes

Nominal Diameter	50	75	100	150
Barrel Ext. Dia	57	83	109	161
Internal Dia. of Socket	73	99	126	179
Joint thickness	8	8	8.5	9
Length of pipes	1,000	1,500	1,800	
	2,000	2,500	3,000	

4.2 Bends With and Without Access Doors

Nominal Dia	Angle of Bend
50	92½°, 112½° and 135°.
75	
100	
150	

4.3 Equal and Unequal Branches With and Without Access door

a) *Equal Branch* *Angle θ*
Nominal Dia

50	92½°, 112½° and 135°.
75	
100	
150	

b) *Unequal Branches*

Nominal Dia Body	Dia Branch	Angle θ
75	50	92½°, 112½° and 135°.
100	50	
100	75	
150	100	

4.4 Nominal Dia *Offsets*

50	75, 115 and 150.
75	
100	
150	

4.5 Taper

Nominal Diameter

Spigot DN	Socket dn
75	50
100	50
100	75
150	100

4.6 Access Door — See Table 8 of the Standard.

4.7 Collars

Nominal Diameter	L
50	140
75	150
100	160
150	170

4.8 Connectors (C.I. to Stoneware)

Nominal Dia 100 and 150.

4.9 Connectors— Plug (Stopper)

Nominal Dia 50, 75, 100 and 150.

4.10 Larger Radius Bends—

Nominal Dia	Angle of Bend
75 } 100 } 150 }	92½°, 112½°, 36°

4.11 Equal and unequal single parallel branches—

Body	Branch
Nominal dia	dn
100 } 100 } 100 }	100 50 50

4.12 Equal and unequal inverted branches socket type

Nominal Body	Diameter Branches	Angle θ
50 } 100 } 100 }	50 } 100 } 50 }	95°, 112½°, 180°

4.13 Traps

Nominal Diameter DN	Angle θ
50 } 75 } 100 } 150 }	95°, 135°, 180°

4.14 Straight inspection piece

Nominal Dia. 50, 75, 100 and 150.

4.15 Floor Traps

Nominal Dia. 50, 75 and 100.

4.16 Traps with Vent

Body	Diameter Angle θ	Vent
DN		dn
100	95°	50
100	135°	50
100	180°	50

Note— For detailed dimensions and body sketches refer to the standard.**4.17 Floor Trap (Nahani)**

Nominal Dia. 50, 75, 100 and 150

4.18 Shoe bends and cowls

Nominal Dia. 50, 75, 100 and 150

5. Tolerances — Tolerances on external diameter of the barrel, internal diameter of the socket and the depth of the socket shall be as follows – (see figures of Table 1 of the Standard).

Dimensions	Nominal Diameter	Tolerance Lead Joint (mm)	Tolerance Rubber Joint (mm)
i) External diameter of barrel, DE	50, 75 100 150	± 3.0 ± 3.5 ± 4.0	+ 3.0 – 0 + 3.5 – 0 + 4.0 – 0
ii) Internal diameter of socket, DI	All diameters	± 3.0	+ 3.0 – 0
iii) Depth of socket, P	All diameters	± 10	± 10

The tolerance on length of pipes shall be ± 20 mm. The tolerances on dimensions of fittings shall be as given below

Note—For details on tolerances, refer 7 of the standard.

6. Mass – Specific mass of cast iron is taken as 7.15 kg/dm³. Tolerance on mass –10 percent.

7. Coating

7.1 In all cases where the coating material has a tar or similar base, it shall be smooth, tenacious and hard enough not to flow when exposed to a temperature of 65°C but not so brittle at a temperature of 0°C as to chip off when scribed lightly with a penknife.

7.2 Coating shall not be applied to any pipe or fitting unless its surface is clean, dry and free from rust.

For detailed information, refer to IS 3989 : 1984 Specification for centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories (second revision).

SUMMARY OF
IS 5382 : 1985 RUBBER SEALING RINGS FOR GAS
MAINS, WATER MAINS AND SEWERS
(First Revision)

1. Scope — Requirements for materials used for vulcanized solid rubber sealing rings for water supply and drainage systems, drain pipes, sewers and rainwater pipes, all at ambient temperature including gas connections. It covers joint rings for all pipelining materials including iron, steel, stonewares, asbestos-cement, concrete, pitch fibre, plastics and glass reinforced plastics. This standard does not cover dimensional and joint design requirements.

2. Types — Six types, 1 to 6 corresponding to the respective nominal hardness of 40,50,60,70,80 and 88 IRHD.

3. Requirements

3.1 Material — The rubber shall be free from extractable substances which impart taste, odour or toxicity to water. If the pipe is to convey drinking water.

3.2 Finish — The rings shall be homogeneous; free from porosity, grit, excessive blooms, blisters or other visible surface imperfections. The fin or flash shall be reduced as much as possible and in any case the thickness of it shall be reduced as much as possible and in any case the thickness of it shall not exceed 0.4 mm and the width 0.8 mm.

3.3 Stretch Test — Stretch gaskets till the circumference is increased by 50 percent, then visually inspect for the following.

The surface of the gasket shall be smooth, free from pitting, cracks, blisters, air marks and any other imperfection that may affect its behaviour in service. The body of the gasket shall be free from porosity and air pockets.

3.4 Physical Requirements — See Tables 1 and 2

TABLE 1 GENERAL REQUIREMENTS

SL. NO. CHARACTERISTICS		REQUIREMENTS					
(1)	(2)	Type 1 (3)	Type 2 (4)	Type 3 (5)	Type 4 (6)	Type 5 (7)	Type 6 (8)
i)	Hardness in IRHD	40 ± 5	50 ± 5	60 ± 5	70 ± 5	80 ± 4	88 ± 3
ii)	Compression set, percent, Max for 24 h at 70 ± 1°C – 2	25	25	25	25	25	25
	for 72 h at 70 ± 1°C – 2	12	12	12	12	15	15
iii)	Ageing, maximum change for unaged values after 7 days in air at 70°C						
	a) Hardness in IRHD	–5 to + 8	–5 to + 8	–5 to + 8	–5 to + 8	–5 to + 8	–5 to + 8
	b) Tensile strength, percent	20	20	20	20	20	20
	c) Elongation at break, percent	–30 to +10	–30 to +10	–30 to +10	–30 to +10	–30 to +10	–30 to +10
iv)	Water immersion change in volume after immersion in neutral water for 7 days at 70°C	–0 to + 8	–0 to + 8	–0 to + 8	–0 to + 8	–0 to + 8	–0 to + 8
v)	Cold resistance, increase in hardness after 72 hours at 0°C, Max	+5	+5	+5	+5	+5	+5
vi)	Splice strength, elongation imposed, percent, Max	100	100	100	100	100	100

TABLE 2 TENSILE STRENGTH AND ELONGATION FOR DIFFERENT TYPES

<i>SL. NO. POLYMER USED</i>		<i>REQUIREMENTS</i>					
		Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Natural rubber (NR) and Isoprene rubber (IR)						
	a) Tensile strength, MPa, percent, Min	18	18	17	15	11	6
	b) Elongation at break, percent, Min	450	450	375	250	175	100
ii)	Butadiene-styrene rubber (SBR)						
	a) Tensile strength, MPa, percent, Min	12	13	14	13	11	8
	b) Elongation at break, percent, Min	450	425	400	300	250	150
iii)	Ethylene propylene rubber (EPM)						
	a) Tensile strength, MPa, percent, Min	11	11	11	11	9	8
	b) Elongation at break, percent Min.	450	400	325	200	125	100

3.5 Water Absorption — shall not absorb more than 10 percent.

3.6 Optional Requirements

- a) Low temperature Applications
- b) Stress relaxation in compressions

Note — For methods of tests refer to the relevant parts of IS 3400 Methods of test for vulcanised rubber and Appendices B and C of the standard.

For detailed information, refer to IS 5382 :1985 Specification for rubber sealing rings for gas mains, water mains and sewers (first revision).

SUMMARY OF
IS 5531 : 1988 CAST IRON SPECIALS FOR ASBESTOS CEMENT
PRESSURE PIPES FOR WATER, GAS AND SEWAGE
(First Revision)

1. Scope — Requirements for cast iron specials to be used with asbestos cement pressure pipes for water, gas and sewage.

1.2 Applicable to cast iron specials for use with asbestos cement pressure pipes suitable for connection with cast iron detachable joints or asbestos cement couplings.

2. Material — As per the prescribed standard

3. Mechanical Tests

3.1 Tensile Strength — Min. 150 MPa.

3.2 Brinell Hardness — Not to exceed 215 HBS.

4. Hydrostatic Test

4.1 Shall withstand (without showing leakage, sweating or other defects) the test pressure, maintained for atleast 15 seconds, as specified in IS 1592 : 1989 for the class of asbestos cement pressure pipes with which they are to be used.

5. Dimensions — (mm)

5.1 Cast Iron Plain and Bends

Nominal Dia	80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600
Bend Angle	90°, 45°, 22½°, and 11¼°

5.2 Cast Iron Plain and Bends

Nominal Dia	80, 100, 125, 150, 200, 250, 300, 350, 400
Length	125, 130, 135, 140, 150, 153, 160, 165, 170.
Nominal Dia	450, 500, 600
Length	175, 180, 185

5.3 Cast Iron Plain and Reducers

<i>Nominal Dia (Large end)</i>	<i>Nominal Dia (Small end)</i>
100	80
125	80, 100
150	80, 100, 125
200	100, 125, 150
225	125, 150, 200
250	80, 100, 125, 150, 200, 250
300	80, 100, 125, 150, 200, 250, 300
350	200, 250, 300, 350
400	200, 250, 300, 350, 400
500	250, 300, 350, 400, 450, 500
600	300, 350, 400, 450, 500, 600

5.4 Cast Iron Crosses

Nominal Dia	80, 100, 125, 150, 250, 300, 350, 400, 450, 500, 600
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5.5 Cast Iron Plain and Flanged Spigots—

Nominal Dia	80, 100, 125, 150, 250, 300 350, 400, 450, 500, 600
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5.6 Cast Iron Plain and Tees and Plain and Waves

<i>Nominal Dia (Main)</i>	<i>Nominal Dia (Branch)</i>
80	80
100	80, 100
125	80, 100, 125
150	80, 100, 125, 150
200	80, 100, 125, 150, 200
250	80, 100, 125, 150, 200, 250
300	80, 100, 125, 150, 200, 250, 300
350	200, 250, 300, 350
400	200, 250, 300, 350, 400
450	250, 300, 350, 400, 450
500	250, 300, 350, 400, 450, 500
600	300, 350, 400, 450, 500, 600

6. Tolerances

Wall thickness, e — (2.00 mm + 0.05 e)
(see note)

Flange thickness, b \pm (3.00 mm + 0.05 b)

where

e = standard thickness of the wall in mm, and

b = standard thickness of the flange in mm.

Note — No limit for the plus tolerances is specified.

6.1 Other Dimensions

<i>Dimension</i>	<i>Tolerance</i>
	mm
Machined outside diameters	+1.5
(D_2 and d_2)	– 1.0
Length (l) and height (h)	+15
	– 10

6.2 Mass — Tolerance on the mass of the specials shall be ± 8 percent except for bends and fittings with more than one branch and non-standard fittings, where it shall be ± 12 percent.

7. Coatings

7.1 Coating shall not be applied to any castings, unless its surface is clean, dry and free from rust.

7.2 In all cases where the coating material has tar or similar base, it shall be smooth, tenacious and hard enough not to flow when exposed to a temperature of 65°C but not so brittle at a temperature of 0°C as to chip off when scribed lightly with a pen knife.

Note— For method of test, refer to IS 1500 : 1983 Method for brinell hardness test for metallic materials (second revision).

For detailed information, refer to IS 5531 : 1988 Specification for cast iron specials for asbestos cement pressure pipes for water, gas and sewage (second revision).

SUMMARY OF
IS 6163 : 1978 CENTRIFUGALLY CAST (SPUN) IRON LOW
PRESSURE PIPES FOR WATER, GAS AND SEWAGE
(First Revision)

1. Scope — Requirements for centrifugally cast (spun) iron low pressure pipes, known as LP pipes, for conveyance of water, gas and sewage, manufactured in metal or sand moulds.

1.2 This standard is applicable to cast iron pipes having spigots and sockets as specified in this standard, and also to pipes with other types of joints particularly rubber joints. In case of rubber joints the inner profile of the socket end of the pipe shall depend on the type of rubber joint ensuring that the overall dimensions are maintained for reasons of safety and interchangeability.

2. Mechanical Tests

2.1 Ring Test (for Pipes Cast in Metal Moulds)

Up to and including Modulus of Rupture

300 mm nominal dia. 40 kgf/mm², Min

2.2 Tensile Test

2.2.1 Pipes Cast in Metal Moulds

Nominal Dia	Tensile Strength Min
Over 300 mm and up to 600 mm	20 kgf/mm ²
Over 600 mm	18 kgf/mm ²

2.2.2 Pipes Cast in Sand Moulds

Tensile strength (all diameters)	18 kgf/mm ² , Min
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3. Brinell Hardness Test — Hardness of external unmachined surface shall not exceed 230 HB.

4. Hydrostatic Test — Shall withstand test pressure of 17.5 kf/cm² without showing leakage, sweating or other defects, when kept under pressure for 15 seconds. All pipes shall withstand a test pressure of 6 kgf/cm² after installation.

5. Sizes (in mm)

5.1 Sockets and Spigots of Low Pressure Pipes (Lead Joint)

Nominal Dia	External Dia of Barrel	Socket	
		Internal Dia.	Depth
80	98	116	84
100	118	137	88
125	144	163	91
150	170	189	94
200	222	241	100
250	274	294	103
300	326	346	105
350	378	398	107
400	429	449	110
450	480	501	112
500	532	553	115
600	635	657	120
700	738	760	122
750	790	813	123

5.2 Socket and Spigot Low Pressure Pipes – Class LP

Nominal Dia	Barrel		Mass Approx kg/m
	External Dia.	Thickness	
80	98	4.9	10.25
100	118	5.1	12.94
125	144	5.4	16.82
150	170	5.7	21.04
200	222	6.5	31.48
250	274	7.0	42.00
300	329	7.6	54.27
350	378	8.8	72.20
400	429	9.4	87.70
450	480	10.0	105.70
500	532	11.4	132.20
600	635	12.6	175.80
700	738	14.0	226.60
750	790	14.6	253.40

Working length – 3.66, 4, 4.88 and 5.5 m.

6. Tolerances

a) External diameter of barrel

$$\pm \frac{1}{2}f = +(4.5 + 0.0015 \text{ dn}) \text{ mm}$$

b) Internal diameter of socket

$$\pm \frac{1}{2}f = +(3 + 0.001 \text{ dn}) \text{ mm}$$

c) Depth of socket

$$\text{Nominal dia up to 600 mm} — \pm 5 \text{ mm}$$

$$\text{Nominal dia over 600 mm} — \pm 10 \text{ mm}$$

d) Length — ± 25 mme) Wall thickness — $(1 + 0.05 e) \text{ mm}$

f) Maximum deviation from straight line (in mm) shall not be greater than 1.25 times the length of pipe in metres.

Where

“f” is caulking space of joint

in mm — $9 + 0.003 \text{ dn}$

dn — Nominal dia in mm

e — Wall thickness in mm

7. Mass

7.1 Density of cast iron is taken as 7.15 kg/dm³. Tolerance ± 5 percent.

8. Coating — Where coating material has tar or similar base, it shall be smooth and tenacious and hard enough not to flow at temperature of 77°C and not so brittle as to chip off at 0°C when scribed lightly with a penknife. When pipes are used for conveying potable water, inside coating shall not contain any constituent soluble such water or any ingredient which could impart any taste or odour to the potable water after sterilization and washing of the mains.

Note — For method of test refer to IS 1500 : 1983 Method for Brinell hardness test for metallic materials(*second revision*)

For detailed information, Refer to IS 6163 : 1978 Specification for centrifugally cast (spun) iron low pressure pipes for water, gas and sewage.

SUMMARY OF

IS 6418 : 1971 CAST IRON AND MALLEABLE CAST IRON FLANGES FOR GENERAL ENGINEERING PURPOSES

1. Scope

1.1 Covers grey cast iron and malleable cast iron flanges for general engineering purposes, which shall be applicable from 0 to 300°C for oil, water, steam, compressed air, gases and other non-corrosive fluids.

1.2. Type of gasket and gasket materials are not covered in the standard and shall be subject to agreement between the manufacturer and the purchaser.

2. Pressure and Temperature Rating — Table 1**TABLE 1 PRESSURE TEMPERATURE RATINGS FOR GRLY AND MALLEABLE CAST IRON FLANGES**

Nominal Pressure N/mm ²	Type of Material		Design Pressure (N/mm ²) at Temperature °C							
	Cast Iron	Malleable Cast Iron	−10 to 120	150	180	200	220	250	260	300
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(29)	(30)	(31)
0.25	15	—	0.25	—	—	—	—	—	—	—
	20	—	0.25	0.23	0.20	0.20	0.20	0.18	0.17	0.15
0.60	15	—	0.60	—	—	—	—	—	—	—
	20	—	0.60	0.56	0.52	0.50	0.50	0.45	0.43	0.36
		IS : 2107	0.60	0.58	0.56	0.55	0.55	0.50	0.50	0.50
		IS : 2108	0.60	0.58	0.56	0.55	0.55	0.50	0.50	0.50
1.0	15	—	1.0	—	—	—	—	—	—	—
	20	—	1.0	0.92	0.85	0.80	0.80	0.70	0.68	0.60
1.6	20	—	1.60	1.48	1.39	1.30	1.30	1.10	1.08	1.00
	—	IS : 2107	1.60	1.48	1.52	1.50	1.40	1.40	1.38	1.30
	—	IS : 2108	1.60	1.56	1.52	1.50	1.40	1.40	1.38	1.30
2.5	25	—	2.50	2.30	2.12	2.00	1.80	1.80	1.75	1.60
	—	IS : 2107	2.50	2.30	2.35	2.30	2.20	2.10	2.08	2.00
	—	IS : 2108	2.50	2.42	2.35	2.30	2.20	2.10	2.08	2.00

Note — For grey cast iron flanges, the pressure and temperature rating shall be reduced by 25 percent, where moderate shock (as may occur in efficient boiler fee main) is likely to be present.

Note — Intermediate values may be obtained by linear interpolation. 1 N/mm² = 0.012 kg/mm².

3. Designation —By nominal size and flange table reference. First part of the table reference is nominal pressure and the second part indicates the material and type of flange as follows

- Grey cast iron— intergral (1)
- Malleable cast iron—integral (2)
- Malleable cast iron — screwed boss (3)

Table 2	0.25/1 Integral grey cast iron flanges Nominal pressure—0.25 N/mm ² . Nominal size— 10 to 4000 mm
Table 3	0.6/1 Integral grey cast iron flanges Nominal pressure—0.6 N/mm ² . Nominal size— 10 to 3600 mm
Table 4	0.6/2 Malleable cast iron integral flanges Nominal pressure—0.6 N/mm ² . Nominal size— 10 to 150 mm
Table 5	0.6/3 Malleable cast iron screwed boss flanges Nominal pressure — 0.6 N/mm Nominal size— 6 to 150 mm
Table 6	1.0/1 Integral grey cast iron flanges Nominal pressure—1.0 N/mm ² . Nominal size— 200 to 3000 mm

Table 7	1.6/1 Integral grey cast iron flanges Nominal pressure— 1.6 N/mm ² Nominal size— 10 to 1000 mm
Table 8	1.6/2 Malleable cast iron integral flanges Nominal pressure— 1.0 and 1.6 N/mm ² Nominal size— 10 to 150 mm
Table 9	1.6/3 Malleable cast iron screwed boss flanges Nominal pressure— 1.0 and 1.6 N/mm ² Nominal size— 6 to 150 mm
Table 10	2.5/1 Integral grey cast iron flanges Nominal pressure— 2.5 N/mm ² Nominal size— 10 to 500 mm
Table 11	2.5/2 Malleable cast iron integral flanges Nominal pressure— 2.5 N/mm ² Nominal size— 10 to 150 mm
Table 12	2.5/3 Malleable cast iron screwed boss flanges Nominal pressure— 2.5 N/mm ² Nominal size— 6 to 150 mm

Note 1— Nominal sizes are 6, 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 300, 350, 400, 500, 600, 700, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600, 2800, 3000, 3200, 3400, 3600, 3800 and 4000.

Note 2 – For typical illustration of “Integral Flange” and “Screwed Boss Flange” See Figures 1 and 2 of the standard.

Note 3 – For detailed dimensions see Table 2 to 12 of the standard.

4. Flange Facing

- Smooth — With no visible tool marks, or
- Serrated — With a continuous spiral groove of 1.5 mm pitch and approximately 0.25mm deep.

5. General

5.1 Flange surfaces shall be free from casting surface defects and segregations.

5.2 It is recommended to use stud bolts with nuts on both sides for nominal pressures above 15 kgf/cm².

6. Hydraulic Test—Test pressure applied to the joint shall not exceed 1.5 times the nominal pressure for flanges.

For detailed information, refer to IS 6418 : 1971 Specification for cast iron and malleable cast iron flanges for general engineering purposes.

SUMMARY OF
IS 7181 : 1986 HORIZONTALLY CAST IRON DOUBLE FLANGED
PIPES FOR WATER, GAS AND SEWAGE
(First Revision)

1. Scope—Requirements for double flanged cast iron pipes of Class B only up to dn 750 for pressure main lines of water, gas and sewage manufactured by horizontal castings in sand moulds.

2. Mechanical Tests

2.1 Tensile Test—Minimum 150 MPa.

2.2 Hardness—Not more than 230 HBS.

3. Hydrostatic Test—Shall not show any sign of leakage, sweating or other defects when pressure indicated below is applied for 15 s.

**HYDROSTATIC TEST PRESSURE FOR
HORIZONTALLY CAST PIPES**

<i>Nominal Diameter DN</i>	<i>Test Pressure</i>	<i>Suggested Maximum Hydraulic Working Pressure including Surge</i>
(1)	(2) MPa	(3) MPa
Upto and including 300 mm	2.5	1.2
Over 300 mm and upto and including 600 mm	2.0	1.0
Over 600 mm	1.5	0.6

4. Sizes

2.1 Nominal diameter—DN : 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700 and 750 mm.

Working Lengths — 2.75 and 3 m.

2.2 Nominal Thickness—10.0, 10.5, 11.1, 11.7, 12.8, 14.0, 15.2, 16.3, 17.5, 18.7, 19.8, 22.2, 24.5 and 25.6 corresponding to nominal diameters 80 to 750 mm respectively.

5. Tolerances

5.1 On External Diameter

<i>Dimension</i>	<i>Nominal Diameter DN</i>	<i>Tolerance mm</i>
External diameter of barrel (DE)	All diameters	$\pm (4.5+0.0015 \text{ DN})$

5.2 On Thickness

<i>Dimension</i>	<i>Tolerance</i>
Wall thickness	$-(1+0.05e)$
Flange thickness	$\pm (2+0.05b)$

Where

e = thickness of wall in mm, and
b = thickness of flange in mm.

5.3 On length— ± 10 mm

Deviation from a straight line—Less than $0.00125 l$ where l is the length.

6. Coating

6.1 Coating shall not be applied to any pipe unless its surfaces are clean, dry and free from rust.

6.2 In all cases where the coating material has a tar or similar base, it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 65°C but not so brittle at a temperature of 0°C as to chip off when scribed lightly with a penknife.

For detailed information, Refer to IS 7181 : 1986 Specification for horizontally cast iron double flanged pipes for water, gas and sewage (first revision).

SUMMARY OF

IS 8329 : 2000 CENTRIFUGALLY CAST (SPUN) DUCTILE IRON PRESSURE PIPES FOR WATER, GAS AND SEWAGE

(First Revision)

1. Scope — Specifies the requirements and associated test methods applicable to ductile iron pipes manufactured in metal (lined or unlined) or sand moulds and their joints for the construction of pipe lines :

- to convey water, sewage or gas
- to be installed below or above ground
- operated with or without pressure.

1.2. This standard also specifies requirements for materials, dimensions and tolerances, mechanical properties and standard coatings and linings of ductile iron pipes.

1.3 *The standard applies to pipes, which are* — Manufactured with socketted, flanged or spigot ends for jointing by means of various types of gaskets, which are not within the scope of this standard and normally to be delivered externally and internally lined and are suitable for fluid temperatures between 0°C and 50°C, excluding frost.

1.4. This standard does not include the provisions for fittings used with the pipes conforming to this standard. A separate standard IS : 9523 covers the specification on such fittings.

1.5. Fittings conforming to IS 13382 : 1992* may also be used with ductile iron pipes, when the pressure requirements matches.

2. Classification

2.1 K7, K8, K9, K10, K12, depending on service conditions and manufacturing process.

2.2 Wall Thickness, “e”

$$e = K (0.5 + 0.001 \text{ dn})$$

where

$$e = \text{wall thickness in mm}$$

$$\text{dn} = \text{the nominal diameter, and}$$

$$K = \text{the whole number coefficient.}$$

2.3 The value of K will depend on the following service conditions:

SERVICE CONDITIONS

Nominal Dia	Water Main	Sewers	Gas Mains
80 - 300	K9 - K12	K7 - K12	K9 - K12
350 - 600	K8 - K10	K7 - K10	K9 - K10
700 - 2000	K7 - K10	K7 - K10	K9 - K10

2.4 *Minimum classes for screwed or welded on flange pipes as per working criteria :*

MINIMUM CLASS FOR DUCTILE IRON FLANGED PIPES

Nominal Dia	Screwed on Flange Minimum				Welded on Flange Minimum			
	PN 10	PN 16	PN 25	PN 40	PN 10	PN 16	PN 25	PN 40
80 – 450	K 9	K 9	K 9	K 9	K9	K9	K9	K9
500– 600	K10	K10	K10	K10	K9	K9	K9	K10
700–1200	K10	K10	K10	—	K9	K9	K9	—
1400– 2000	K10	K10	—	—	K9	K9	—	—

Where PN is nominal pressure.

* Pressure pipe lines for cast iron special for mechanical and push on flexible joints for water, gas and sewage.

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3. Joints

- Push on joint
- Flanged joint
- Flexible joints and Inter connection
- Restrained joints

Note – For details see 6 of the standard.

4. Rubber Gasket — As per IS 5382 : 1985 for push on joints and mechanical joints, and as per IS 638: 1979 for flanged joints.

5. Tests

5.1. Tensile and Elongation

Nominal Diameter (dn) mm	Minimum Tensile Strength MPa Percent	Minimum Elongation at Break,
80 – 1000	420	10
1000 – 2000	420	7

5.2. Brindl hardness shall not exceed 230 HB.

5.3. Hydrostatic test

Nominal Diameter (dn) mm	‘P’- Minimum Hydrostatic Test Pressure at Works, MPa							
	Centrifugally cast pipes with flexible joints				Pipes with screwed or welded-on flanges			
	Class K7	Class K8	Class K9, Class K10, Class K12		PN10 Flange	PN16 Flange	PN25 Flange	PN40 Flange
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
80 to 300		3.2	4.0	5.0	1.6	2.5	3.2	4.0
350 to 600		2.5	3.2	4.0	1.6	2.5	3.2	4.0
700 to 1000		1.8	2.5	3.2	1.6	2.5	3.2	—
1100 to 2000		1.2	1.8	2.5	1.6	2.5	2.5	—

Where “P” is the hydrostatic test pressure at works in MPa, maintained for atleast 10 s, and the pipe shall not show any sign of leakage, sweating or other defects.

6. Dimensions

6.1 Working Length — 4,5, 5.5 and 6 m for socket and spigot pipes, 4, 5 and 5.5 for flanged pipes.

6.2 Nominal Diameter — 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1000, 1100, 1200, 1400, 1600, 1800 and 2000 mm.

6.3 Wall Thickness — See 2.2.

7. Tolerances — See 15 of the standard.

8. Coating—Any one of the following protection may be applied depending upon the external condition of use :

Metallic zinc with finishing layer.

Zinc rich paint with finishing layer, bituminous paint.

*Rubber sealing rings for Water, Mains, Gas and Sewer (first revision).

**Sheet rubber jointing and Rubber insertion jointing (second Revision)

For detailed information, refer to IS 8329:2000 Centrifugally cast (spun) iron, pressure pipes for water, gas and sewage (third revision).

SUMMARY OF

IS 8794 : 1988 CAST IRON DETACHABLE JOINTS FOR USE WITH ASBESTOS CEMENT PRESSURE PIPES

(First Revision)

- 1. Scope** — Requirements for cast iron detachable joints to be used with asbestos cement pressure pipes conforming to IS 1592 : 1989*.

- 2. Metal** —As per the prescribed standard.

3. Requirements

- 3.1 Brinells hardness**—Not to exceed 215 HBS.

- 3.2 Tensile strength**—Min. of 150 MPa.

- 3.3 Hydrostatic test** — It should not show any leakage, or sweating or any other defect under a test pressure as per IS : 1592-1989 maintained for minimum of 15 seconds.

4. Dimensions for Flanges and Collars

Scope — Requirements for cast iron detachable flanges to be used with asbestos cement pressure pipes conforming to IS 1592 : 1989*.			Nominal Dia	Class	External Dia of AC Pipe
Material — As per the prescribed standard.			dn (1)	(2)	D2 (3)
Requirements			250	5	271.0
				10	276.5
				15	284.5
Brinells hardness — Not to exceed 215 HBS.				20	294.5
				25	305.5
				5	322.5
Tensile strength — Min. of 150 MPa.			300	10	328.5
				15	340.5
				20	352.5
Hydrostatic test — It should not show any leakage, cracking or any other defect under a test pressure as per IS 1592-1989 maintained for minimum of 15 seconds.				25	366.5
				5,10	379.5
				15	392.0
Dimensions for Flanges and Collars				20	405.0
				25	419.0
				5,10	432.0
Nominal Dia	Class	External Dia of AC Pipe	400	15	448.0
dn		D2		20	463.0
(1)	(2)	(3)		25	478.0
80	5,10,15	99.5	450	5,10	482.0
		101.5		15	498.0
		106.5		20	515.0
		120.0		25	532.0
100	5,10	120.0	500	5,10	536.5
		121.0		15	554.5
		126.5		20	572.5
		132.5		25	591.5
125	5,10	145.0	600	5,10	643.5
		147.0		15	665.5
		152.5		20	686.5
		159.5		25	710.5
150	5,10	171.0			
		176.5			
		183.0			
		191.0			
200		221.0			
		225.0			
		233.5			
		242.5			
		253.5			

5. Coating

- 5.1** Coating shall not be applied to any part unless its surface is clean, dry and free from rust.

- 5.2** In all instances where the coating material has a tar or similar base, it shall be smooth and tenacious, and hard enough not to flow when exposed to a temperature of 65°C but not so brittle at a temperature of 0°C as to chip off when scribed lightly with a pensknife.

*Asbestos Cement Pressure Pipes (*Third Revision*).

For detailed information, refer to IS 8794 : 1988. Specification for cast iron detachable joints for use with asbestos cement pressure pipes (first revision).

SUMMARY OF
IS 9523 : 2000 DUCTILE IRON FITTINGS FOR PRESSURE PIPES
FOR WATER, GAS AND SEWAGE
(First Revision)

1. Scope

1.1 Requirements for ductile iron fittings for pressure pipes for water, gas and sewage sizes for 80 to 200mm nominal diameter.

1.2 Applicable to fittings meant for mechanical joints (bolted gland), push on joints and flanged joints for jointing by means of various types of gasket. The design of socket and gasket are not within the scope.

1.3 Does not restrict use and development of other types of joints as long as they maintain overall dimensions for safety and interchangeability.

1.4 Are normally supplied with externally and internally coated to protect against corrosion.

1.5 A suitable for fluid temperature between 0°C and 50°C excluding frost.

2. General requirements

2.1 Manufacture — Metal used for manufacture of casting shall conform to the appropriate grade specified in IS 1865 : 1991*

2.2 Thickness — C is calculated by using

$$e = K (0.5 + 0.001 DN) \text{ where}$$

$$k = 14, 12$$

dn = Nominal Diameter

3. Mechanical test**3.1 Tensile test**

Nominal Diameter	Type of casting	Tensile Strength (Mpa) (Min)	Elongation at break, percent (Min)
All size	Fittings	420	5

3.2 Hardness test— Shall not exceed 250 HBS.

4. Hydrostatic test— Shall withstand the pressure test without showing any leakage at prescribed test pressure.

5. Sizes— Nominal sizes of 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 600, 700, 750, 800, 900, 1000, 1100, 1200, 1400, 1600, 1800 and 2000 mm.

Note — For dimensional and other requirements for socket/spigot of push on joints, mechanical joints and flanges. See table 3 to 7 and for fittings table 15 to 31. Tolerances for various dimension of flanges shall be as given in tables 8 to 11. Tolerances in ovality is as given in table 12 and 13.

6. Coating**6.1 External coatings one of the following**

- a) Metallic zinc with finishing layer (Annex-A)
- b) Zinc rich paint with finishing layer (Annex-A)
- c) Bituminous paint (Annex C)
- d) External steeling (Annex D)

6.2 Internal lining— following lining may be applied.

- a) Portland cement (with or without additives) mortar (Annex-B)
- b) Blast furnace slag cement mortar (Annex-B)
- c) High alumina cement mortar (Annex-B)
- d) Cement mortar with seal coat (Annex B)
- e) Bituminous- paint (Annex C)

*Iron castings with spheroidal, nodular or modular graphite
(third revision)

For detailed information, refer to IS 9523 : 1980 Specification for ductile iron fittings, for pressure pipes for water, gas and sewage.

SUMMARY OF
IS 10292 : 1988 DIMENSIONAL REQUIREMENTS FOR RUBBER
SEALING RINGS FOR C I D. JOINTS IN
ASBESTOS CEMENT PIPING
(First Revision)

1. Scope — Specifies the dimensional requirements for rubber sealing rings to be used with cast iron detachable joints conforming to IS 8794 : 1988* for joining the asbestos cement pressure pipes conforming to IS 1592 : 1989⁺. This standard covers the dimensions of rubber sealing rings having circular cross section only, up to 600 mm nominal diameter.

2. General — Requirements of rubber sealing rings as specified in IS 5382 : 1985, shall be complied with. The rubber rings shall conform to type 3 of IS 5382 : 1985.

3. Dimensions — See Table

TABLE 1 DIMENSIONS OF RUBBER SEALING RINGS

<i>Nominal Dia of Pipe and Joint</i>	<i>Class</i>	<i>Inner Dia Y</i>	<i>Cross Sectional Dia X</i>	<i>Number Per Set</i>
(1)	(2)	(3)	(4)	(5)
		mm		mm
80	5,10,15,20	90	14	2
	25	90	14	2
100	5,10,15,20	109	14	2
	25	115	14	2
125	5,10,15,20	131	14	2
	25	138	14	2
150	5,10,15,20	155	14	2
	25	165	14	2
200	5,10,15,20	201	14	2
	25	219	14	2
250	5,10,15,20	246	14	2
	25	264	14	2
300	5,10,15,20	293	14	2
	25	316	14	2
350	5,10,15,20	345	16	2
	25	362	16	2
400	5,10,15,20	392	16	2
	25	412	16	2
450	5,10,15,20	438	18	2
	25	459	18	2
500	5,10,15,20	487	20	2
	25	510	20	2
600	5,10,15,20	585	20	2
	25	613	20	2

*Cast iron detachable joints for use with asbestos cement pressure pipes (*first revision*)

*Asbestos cement pressure pipes (*third revision*)

4. Tolerances — A tolerance of $\pm \begin{smallmatrix} 0.5 \\ 0 \end{smallmatrix}$ mm shall be allowed on the cross sectional dia.

*Rubber sealing rings for gas mains, water mains and sewers (*first revision*)

For detailed information, refer to IS 10292 : 1988. Specification for dimensional requirements for rubber sealing rings for C I D joints in asbestos cement piping (first revision).

SUMMARY OF
IS 10299 : 1982 CAST IRON SADDLE PIECES FOR SERVICE
CONNECTION FROM ASBESTOS CEMENT PRESSURE PIPES

1. Scope — Requirements for cast iron saddle piece for service connection from asbestos cement pressure pipes conforming to IS 1592 : 1989*

2. Metal —As per the prescribed standard.

3. Tests

3.1. Tensile test— Minimum 150 MPa.

3.2 Brinell Hardness — Not more than 215 HB.

4. Dimensions see Table 1

TABLE 1 DIMENSIONS FOR SADDLE PIECES

<i>Nominal Diameter of Pipe</i>	<i>Thickness of Saddle or Strap</i>	<i>Width of Saddle or Strap</i>	<i>Boss Diameter</i>	<i>Boss Thickness</i>	<i>Tapping Size</i>	<i>Mass</i>
(DN)	(t)	(b)	(d)	(t1)	Max	Kg
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	11	38	60	13	25	1.7
100	11	42	65	13	25	2.0
125	11	45	75	13	25	2.5
150	12	45	75	14	37	3.0
200	12	45	85	14	37	3.9

5. Tolerances

Dimensions

Cored holes and other

±2

dimensions

Drilled holes

Tolerances mm

±1.5

6. Mass— Shall be calculated by taking the density of the cast iron as 7.15 kg/dm³. Tolerance shall be –5 percent. No unit for plus tolerance is specified.

7. Coating

7.1 Coating shall not be applied to any part unless its surface is clean, dry and free from rust.

7.2 In all instances where the coating material has a tar or similar base, it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77°C but not so brittle at a temperature of 0°C as to chip off when scribed lightly with a penknife.

* Asbestos cement pressure pipes (*third revision*)

For detailed information, refer to IS 10299 : 1982 Specification for cast iron saddle pieces for service connection from asbestos cement pressure pipes.

SUMMARY OF

IS 12820 : 2004 DIMENSIONAL REQUIREMENTS OF RUBBER GASKETS FOR MECHANICAL JOINTS AND PUSH-ON JOINTS FOR USE WITH CAST IRON PIPES AND FITTINGS FOR CARRYING WATER, GAS AND SEWAGE

(First Revision)

1. Scope— Specifies the dimensional requirements for rubber gaskets to be used in cast iron pipes/fittings for the mechanical joints and push-on flexible joints for carrying water, gas and sewage.

2. Requirement for Gaskets — As per IS 5382 : 1985*.

3. Quality**TABLE 1 TYPE OF RUBBER AND HARDNESS**

<i>Joint</i>	<i>Type of Rubber*</i>	<i>Hardness IRHD</i>
Mechanical Joint	4	60 ± 5
— Bulb 2		50 ± 5
Push-on-joint		
— Heel5		80 ± 4

* Refer to Table 1 of IS 5382 : 1985

4. Dimensions — Refer to the Figs. in the Standard. See Tables 2 and 3 .

* Rubber sealing rings for gas mains, water mains and sewers (first revision)

TABLE 2 DIMENSIONS OF RUBBER GASKETS FOR MECHANICAL JOINT

All dimensions in millimetres.

<i>Nominal Diameter</i>	<i>Dimensions</i>					
DN	N	Q	R	T	U	V
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	130	98	32	10	16	6
100	150	118	32	10	16	6
125	176	144	32	10	16	6
150	202	170	35	10	16	6
200	254	222	35	10	16	6
250	308	274	35	10	17	6
300	360	326	35	10	17	6
350	416	378	40	10	19	8
400	467	429	40	10	19	8
450	518	480	40	10	19	8
500	570	532	45	10	20	8
600	675	635	45	10	20	8
700	788	738	45	10	25	8
750	840	790	45	10	25	8
800	892	842	45	15	25	8
900	995	945	45	15	25	8
1000	1098	1048	45	15	25	8
1050	1184	1124	50	15	30	10
1100	1220	1152	55	20	34	10
1200	1324	1256	55	20	34	10
1500	1635	1567	60	20	34	10

TABLE 3 DIMENSIONS OF RUBBER GASKETS FOR PUSH-ON JOINTS

<i>Nominal Diameter</i>	<i>Bulb</i>		<i>Heel</i>			<i>Height</i>
dn	C	J	A	D	N	B
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	16	122	10	5	124	26
100	16	142	10	5	144	26
125	16	169	10	5	171	26
150	16	196	10	5	198	26
200	18	252.5	11	6	254.5	30
250	18	306	11	6	308	32
300	20	362.5	12	7	364.5	34
350	20	416	12	7	418	34
400	22	472	13	8	474	38
450	22	525	13	8	527	38
500	24	580	14	9	582	42
600	26	689	15	10	691	46
700	29	799	17.5	10	801.5	51
750	30	854	18.5	10.3	856.5	52.5
800	30	906	18.5	10.3	908.5	52.5
900	30	1009	18.5	10.3	1012	52.5
1000	30	1118	18.5	10.3	1120	52.5
1050	30.5	1181	19	10.3	1183	52.5

5. Tolerances

TABLE 4 TOLERANCES ON DIMENSIONS OF RUBBER GASKETS FOR MECHANICAL JOINTS

Sl.No.	Dimension	Nominal Diameter (mm)	Tolerances (mm)
i)	Thickness, U	80 to 600	± 1.0
		700 to 1500	± 1.5
ii)	Internal diameter, Q	80 to 300	± 1.5
		350 & 400	± 2.0
		450 to 600	± 3.0
		700 to 1500	± 4.0
iii)	Width, R	80 to 600	± 5.0
		700 to 1500	± 8.0
iv)	Dimension, V	80 to 600	± 2.0
		700 to 1500	± 3.0
v)	Dimension, T	80 to 750	± 2.0
		800 to 1500	± 4.0

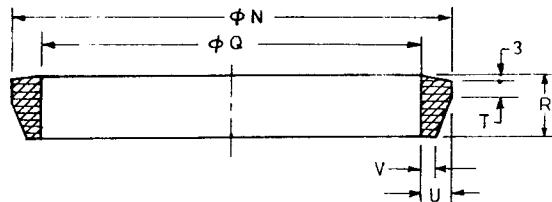


TABLE 5 TOLERANCES ON DIMENSIONS OF RUBBER GASKETS FOR PUSH-ON JOINTS

Sl.No.	Dimension	Nominal Diameter (mm)	Tolerances (mm)
i)	Bulb		
	C	80 to 600	± 0.5
		250 to 1050	± 0.8
		700 to 1050	± 1.0
	J	80 to 125	± 1.0
		50 to 300	± 1.5
		350 & 400	± 2.0
		450 to 600	± 3.0
		700 to 800	± 4.0
		900 to 1050	± 6.0
ii)	Heel		
	A	80 to 250	± 0.5
		300 to 450	± 0.6
		500 to 1050	± 0.8
	D	80 to 250	± 0.3
		300 to 700	± 0.4
		750 to 1050	± 0.5
	N	80 to 125	± 1.0
		150 to 300	± 1.5
		350 & 400	± 2.0
		450 to 600	± 3.0
		700 to 800	± 4.0
		900 to 1050	± 6.0
iii)	Height		
	B	80 to 150	± 0.5
		200 to 600	± 0.8
		700 to 1050	± 1.0

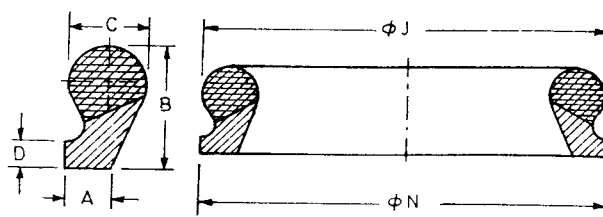


FIG. 1 & 2

For detailed information, refer to IS 12820 : 2004. Specification for dimensional requirements of rubber gaskets for mechanical joints and push-on-joints for use with cast iron pipes and fittings for carrying water, gas and sewage (first revision)

SUMMARY OF

IS 12987 : 1991 CAST IRON DETACHABLE JOINTS FOR USE WITH ASBESTOS CEMENT PRESSURE PIPES (LIGHT DUTY)

1. Scope — Covers the requirements for cast iron detachable joints to be used with asbestos cement pressure pipes (light duty) conforming to IS 9627:1980.*

2. Metal — Prescribed Standard

3. Tests Requirements.

3.1 Tensile Strength — Minimum of 150 MPa.

3.2 Brinell Hardness — Not more than 215 HBs.

3.3 Hydrostatic test — May be carried out for collars only. The collars shall withstand the test pressure specified in Table 1 of IS 9627 : 1980 for 15 Seconds without showing any leakage, sweating or other defects.

4. Dimensions

4.1 Nominal Dia — 50, 80, 100, 125, 150, 200 mm with classes 5 and 10 for each Dia. for flanges and collars.

Note — Nominal diameter of detachable joint shall refer to the corresponding nominal diameter of the asbestos cement pressure pipes.

5. Coatings

5.1 Coating shall not be applied to any part unless its surface is clean, dry and free from rust

5.2 All cast iron parts shall be coated externally and internally with the same material; the parts being pre-heated prior to total immersion in a bath containing a uniformly heated bituminous/tar or other suitable base.

Note — Coal tar should not be used in cast iron detachable joints used with AC pipes for carrying potable water.

5.3 In all instances where the coating material has a tar or similar base, it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 66°C but not so brittle at a temperature of 0°C as to chip off when scribed lightly with a penknife.

*Asbestos cement pressure pipes (light duty).

+Grey iron castings (fourth revision).

For detailed information, refer to IS 12987 : 1991 Specification for cast Iron detachable joints for use with asbestos cement pressure pipes (light duty).

SUMMARY OF

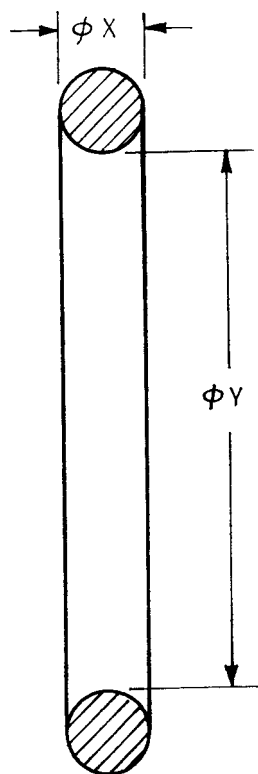
IS 12988 : 1991 DIMENSIONAL REQUIREMENTS FOR RUBBER SEALING RINGS FOR CID JOINTS FOR LIGHT DUTY AC PIPES – DIMENSIONAL REQUIREMENTS

1. Scope—Specifies the dimensional requirement for rubber sealing rings to be used with cast iron detachable joints conforming to IS : 12987 : 1991* for joining light duty asbestos cement pressure pipes conforming to IS : 9627 1980*

2. General

2.1 The rubber sealing rings shall conform to the general requirement and type 3 of IS 5382:1985[†]

3. Dimensions



Nominal Dia of Pipe & Joint mm	Class	Inner Dia “ϕY” mm	Cross Number Sectional Per Dia, ϕ X” mm	Set
50	5 and 10	60	10	2
80	5 and 10	90	14	2
100	5 and 10	109	14	2
125	5 and 10	131	14	2
150	5 and 10	155	14	2
200	5 and 10	201	14	2

4. Tolerances

4.1 A tolerance of $\begin{smallmatrix} +0.5mm \\ -0.0mm \end{smallmatrix}$ shall be allowed on cross sectional diameter “ϕX” and ± 1 percenton inner dia “ϕY”.

FIG. 1 RUBBER SEALING RINGS FOR LIGHT DUTY AC PIPES

* Rubber sealing rings for gas mains, water mains and sewers (first revision).

† Asbestos cement pressure pipes (light duty).

* Cast Iron detachable joints for use with asbestos cement pressure pipes (Light Duty).

For detailed information, refer to IS 12988 : 1991 Specification for rubber sealing rings for CID joints for light duty AC pipes—Dimensional requirements.

SUMMARY OF

IS 13382 : 2004 CAST IRON SPECIALS FOR MECHANICAL AND PUSH ON FLEXIBLE JOINTS FOR PRESSURE PIPE LINES FOR WATER, GAS AND SEWAGE

(First revision)

1. Scope — Requirements for cast iron special castings to be used with pressure pipes for carrying water, gas and sewage for sizes from DN 80 mm up to 1 500 mm cast iron and ductile iron.

1.2. This standard is applicable to fittings meant for mechanical joints (bolted gland), push-on-joints (single rubber gasket) and flanged joints.

2. Metal — Shall conform to appropriate grade of IS 210 : 1993*

3. Joints

3.1 In case of push-on joints the spigot ends of pipes and fittings shall be suitably chamfered for smooth entry of pipe in the socket of the casting fitted with rubber gasket.

3.2 In case of flange and mechanical joint castings, the flanges shall be at right angle to the axis of the joint. The bolt holes shall be cored or drilled.

3.3 The bolt hole circles shall be concentric with the bore and shall be located off the centre line, unless otherwise specified by the purchaser. Where there are two or more flanges, the bolt holes shall be correctly aligned.

3.4 The flanges shall be plain faced over the contact surface with a tool mark finishing having a pitch of 1 ± 0.3 mm, serrations may be spiral or concentric.

4. Rubber Gaskets — Shall conform to IS 12820 : 1989†

5. Tests Requirement

5.1 Tensile Test — Minimum 150 MPa.

5.2 Hardness Test — Not more than 210 HBS.

5.3 Hydrostatic Test — shall not show leakage, sweating or any other defect, under test pressures given below and maintained for 15 s.

Nominal Diameter <i>dn</i>	Test Pressure	
	<i>Castings without Branches or with Branches not Greater than Half the Principal Dia</i>	<i>Castings with Branches Greater than Half the Principal Diameter</i>
mm	MPa	MPa
(1)	(2)	(3)
Up to and including 300	2.5	2.5
Over 300 and upto and including 600	2.0	2.0
Over 600 and upto and including 1 500	1.5	1.0

* Grey iron castings (*fourth revision*)

†Dimensional requirements of rubber gaskets and push-on joints for use with cast iron pipes and fittings for carrying water, gas and sewage.

SP 21 : 2005

6. Sizes *Nominal Diameter* of the casting — 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1 000, 1 050, 1 100, 1 200 and 1 500.

Note — 1 For dimensional and other requirements for socket/spigot of push on joints mechanical joints and flanges see section 2 = (Tables 5 to 10) of the standard.

Note — 2 For dimensional and other requirements for castings see section 3 (Tables 11 to 34) of the standard.

7. Tolerances

7.1 Tolerances on Thickness — Tolerances on wall thickness and flange thickness of fittings are limited as follows :

<i>Dimensions</i>	<i>Tolerances</i> <i>mm</i>
Wall thickness	$-(2+0.05e)$
Flange thickness	$\pm(3+0.05b)$

Where

e = standard thickness of the wall in millimetres, and

b = standard thickness of the flanges in millimetres.

Note — No limit for the plus tolerances is specified.

7.2 Tolerances on Lengths — Tolerances on lengths of fittings normally manufactured shall be as follows

<i>Type of Fitting</i>	<i>Length</i>	<i>Deviation / Tolerance</i> <i>mm</i>
Flanged socket	L	DN 80 to 1 200 : ± 25
Flanged spigot collar & taper		DN 1 400 to 1 600 : ± 35
Bend 90°	L	$\pm(15+0.03 \text{ DN})$
Bend 45°	L	$\pm(10+0.025 \text{ DN})$
Bend 22 1/2° and 11 1/4°	L	DN 80 to DN 1 000 : $\pm(10+0.02 \text{ DN})$ DN 1 200 to 1 600 : $\pm(10 \pm 0.025 \text{ DN})$
Tee	L and h	DN 80 to 1 200 : $+50$ -25 DN 1 400 to 1 600 : $+75$ -35

Note: For details on tolerances, see 12 of the standard.

8. Coating

8.1 The coating material shall set rapidly with good adherence and shall not scale off.

8.2 Where the coating material has a tar or similar base, it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 65°C but not so brittle at a temperature of 0°C as to chip off when scribed with a penknife.

For detailed information, refer to IS 13382 : 2004. Specification for cast Iron specials for mechanical and push-on flexible joints for pressure pipe lines for water, gas and sewage (first revision)

SUMMARY OF

IS 11925 : 1986 PITCH IMPREGNATED FIBRE PIPES AND FITTINGS FOR DRAINAGE PURPOSES

1. Scope — Covers materials, dimension and methods of testing of pitch impregnated fibre pipes and fittings in diameters ranging from 50 to 200 mm for drainage purposes below and above ground level.

1.2 The standard also covers perforated pipes of the same materials for sub-surface drainage.

2. Material

2.1 Pipes shall consist of a preformed felted fibrous structure impregnated, with pitch, bitumen or other no less suitable compound.

2.2 Couplings and fittings shall be made of :

- The same material as the pipe, or
- Polypropylene or other plastics material no less suitable, or
- Mineral fibre moulded from an inert aggregate mixed with an inorganic cement and impregnated with pitch, bitumen or other no less suitable material.

3. General

3.1 Pipes

3.1.1 Length — Between 1.5 to 3.5 m with a tolerance of ± 25 mm. Variation from straight length maximum 1 in 100.

Nominal Diameter of Pipes

	Nominal Bore, mm						
Limits of internal diameter, mm	50	75	100	125	150	200	225
Minimum	50	75	100	125	150	200	225
Maximum	54	80	106	133	160	213	239

3.1.2 Pipes shall be made with ends suitable for the joint specified; square cut plain ends for snap joints and “C” coupling joints and with machined ends for taper coupling joints, soil “O” ring joints and for spigot and socket joints.

3.2 Perforated Pipes

3.2.1 Perforations shall be evenly spaced on rows parallel to the axis of the pipe.

3.2.2 The perforations shall be not less than 5 mm dia and not greater than 16 mm dia and the spacing in any row of perforations shall be 150 ± 10 mm between adjacent holes in that row.

For pipes up to 100 mm bore there shall be two rows of holes and for larger sizes there shall be four rows of holes.

The centre lines of all perforations shall be contained within an arc of 160° and shall be cleanly drilled

4. Joints and Couplings

- Taper Cupling Joint
- Snap ring joint.
- Soil pipe “O” ring joints.
- Spigot and socket or rebated joints.
- Joints “C” coupling joints.

Note— For details refer to 5 of the standard.

5. Fittings — Shall be either moulded to shape, or fabricated from pipe prior to impregnation.

5.2 Polypropylene fittings shall be black and consist of polypropylene polymer or copolymer composed principally of isotatic polypropylene together with suitably compounded stabilizers, lubricants and fillers.

5.3 Body Wall Thickness of Polypropylene Fittings—

	Nominal Bore, mm						
	50	75	100	125	150	200	225
Minimum thickness below ground work	3.5	3.5	4.0	5.2	5.2	7.0	7.0
Minimum thickness above ground work	2.7	2.7	2.7	3.8	3.8	3.8	3.8

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6. Test

6.1 Pipes, Couplings and Fittings (except plastic materials).

6.1.1 *Chemical resistance* — Shall not show any evidence of softening or disintegration

6.1.2 *Water Absorption* — Gain in mass, expressed as a percentage of the original mass, shall not exceed 2 percent.

6.1.3 *Resistance to Boiling Water* — Shall show no sign of disintegration or separation into laminations.

6.1.4 *Heat resistance* — Shall show no appreciable distortion and no appreciable exudation of impregnant.

6.1.5 *Resistance to flattening (pipe only)*— Neither test piece shall show a decrease in diameter exceeding 3 percent at the point of application of the load.

6.1.6 *Crushing strength test* — When tested for dry crushing wet crushing, resistance to kerosene, crushing after boiling water and crushing strength for coupling and fittings, the load at rupture shall not be less than that shown below:

		Nominal Bore, mm						
		50	75	100	125	150	200	225
Pipes	kg per m	1640	1640	1640	1940	1940	2380	2530
	kg per test length	500	500	500	590	590	725	760
	Couplings (kg per coupling)	122	143	169	195	195	304	317

6.1.7. *Test of adhesive used in fabricated fittings* — Shall with stand, without fracture of the joint, on drop of 3.520.05 kg weight through its full distance of 1800mm.

6.2. Couplings and Fittings of Plastic Materials.

6.2.1. *Impact test*— Shall show no evidence of open or closed cracking either on inside on outside surface when tested as per the prescribed procedures.

6.2.2. *Tensile strength of weld line* — The ring shall not fracture whilst being driven the specified distance.

6.3. *Tests for Joints*— Shall be capable of withstanding the specified internal hydraulic pressure .

Note—IS 5382 : 1985 Rubber sealing rings for gas gains, water mains and sewers (first revision).

For detailed information, refer to IS 11925 : 1986 Specification for pitch impregnated fibre pipes and fittings for drainage purposes.

SUMMARY OF
IS 404 (PART 1) : 1993 LEAD PIPES – FOR OTHER THAN
CHEMICAL PURPOSES
(Third Revision)

1. Scope — Requirements of lead pipes for other than chemical purposes. The lead pipes covered in this standard are not suitable for potable water supply.

10, 13, 16, 20, 25, 30, 40,
50, 60, 80, 100 and 125 mm.

2. Freedom from Defects: Shall be sound in all respect and free from laminations, flaws, pronounced extrusion marks or other harmful defects and shall, as far as possible, be circular in cross section, smooth and of uniform wall thickness throughout.

5. Thickness

2, 3, 4, 5, 6, 8 and 10 mm.

3. Chemical Composition

Chemical Composition of Lead Pipes

<i>Constituent</i>	<i>Grade 1</i>	<i>Grade 2</i>
(1)	(2)	(3)
Lead, <i>Min</i>	99.80	99.25
Antimony, <i>Max</i>	0.06	0.10
Copper, <i>Max</i>	—	0.07
Tellurium, <i>Max</i>	0.005	—
Tin, <i>Max</i>	0.075	0.50
Zinc, <i>Max</i>	—	0.005
Total of all impurities <i>Max</i>	0.20	0.75

6. Tolerances

6.1 *The tolerance on the nominal internal diameter shall be + 0% and — 5%.*

6.2 *The tolerance on wall thickness shall be ± 7.5 percent.*

7. Drift Expansion Test — Shall meet the requirements specified below

Drift Expanding Test

<i>Nominal IDmm</i>	<i>Upto and Including</i>	<i>Angle of Mandrel Degree</i>	<i>Minimum Expansion in OD Percent</i>
(1)	(2)	(3)	(4)
10	15	23	100
15	25	35	100
25	—	35	75

4. Nominal Diameters (internal)

For detailed information, refer to IS 404 (Part) : 1993 Specification for lead pipes—for other than chemical purposes (third revision).

SUMMARY OF
IS 3076 : 1985 LOW DENSITY POLYETHYLENE PIPES FOR
POTABLE WATER SUPPLIES
(Second Revision)

1. Scope — Requirements for low density black polyethylene pipes of outside diameters up to 140 mm for use in potable water supplies.

2. Classification

<i>Class of Pipe at 27°C</i>	<i>Working Pressure</i>
Class 1	0.25 MPa
Class 2	0.4 MPa
Class 3	0.6 MPa
Class 4	1.0 MPa

Note — The above pipes are recommended for water temperature ranging from -40°C to $+38^{\circ}\text{C}$. The creep rupture strength of the pipe diminishes with the increase in temperature above 20°C and therefore the working pressure should be modified as given in figure of the standard.

3. Material

3.1 The low density polyethylene shall have a base density (virgin polymer) of not more than 0.928 g/ml at 27°C .

3.2 The material used for extrusion shall be dried to bring the moisture content to less than 0.1 percent by mass.

3.3 The percentage of antioxidant used shall be not more than 0.3 percent by mass.

3.4 The carbon black used shall comply with the following :

- a) Density : 1.5 to 2.0 g/ml.
- b) Volatile matter : not more than 9 percent when tested in accordance with Appendix A of the Standard.
- c) Toluene extract : not more than 0.1 percent by mass when determined by the method in Appendix B of the Standard.
- d) The percentage of carbon black in the material shall be 2.5 ± 0.5 by mass, and
- e) The dispersion of carbon black shall be satisfactory.

4. Dimensions

DIMENSION OF LOW DENSITY POLYETHYLENE PIPES

All dimensions in millimetres									
Outside Diameter	Tolerance on Outside Diameter	Wall Thickness for Working Pressures							
		Class 1 (0.25 MPa)		Class 2 (0.4 MPa)		Class 3 (0.6 MPa)		Class 4 (1.0 MPa)	
		Min	Max	Min	Max	Min	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
10	+0.3	—	—	—	—	—	—	—	—
12	+0.3	—	—	—	—	—	—	2.0	2.4
16	+0.3	—	—	—	—	—	—	2.7	3.2
20	+0.3	—	—	—	—	2.2	2.7	3.3	3.9
25	+0.3	—	—	—	—	2.7	3.2	4.2	4.9
32	+0.3	—	—	2.4	2.9	3.4	4.0	5.3	6.1
40	+0.4	1.9	2.3	3.0	3.5	4.3	5.0	6.6	7.5
50	+0.5	2.4	2.9	3.7	4.3	5.3	6.1	8.3	9.4
63	+0.6	3.0	3.5	4.7	5.4	6.7	7.6	10.4	11.7
75	+0.7	3.6	4.2	5.5	6.3	8.0	9.0	—	—
90	+0.8	4.3	5.0	6.6	7.5	9.6	10.8	—	—
110	+1.0	5.2	6.0	8.1	9.2	11.7	13.1	—	—
125	+1.2	5.9	6.7	9.2	10.4	—	—	—	—
140	+1.3	6.6	7.5	10.3	11.6	—	—	—	—

5. Visual Appearance— The internal and external surfaces of the pipes shall be smooth, clean, and free from groovings and other defects. The ends shall be cleanly cut and shall be square with the axis of the pipe.

6. Performance Requirements

6.1 Hydraulic Characteristics— When subjected to internal pressure creep rupture test the pipe shall show no signs of localized swelling, leakage or weeping and shall not rupture during the prescribed test duration. The temperatures, durations of test and stresses for quality and acceptance tests shall be as given in Table 2.

6.2 Reversion Test— The dimension shall not change by more than 3 percent in the longitudinal direction.

6.3 Tensile Test

<i>Thickness of Pipe Wall</i>	<i>Tensile Strength Min</i>	<i>Elongation at Break Min</i>
≤ 5 mm	8.85 MPa	350 percent
> 5 mm	8.85 MPa	200 percent

7. Supply of Pipes — The pipes shall be supplied on coil of nominal lengths 25, 50, 100, 150 and 200 m.

Note — For method of test refer to 6 of the Standard

For detailed information, refer to IS 3076 : 1985 Specification for low density, polyethylene pipes for potable water supplies. (second revision).

SUMMARY OF
IS 4984 : 1995 HIGH DENSITY POLYETHYLENE PIPES
FOR WATER SUPPLY
(Fourth Revision)

1. Scope — Requirements for high density polyethylene pipes from 16 mm to 1000 mm nominal diameter of pressure rating from 0.25 MPa to 1.6 MPa in material grades of PE 63, PE 80, and PE 100, for use for buried water mains and services and for water supply above ground, both inside and outside buildings.

2. Designation

2.1 Pipes shall be designated according to the grade of material followed by pressure rating and nominal diameter. For example, PE 63 PN 10 DN 200 indicates a pipe pertaining to material grade 63, pressure rating 1.0 MPa and outside nominal diameter 200 mm.

2.2 Classification of Pipe Material

Sl. No.	Material Grade	MRS (Minimum Required Strength) of Material in MPa at 20°C, 50 years	Maximum Allowable Hydrostatic Design Stress (σ) MPa	
			At 20°C	At 30°C
(1)	(2)	(3)	(4)	(5)
i)	PE 63	6.3	5.0	4.0
ii)	PE 80	8.0	6.3	5.0
iii)	PE 100	10.0	8.0	6.3

2.3 Pressure Rating — Pipes shall be classified by pressure rating (PN) corresponding to the maximum permissible working pressure at 30°C, as follows :

Pressure Rating of Pipe	Maximum Permissible Working Pressure
PN 2.5	0.25 MPa
PN 4	0.40 MPa
PN 6	0.60 MPa
PN 10	1.00 MPa
PN 12.5	1.25 MPa
PN 16	1.60 MPa

Note—The pipes are recommended for maximum water temperature of + 45°C. The pipes may also be used upto the ambient temperature of -40°C. As the creep rupture strength of the pipe varies with the change in water temperature, the maximum working pressure should be modified by applying the pressure coefficient given in fig. 1 of the standard.

2.4 Nominal Diameter (dn) — The nominal diameter of pipes covered in this standard are :

16, 20, 25, 32, 40, 50, 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450, 560, 630, 710, 800, 900 and 1000 mm.

3. Colour — Shall be black

4. Material

4.1 High Density Polyethylene — High density polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA-45-T-006 of IS 7328 : 1992*. HDPE conforming to designation PEEWA-45-T-012 of IS 7328 : 1992 may also be used with the exception that melt flow rating (MFR) shall not exceed 1.10 g / 10 minutes. In addition the material shall also conform to 5.6.2 of IS 7328:1992.

The specified base density shall be between 940.5 kg/m³ and 946.4 kg/m³ (both inclusive) when determined at 27°C. The value of the density shall also not differ from the nominal value by more than 3 kg/m³.

The MFR of the material shall be between 0.41 and 1.10 (both inclusive) when tested at 190°C with nominal load of 5 kg.

The resin shall be compounded with carbon black. The carbon black content in the material shall be within 2.5 ± 0.5% and the dispersion of carbon black shall be satisfactory.

4.3 Anti-Oxidant — The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin.

4.4 Reworked Material — Not more than 10 percent of the manufacturer's own reworked material resulting from the manufacture of pipes.

* High density polyethylene materials for molding and extension (first revision).

5. Dimensions

TABLE 2 OUTSIDE DIAMETER, TOLERANCE AND OVALITY OF PIPES

Nominal Diameter dn	Outside Diameter mm	Tolerance mm (only positive tolerances)	Ovality mm
(1)	(2)	(3)	(4)
16	16.0	0.3	1.2
20	20.0	0.3	1.2
25	25.0	0.3	1.2
32	32.0	0.3	1.3
40	40.0	0.4	1.4
50	50.0	0.5	1.4
63	63.0	0.6	1.5
75	75.0	0.7	1.6
90	90.0	0.9	1.8
110	110.0	1.0	2.2
125	125.0	1.2	2.5
140	140.0	1.3	2.8
160	160.0	1.5	3.2
180	180.0	1.7	3.6
200	200.0	1.8	4.0
225	225.0	2.1	4.5
250	250.0	2.3	5.0
280	280.0	2.6	9.8
315	315.0	2.9	11.1
355	355.0	3.2	12.5
400	400.0	3.6	14.0
450	450.0	4.1	15.6
500	500.0	4.5	17.5
560	560.0	5.0	19.6
630	630.0	5.7	22.1
710	710.0	6.4	24.9
800	800.0	7.2	28.0
900	900.0	8.1	31.5
1000	1000.0	9.0	35.0

5.2 For Wall Thickness — Refer Tables 3, 4 and 5 of the standard.

Note: For explanatory notes and methods of tests, refer to Appendices A to C of the standard.

For detailed information, refer to IS 4984 : 1995 Specification for high density polyethylene pipes for water supply (fourth revision).

5.3 Length — 5 m to 20 m.

5.4 Coiling — The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented.

6. Visual Appearance

6.1 The internal and external surfaces of the pipes shall be smooth, clean and free from grooving and other defects. The ends shall be cleanly cut and shall be square with axis of the pipes. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible provided that the wall thickness remains within the permissible limits.

7. Performance Requirements

7.1 Hydraulic Characteristics — When subjected to internal pressure creep rupture test the pipes under test shall show no signs of localized swelling, leakage or weeping, and shall not burst during the prescribed.

7.2 Reversion Test — Longitudinal Reversion shall not be greater than 3 percent.

7.3 Overall Migration test — Shall be within the limits stipulated in*.

7.4 Carbon Black Content and Dispersion — the carbon black content shall be within 2.5 ± 0.5 percent, and the dispersion of carbon black shall be satisfactory.

*Polyethylene for is safe use in contact with food stuff, pharmaceuticals and drinking water.

SUMMARY OF
IS 4985 : 2000 UNPLASTICIZED PVC PIPES FOR POTABLE
WATER SUPPLIES
(Third Revision)

1. Scope

1.1 Requirements for plain end as well as socket end pipes including those for use with electronic sealing rings.

1.2 This standard does not cover unplasticized PVC pipes use in suction and delivery lines of agricultural pumps.

1.3 The pipes covered in this standard are not suitable for use as casing pipes in tubewells.

2. Classification— Shall be classified by pressure ratings (working pressure at 27°C).

<i>Class of Pipe</i>	<i>Working Pressure (PN)</i>
Class 1	0.25 MPa (2.5kg/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 (12.5kg/cm ²)

Note— The above pipes are recommended for water temperature 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 upto 45°C the strength of pipes reduce and working pressure shall be modified in accordance with fig1 of the standard.

3. Composition—Material shall consist substantially of unplasticized polyvinyl chloride to which maybe added additives that are needed to facilitate the manufacture of pipe and production of sound and durable pipe of good surface finish mechanical strength and opacity.

The monomer consent (VCM) in the resin shall be within the links of IS 10151:1982*

4. Dimension**4.1 Dimensions of UPVC Pipes:**

* Polyvinyl chloride (PVC) and its copolymers for use in contact with food stuffs, pharmaceuticals and drinking water

DIMENSION OF UPVC PIPES

<i>Nominal outside Diameter mm</i>	<i>Mean outside Diameter mm</i>	
	Min	Max
20	20.0	20.3
25	25.0	25.3
32	32.0	32.3
40	40.0	40.3
50	50.0	50.3
63	63.0	63.3
75	75.0	75.3
90	90.0	90.3
110	110.0	110.4
125	125.0	125.4
140	140.0	140.5
160	160.0	160.5
180	180.0	180.6
200	200.0	200.6
225	225.0	225.8
280	280.0	280.9
315	315.0	316.0
335	355.0	356.1
400	400.0	401.2
450	450.0	451.2
500	500.0	501.5
560	560.0	561.7
630	630.0	631.9

4.2 Dimensions of UPVC Plain End Pipe for Plumbing in Buildings

<i>Nominal Outside Diameter mm</i>	<i>Mean Outside Diameter, mm</i>	
	Min	Max
20	20.0	20.3
25	25.0	25.3
32	32.0	32.3
40	40.0	40.3
50	50.0	50.3

Note— For detailed dimensions including wall thickness of all classes of pipes and tolerances refer to 7 of the standard.

5. Physical and Chemical Characteristics

5.1 Visual Appearance: The colour of pipes shall be light grey. The internal and external surfaces of the pipes shall be smooth clean and free from grooving and other defects.

5.2 Opacity – Wall of the plain pipe shall not transmit more than 0.2 percent of the visible light falling on it.

5.3 Effect on Water — Pipes shall not have any detrimental effect on composition of water flowing through them. When tested toxic substances extracted from internal walls of the pipes shall not exceed the concentrations in the test solution as given in 10.3 of the standard.

5.4 Reversion Test — A length of pipe 200 ± 20 mm long shall not alter in length by more than 5 percent.

5.5 Vicat Softening Temperature — Shall not be less than 80°C .

5.6 Density—Shall be between 1.40 and 1.46 g/cm^3

5.7 Sulphated Ash content— Shall not exceed 11 percent.

6. Mechanical properties

6.1 Hydrostatic Characteristics—Shall not fail during the prescribed test duration.

6.2 Resistance to external blows at 0°C shall have a true impact rate of not more than 10 percent.

Note — For methods of measurements and tests, refer to IS 6307 : 1987 Rigid PVC sheets (*first revision*) relevant parts of IS 12235 : 1986. Methods of test for unplasticized PVC pipes for potable water supplies, IS 3360 (Part 3/ sec 1): 1995 Plastics Methods of testing, Part 3 Physical and dimensional properties, Section 1 Determination of density and relative density of non-cellular plastics

For detailed information, refer to IS 4985 : 2000 Specification for unplasticised PVC pipes for potable water supplies (third revision).

SUMMARY OF
IS 7834 : 1987 INJECTION MOULDED PVC SOCKET FITTINGS
WITH SOLVENT CEMENT JOINTS FOR WATER SUPPLIES
PART – 1 GENERAL REQUIREMENT
(First Revision)

1. Scope — General requirements regarding materials, manufacture, methods of test, inspection and marking of all types of injection moulded PVC socket fittings intended for connection, by using solvent cement, to PVC pipes covered by IS 4985 : 1988 [Specification for unplasticized PVC pipes for potable water supplies (second revision) for water supplies.

2. Materials — Shall substantially consist of polyvinyl chloride, to which may be added only those additives that are needed to facilitate the manufacture of sound pipe of good surface finish, mechanical strength and opacity.

3. Size of Fitting

3.1 Shall be designated by the diameters of their sockets. The inside diameters of the sockets of the fittings shall correspond to the outside diameters of the pipes given in IS 4985 : 2000*

4. Thickness — Minimum of 3 mm.

5. Socket Length and Diameter at Mid-Point of Socket Length.

5.1 Minimum socket length (L) of any fitting shall be $= 0.5 D + 6$ mm (subject to a minimum of 12 mm) where D is the nominal inside diameter of fittings.

* Unplasticized PVC pipes for potable water supplies (third revision).

TABLE 1 - SOCKET DIMENSIONS

Nominal Size	Minimum Socket Length	Mean Socket Internal Diameter at Mid-Point of Socket Length	
		Min	Max
(1)	(2)	(3)	(4)
16	14	16.1	16.3
20	16	20.1	20.3
25	19	25.1	25.3
32	22	32.1	32.3
40	26	40.1	40.3
50	31	50.1	50.3
63	38	63.1	63.3
75	44	75.1	75.3
90	51	90.1	90.3
110	61	110.1	110.4
125	69	125.1	125.4
140	76	140.1	140.5
160	86	160.2	160.5
180	96	180.2	180.5
200	106	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

5.2 *Out of Roundness Tolerances of Socket Inside Diameter* — Maximum tolerance (Maximum dia. minus Minimum dia) shall be

- a) less than or equal to $0.007 D$, or
- b) equal to 0.2 mm (if $0.007 D$ is less than 0.2 mm).

6. Tests for Performance Requirements

6.1 *Stress Relief Test* — Shall not show blisters, excessive delamination or cracking, or weldline splitting.

6.2 *Opacity* — Wall of fitting shall not transmit more than 0.2 percent of visible light falling on it.

6.3 Effect on Water — Shall not have any detrimental effect on composition of water flowing through them. Toxic substances extracted by water from internal walls of fitting shall not exceed the following :

Lead (first extraction)	1.0 mg/I
Lead (third extraction)	0.3 mg/I
Dialkyl tin C ₄ and higher	0.02 mg/I

homologues measured as tin (third extraction)
Other toxic substances (third extraction) 0.01 mg/I

6.4 Short Term Hydraulic Test — Fitting shall withstand a pressure of $4.2^{+0.2}_{-0}$ times the working pressure for one hour without failure.

Note— For methods of test to Appendices A to D the standard.

For detailed information, refer to IS 7834 (Part) : 1987 Specification for injection moulded PVC socket fittings with solvent cement joints for water supplies : Part 1 general specific requirements (first revision).

SUMMARY OF

**IS 7834 (PART 2) : 1987 INJECTION MOULDED PVC SOCKET
FITTINGS WITH SOLVENT CEMENT JOINTS FOR WATER
SUPPLIES PART 2 SPECIFIC REQUIREMENTS FOR 45° ELBOWS.**

(First Revision)

1. Scope —Requirements for manufacture, dimensions, tolerances and marking for 45° elbows made of injection moulded PVC for water supplies.

2. Requirements

2.1 Laying Length and tolerance thereon shall be as follows —

**TABLE 1 DIMENSIONS FOR LAYING
LENGTHS OF 45° ELBOWS**

<i>Size mm</i>	<i>45° Elbow Laying Length, mm</i>
16	4.5 ± 1
20	5 ± 1
25	6 + 1.2 – 1
32	7.5 + 1.6 – 1
40	9.5 + 2 – 1
50	11.5 + 2.5

63	– 1 14 + 3.2 – 1
75	16.5 + 4 – 1
90	19.5 + 5 – 1
110	23.5 + 6 – 1
125	27 + 6 – 1
140	30 + 7 – 1
160	34 + 8 – 1
180	38 + 8 – 1
200	43 + 9 – 1
225	48 + 10 – 1
250	53 + 11 – 1
280	60 + 12 – 1
315	67 + 13 – 1

2.2 The inside diameter of the socket and the socket length shall comply with those given in IS 7834 (Part 1) : 1987*.

*General requirements.

Note — For typical illustration, see Fig 1 of the standard.

For detailed information, refer to IS 7834 (Part 2) : 1987 Specification for injection moulded PVC socket fittings with solvent cement joints for water supplies : Part 2 Specific requirements for 45° elbows (first revision).

SUMMARY OF
IS 7834 (PART 3) : 1987 – INJECTION MOULDED PVC SOCKET
FITTINGS WITH SOLVENT CEMENT JOINTS FOR
WATER SUPPLIES
PART-3 SPECIFIC REQUIREMENTS FOR 90° ELBOWS
First Revision

1. Scope —Requirements for manufacture, dimensions, tolerances and marking for 90° elbows made of injections moulded PVC for water supplies.

2. Requirements

2.1 The laying length and the tolerances there on shall comply with those given in Table 1.

**TABLE 1 DIMENSIONS FOR LAYING
LENGTH OF 90° ELBOWS**

<i>Size</i> mm	<i>90° Elbow Laying Length,</i> mm
16	9 ± 1
20	11 ± 1
25	13.5 + 1.6 – 1
32	17 + 1.6 – 1
40	21 + 2 – 1
50	26 + 2.5 – 1
63	32.5 + 3.2 – 1
75	38.5 + 4 – 1
90	46 + 5 – 1
110	56 + 3 – 1
125	63.5 + 6 – 1
140	71 + 7 – 1
160	81 + 8 – 1
180	91 + 9 – 1
200	101 + 9 – 1
225	114 + 10 – 1
250	126 + 11 – 1
280	141 + 12 – 1
315	158 + 13 – 1

2.2 The inside diameter of the socket and the socket length shall comply with those given in IS 7834 (Part 1):1987.*

* General requirements

Note— For typical illustration of 90° elbow see Fig.1 of the standard.

For detailed information, refer to IS : 7834 (Part 3) : 1987 Specification for injection moulded PVC socket fittings with solvent cement joints for water supplies ; Part 3 – for 90° elbows (first revision).

SUMMARY OF
IS 7834 (PART 4) : 1987– INJECTION MOULDED PVC SOCKET
FITTINGS WITH SOLVENT CEMENT JOINTS FOR
WATER SUPPLIES
PART 4 SPECIFIC REQUIREMENTS FOR 90° TEES
(First Revision)

1. Scope – Requirements for manufacture, dimensions, tolerances and marking for 90° tee made of injection moulded PVC for water supplies.

2. Requirements

2.1 The laying length and tolerances there on shall comply with those given in Table 1.

TABLE 1 DIMENSIONS FOR LAYING LENGTH OF 90° TEES

Size mm	90° Elbow Laying Length, mm
16	9 ± 1
20	11 ± 1
25	$13.5 + 1.6$ – 1
32	$17 + 1.6$ – 1
40	$21 + 2$ – 1
50	$26 + 2.5$ – 1
63	$32.5 + 3.2$ – 1
75	$38.5 + 4$ – 1
90	$46 + 5$ – 1
110	$56 + 3$ – 1
125	$63.5 + 6$ – 1
140	$71 + 7$ – 1
160	$81 + 8$ – 1
180	$91 + 9$ – 1
200	$101 + 9$ – 1
225	$114 + 10$ – 1
250	$126 + 11$ – 1
280	$141 + 12$ – 1
315	$158.5 + 13$ – 1

2.2 The inside diameter of the socket and the socket length shall comply with those given in IS 7834 (Part 1):1987.*

* General requirements

Note — For typical illustration of 90° Tees see Fig.1 of the standard.

For detailed information, refer to IS : 7834 (Part 4) : 1987 Specification for injection moulded PVC socket fittings with solvent cement joints for water supplies : Part 4 Specific requirements for 90° tees. (first revision).

SUMMARY OF

**IS 7834 (PART 5) : 1987 – INJECTION MOULDED PVC SOCKET
FITTINGS WITH SOLVENT CEMENT JOINTS FOR WATER
SUPPLIES PART – 5 SPECIFIC REQUIREMENTS FOR 45° TEES.**

(First Revision)

1. Scope—Requirements for manufacture, dimensions, tolerances and marking for 45° tees made of injections moulded PVC for water supplies.

2. Requirements

2.1 The laying length Z and Z_1 and the tolerance there on shall be as per Table 1.

2.2 The inside diameter of the socket and the socket length shall comply with those given in IS 7834 (PART 1):1987.*

* General requirements

**TABLE 1 DIMENSIONS FOR LAYING LENGTH
OF 45° TEES**

Size mm	45° Elbow Laying Length, mm	
	Z mm	Z_1 mm
	16	— —
20	27 ± 3	6 ± 2 — 1
25	33 ± 3	7 ± 2 — 1
32	42 ± 4	8 ± 2 — 1
40	51 ± 5	10 ± 2 — 1
50	63 ± 6	12 ± 2 — 1
63	79 ± 7	14 ± 2 — 1
75	94 ± 9	17 ± 2 — 1
90	112 ± 11	20 ± 3 — 1
110	137 ± 13	24 ± 3 — 1
125	157 ± 15	27 ± 3 — 1
140	175 ± 17	30 ± 4 — 1
160	200 ± 20	35 ± 4 — 1
	— 6	— 1

Note— For typical illustration of 45° Tees and symbols Z and Z_1 see Fig.1 of the standard

For detailed information, refer to IS : 7834 (Part 5) : 1987 Specification for Injection moulded PVC socket fittings with solvent cement joints for water supplies : Part 5 Specific requirements for 45° tees. (first revision).

SUMMARY OF

**IS 7834 (PART6) : 1987 INJECTION MOULDING PVC SOCKET FITTINGS
WITH SOLVENT CEMENT JOINTS FOR WATER SUPPLIES
PART 6 SPECIFIC REQUIREMENTS FOR SOCKETS
(First Revision)**

1. Scope — Requirements for manufacture, dimensions, tolerances and marking for sockets made of injections moulded PVC for water supplies.	75	4 + 2
	90	– 1
2. Requirements	110	5 + 2
	125	– 1
2.1 The laying length <i>Z</i> and tolerances thereon shall comply with those given in Table 1.	140	6 + 3
	160	– 1
TABLE 1 DIMENSIONS FOR LAYING LENGTH OF SOCKET	180	6 + 3
	200	– 1
<i>Size</i> <i>mm</i>	225	8 + 3
	250	– 1
16	3 ± 1	8 + 4
20	3 ± 1	– 1
25	3 + 1.6	10 + 5
	– 1	– 1
32	3 + 1.6	10 + 6
	– 1	– 1
40	3 + 2	12 + 6
	– 1	– 1
50	3 + 2	12 + 7
	– 1	– 1
63	3 + 2	
	– 1	

2.2 The inside diameter of the socket, the socket length and the tolerance thereon shall comply with those given in IS 7834 (Part 1) : 1987*.

* General requirements

Note – For typical illustration of socket and *Z* see fig. 1 of the standard.

For detailed information, refer to IS 7834 (Part 6) : 1987 Specification for Injection moulded PVC socket fittings with solvent cement joints for water supplies : Part 6 Specific requirements for sockets (first revision).

SUMMARY OF

**IS 7834 (PART 7) : 1987 INJECTION MOULDED PVC SOCKET
FITTINGS WITH SOLVENT CEMENT JOINTS FOR WATER SUPPLIES
PART 7 SPECIFIC REQUIREMENTS FOR UNIONS.**

(First Revision)

1. Scope—Requirements for manufacture, dimensions, tolerances and marking for union made of injections moulded PVC for water supplies.

2.2 The inside diameter of the socket and the length shall comply with those given in IS 7834 (Part 1):1987*

2. Requirements

* General requirements

2.1 The laying length Z and tolerances there on shall comply with those given in Table 1.

**TABLE 1 DIMENSIONS FOR LAYING LENGTH
OF UNION**

<i>Size mm</i>	<i>Socket Elbow Laying Length mm</i>
16	13.5 ± 1
20	13.5 ± 1
25	13.5 ± 1.2 – 1
32	13.5 + 1.6 – 1
40	15+ 2 – 1
50	17 + 2.5 – 1
63	21±3.2 – 1

Note— For typical illustration of unions, see fig. 1 of the standard

For detailed information, refer to IS 7834 (Part 7) : 1987 Specification for injection moulded PVC socket fittings with solvent cement joints for water supplies ; Part 7 Specific requirements for unions (first revision).

SUMMARY OF

**IS 7834 (PART 8):1987 - INJECTION MOULDED PVC SOCKET
FITTINGS WITH SOLVENT CEMENT JOINTS FOR WATER SUPPLIES
PART 8 SPECIFIC REQUIREMENTS FOR CAPS**

(First Revision)

1. Scope — Requirements for manufacture, dimensions, tolerances and marking for caps made of injections moulded PVC for water supplies.

2. Requirements — The diameter of the socket of cap shall be as follows: 16, 20, 25, 32, 40, 50, 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280 or 315 mm.

Note— For General requirements, refer to IS 7834 (Part 1) 1987.

For detailed information, refer to IS 7834 (Part 8) : 1987 Specification for injection moulded PVC socket fittings with solvent cement joints for water supplies: Part 8 Specific requirements for caps (first revision).

SUMMARY OF

**IS 8008 (PART 1) : 2003 INJECTION MOULDED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 1 GENERAL REQUIREMENTS FOR FITTINGS**

(First Revision)

1. Scope — General requirements for materials, manufacture, methods of test and inspection and marking of all types of injection moulded HDPE pipes covered by IS 4984:1995* for potable water supplies.	Size, mm	Weld Length, mm
	20	3
	25	4
	32	5
2. Composition — The fitting shall be made from a compared consisting of origin poly ethylen grades of fibric PE 63/ PE 80/ PE 100, whichever is applicable.	40	6
	50	8
	63	10
	75	12
3. Sizes and Dimensions of Fittings — Sizes of fittings shall be designated by their outside diameters at free ends, which shall correspond to outside diameters of pipes given in IS 4984 :1995. Out side diameters and corresponding wall thickness of fittings at free ends for weld shall comply with those given in IS 4984 :1995	90	14
	110	15
4. Weld Length — A minimum weld length of 15 mm is specified to make provision for revelding and to avoid wastage of whole fitting due to shortage of weld length.		
5. Performance Requirements		
5.1 Hydraulic Characteristic — There shall be no signs of localised swelling, leakage or weeping.		
5.2 Sanduich Flange Hydraulic Testing — Sanduich hange shall be tested on per 9.1 of the standard.		
5.2 Ovality —Shall conform to Table 2 of IS 4984 : 1995		

*High density polyethylene pipes for potable water supply (*fourth revision*)

Note – For test procedures refer to annex. B and C of IS 4984:1995.

For detailed information, refer to IS: 8008(Part I):2003. Specification for injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part I General requirements.

SUMMARY OF

**IS 8008 (PART 2) : 2003 INJECTION MOULDED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 2 SPECIFIC REQUIREMENTS FOR 90° BENDS
(First Revision)**

1. Scope —Requirements for manufacture, dimensions and tolerances, and marking for injection moulded andh macined HOPE 90° bends for portable water supplies.	50	70 ± 2
	63	80 ± 2
	75	90 ± 2
	90	110 ± 2
	110	140 ± 3
2. Requirements	125	140 ± 3
	140	150 ± 3
	160	170 ± 3
2.1 <i>Laying lengths and tolerances thereon shall be as follows :</i>		

<i>Nominal Diameter</i>	<i>Laying Length</i>
mm	mm
20	35 ± 1
25	40 ± 2
32	50 ± 2
40	60 ± 2

Note — for typical illustration of 90° bend see Fig. 1 of the standard.

2.2 Outside diameters and wall thicknesses at ends for welding shall comply ith the requirements given in IS 8008 (Part I) : 2003.

Note — For general requirements regarding material, manufacture, methods of test, etc, refer to IS 8008 (Part 1) : 2003 injection moulded high density polyethylene (HDPE) fittings for potable water supplies: Part I general requirements, for fittings.

For detailed information, refer to IS 8008 (Part 2):2003. Specification for injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part 2 Specific requirements for 90° bends (first revision)

SUMMARY OF

**IS 8008 (PART 3) : 2003 INJECTION MOULDED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 3 SPECIFIC REQUIREMENTS FOR 90° TEES
(First Revision)**

1. Scope — Requirements for manufacture, dimensions and tolerances, and marking for injection moulded and machined HDPE 90° tees for portable water supplies.	40	63 ± 2
	50	75 ± 2
	63	80 ± 2
	75	88 ± 2
	90	98.5 ± 2
2. Requirements	110	122.5 ± 3
	125	135 ± 3
	140	145 ± 3
2.1 Overall laying lengths and tolerances thereon shall be as follows :	160	157 ± 3

<i>Nominal Diameter</i> mm	<i>Laying Length</i> mm	Note — For typical illustration of 90° tee see Fig.1 of the standard.
20	36.5 ± 1	2.2 Outside diameter and wall thickness at ends for welding shall be in accordance with IS 8008 (Part 1) : 2003.
25	39 ± 1	
32	46 ± 1	

Note — For general requirements, regarding material, manufacture, methods of test, etc. refer to IS 8008 (Part 1) : 2003. Injection moulded high density polyethylene (HDPE) fittings for potable water supplies : PART 1 General requirements for fittings.

For detailed information, refer to IS 8008 (Part 3) : 2003 Specification for injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part 3 specific requirements for 90° tees.

SUMMARY OF

**IS 8008 (PART 4) : 2003 INJECTION MOULDED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 4 SPECIFIC REQUIREMENTS FOR REDUCERS
(First Revision)**

1. Scope — Requirements for manufacture, dimensions and tolerances, and marking for injection moulded and machined HDPE reducers for potable water supplies.	<i>Size</i> mm	<i>Bends Laying Length</i> mm
	32 × 63	70 ± 1
2. Requirements	63 × 75	70 ± 1
	63 × 90	80 ± 1
2.1 Two different diameters at either end shall be concentric.	75 × 90	80 ± 1
	90 × 110	95 ± 1
2.2 Overall laying length and the tolerance thereon shall be as follows:	110 × 160	125 ± 1
	160 × 225	165 ± 1

Note — For typical illustration of reducer see Fig.1 of the standard.

2.3 Outside diameter and wall thickness at ends for welding shall be in accordance with IS 8008 (Part 1) : 2003.

Note — For general requirements regarding material, manufacture, methods of test, etc, refer to IS 8008 (Part-1):2003. Injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part 1 General requirements for fifths.

For detailed information, refer to IS 8008 (Part 4) :2003 Specification for injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part 4 specific requirements for reducers (first revision).

SUMMARY OF

**IS 8008 (PART 5) : 2003 INJECTION MOULDED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 5 SPECIFIC REQUIREMENTS FOR FERRULE REDUCERS**

(First Revision)

1. Scope —Requirements for manufacture, dimensions and tolerances, and marking, for injection moulded made of HDPE ferrule reducers for potable water supplies.	<i>Size</i> mm	<i>Bends Laying Length</i> mm
	32 × 63	48
2. Requirements	90 × 63	74.3
	110 × 63	89.4
2.1 Overall laying lengths and the tolerances thereon shall be as follows :	150 × 63	98.5
	225 × 63	102.8

Note — For typical illustration of ferrule reducer see Fig.1 of the standard.

2.2 Outside diameter and wall thickness of straight pipe portion at reducer end shall comply with the requirements given in IS 8008 (Part 1) : 2003.

Note — For general requirements regarding material, manufacture, methods of test, etc, refer to IS: 8008 (Part1): 2003 Injection moulded high density polyethylene (HDPE) fittings for portable water supplies : Part 1 general requirements, for fittings

For detailed information, refer to IS 8008 (Part 5) : 2003. Specification for injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part 5 Specific requirements for ferrule reducers.

SUMMARY OF

**IS 8008 (PART 6) : 2003 INJECTION MOULDED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 6 SPECIFIC REQUIREMENTS FOR PIPE ENDS**

(First Revision)

1. Scope

1.1 Requirements for manufacture, dimensions and tolerances, and marking for injection moulded and machined HDPE pipe ends for potable water supplies.

2. Dimensions and Tolerances

2.1 Overall dimensions and tolerances there on shall be as follows :

Table 1 Dimensions for Injection and Machined Pipe Ends

Sl. No.	Nominal Diameter	Diameter for Manufacturing	Collar Diameter	PN6			PN 10		
				Laying Length Z	Collar Height H	Welding Length L	Laying Length Z	Collar Height H	Welding Length L
	D	D ₃	D ₄	(5)	(6)	(7)	(8)	(9)	(10)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	20	28	47	50	—	—	50	7	28
ii)	25	34	57	50	9	28	50	9	27
iii)	32	40	67	50	10	27	50	10	27
iv)	40	49	78	50	11	24	50	11	24
v)	50	60	88	50	12	23	50	12	23
vi)	63	72	103	50	14	16	50	14	16
vii)	75	84	123	50	16	14	50	16	14
viii)	90	99	138	80	17	43	80	17	43
ix)	110	119	158	80	18	37	80	18	17
x)	125	134	188	80	18	42	80	25	35
xi)	140	150	188	80	18	34	80	25	27
xii)	160	170	214	80	18	34	80	25	27
xiii)	180	190	214	80	20	30	80	30	20
xiv)	200	210	269	100	24	36	100	32	28
xv)	225	235	269	100	24	46	100	32	38
xvi)	250	261	320	100	25	35	100	35	35
xvii)	280	291	320	100	25	45	100	35	35
xviii)	315	327	370	100	25	35	100	35	35
xix)	355	373	430	120	30	50	120	40	40
xx)	400	427	482	120	33	42	120	46	29
xxi)	450	514	585	120	46	14	130	60	10
xxii)	500	530	585	120	46	24	120	60	10
xxiii)	560	615	685	120	50	10	130	60	10
xxiv)	630	642	685	120	50	30	120	60	20
xxv)	710	737	800	120	50	20	120	—	—
xxvi)	800	840	905	120	52	18	120	—	—
xxvii)	900	944	1 005	120	55	15	120	—	—
xxviii)	1 000	1 047	1 110	140	60	10	140	—	—

Note 1 — For typical illustration of pipe end see Fig.1 of the standard.

Note 2 — Outside diameter and wall thickness of the end to be welded to pipe shall comply with the requirements given in IS 8008 (Part 1) : 2003.

Note — For general requirements regarding material, manufacture, methods of test, etc, refer to IS 8008 (Part 1) : 2003. Injection moulded high density polyethylene (HDPE) fittings for portable water supplies : Part 1 General requirements for fittings

For detailed information, refer to IS 8008 (Part 6) : 2003 Specification for injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part 6 Specific requirements for pipe ends.

SUMMARY OF

**IS 8008 (PART 7) : 2003 INJECTION MOULDED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 7 SPECIFIC REQUIREMENTS FOR SANDWICH FLANGES**

(First Revision)

1. Scope—Requirements for manufacture, dimensions and tolerances, and marking for injection moulded and machine moulded HDPE sandwich flanges

2. Dimensions and Tolerances

2.1 Overall dimensions of sandwich flanges and tolerances thereon shall be as follows :

TABLE 1 DIMENSIONS OF SANDWICH FLANGES

Sl. No.	Nominal Flange size	Pipe Outside Diameter	Inside Diameter	Pitch Circle Diameter	Outside Diameter	Thickness of Flange	Thickness of Mild	Diameter of Hole	Number of Hole
			D	D ₃	D ₄	Z	T	d	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	15	20	32	65	95	20	6 ± 0.3	14	4
ii)	20	25	38	75	105	20	6 ± 0.3	14	4
iii)	25	32	44	85	115	20	6 ± 0.3	14	4
iv)	32	40	53	100	140	20	6±0.3	18	4
v)	40	50	64	110	150	20	6±0.3	18	4
vi)	50	63	76	125	165	20	6±0.3	18	4
vii)	65	75	88	145	185	20	6±0.3	18	4
viii)	80	90	103	160	200	20	9±0.5	18	8
ix)	100	110	123	180	220	20	9±0.5	18	8
x)	100	125	138	210	250	20	9±0.5	18	8
xi)	125	140	154	210	250	20	9±0.5	18	8
xii)	150	160	174	240	285	20	9±0.5	22	8
xiii)	200	180	194	240	285	20	9±0.5	22	8
xiv)	200	200	214	295	340	25	12±0.5	22	8
xv)	200	225	239	295	340	25	12±0.5	22	8
xvi)	250	250	265	350	395	30	16±0.5	22	12
xvii)	250	280	295	350	395	30	16±0.5	22	12
xviii)	300	315	331	400	445	30	19±0.5	22	12
xix)	350	355	376	460	505	30	19±0.5	22	16
xx)	400	400	430	515	565	35	22±0.5	26	16
xxi)	500	450	517	620	670	35	22±0.5	26	26
xxii)	500	500	533	620	670	35	22±0.5	26	20
xxiii)	600	560	618	725	780	35	22 ±0.5	30	20
xxiv)	600	630	645	725	780	35	22±0.5	30	24

Note – Tolerance on various dimensions are given below:

1	2
<i>Dimensions</i>	<i>Tolerance</i>
Inside Diameter, D ₁	± 1mm
Pitch circle diameter, D ₂	± 1mm
Outside diameter, D ₃	± 1mm
Thickness of flange, Z	± 1mm

Note — For general requirements regarding material, manufacture, methods of test, etc., refer to IS 8008 (Part I) : 2003 Injection moulded high density polyethylene (HDPE) fittings for potable water supplies : Part 1 General requirements, for fittings.

For detailed information, refer to IS 8008 (Part 7) : 2003 Specification for injection moulded high density polyethylene (HDPE) fittings for portable water supplies : Part 7 Specific requirements for sandwich flanges.

SUMMARY OF
**IS 8360 (PART 1) : 1977 FABRICATED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE
WATER SUPPLIES**
PART 1 GENERAL REQUIREMENTS

1. Scope — General requirements for material, sizes, performance requirements, sampling and marking of all types of fabricated HDPE fittings intended for connection to HDPE pipes covered by IS 4984 : 1995* for potable water supplies.

2. Material

2.1 Pipes used for the fabrication of HDPE fittings for potable water supplies shall conform to IS 4984 : 1995.

3. Sizes and Dimensions of Fittings

3.1 Sizes of fittings shall be designated by their outside diameters at the free end, which shall correspond to

outside diameters of pipes given in IS 4984 : 1995. Outside diameters and corresponding wall thickness of fittings at free ends for weld shall comply with those given in Table 1 of IS 4984 : 1995

4. Performance Requirements

4.1 Hydraulic Proof Test — Fitting duly plugged, when subjected to a hydraulic proof test of twice the recommended working pressure at ambient temperature and for a period of 1 hour shall not show any sign of localized swelling, leakage or creeping, and shall not burst.

* Injection moulded high density polyethylene pipes for potable water supplies, sewage and industrial effluents (*fourth revision*)

For detailed information, refer to IS 8360 (Part I) : 1977 Specification for fabricated high density polyethylene (HDPE) fittings for potable water supplies : Part 1 General requirements.

SUMMARY OF

**IS 8360 (PART 2) : 1977 FABRICATED HIGH DENSITY
POLYETHYLENE (HDPE) FITTINGS FOR POTABLE WATER
SUPPLIES PART 2 SPECIFIC REQUIREMENTS FOR 90° TEES**

1. Scope—Requirements for manufacture, dimensions and tolerances and marking for fabricated HDPE 90° tees for potable water supplies.

2. Requirements

2.1 *Laying lengths and tolerances thereon shall be as follows :*

Size mm	Overall Laying Length mm
20	50 ± 2
25	62.5 ± 2
32	80 ± 2
40	80 ± 2
50	90 ± 2
63	94.5 ± 4
75	112.5 ± 4
90	135 ± 4
110	165 ± 4
125	181.5 ± 4
140	210 ± 6
160	240 ± 6
180	270 ± 6
200	300 ± 6
225	337.5 ± 8
250	375.5 ± 8
280	420 ± 8
315	472.5 ± 8
355	532.5 ± 10
400	600 ± 10
450	675 ± 10
500	750 ± 10

Note— For typical illustration of 90° fabricated tee see Fig. 1 of the standard.

2.2 Outside diameters and wall thickness of pipes out of which 90° tees are fabricated shall comply with those given in IS 8360 (Part 1) : 1977. Wall thickness of a fabricated 90° tee shall not be less than that of the pipe to which it is to be welded.

Note—For general requirements regarding material, sizes, method of test and sampling refer to IS 8360 (Part 1) : 1977 Fabricated high density polyethylene (HDPE) fittings for potable water supplies : Part 1 General requirements.

For detailed information, refer to IS 8360 (Part 2):1977 Specification for fabricated high density polyethylene (HDPE) fittings for potable water supplies : Part 2 specific requirements for 90° tees.

SUMMARY OF

**IS 8360 (PART 3) : 1977 FABRICATED HIGH DENSITY POLYETHYLENE
(HDPE) FITTINGS FOR POTABLE WATER SUPPLIES
PART 3 SPECIFIC REQUIREMENTS FOR 90° BENDS**

1. Scope

1.1 Requirements for manufacture, dimensions and tolerances and marking for fabricated HDPE 90° bends for potable water supplies.

2. Requirements

2.1 Laying lengths and tolerances thereon shall be as follows —

<i>Size mm</i>	<i>Overall Laying Length mm</i>
20	100 ± 3
25	100 ± 3
30	100 ± 3
40	100 ± 3
50	100 ± 3
63	108 ± 5
75	128 ± 5
90	154 ± 5
110	188 ± 5
125	213 ± 5
140	239 ± 8
160	273 ± 8
180	307 ± 8
200	341 ± 8
225	384 ± 10
250	427 ± 10
280	478 ± 10
315	538 ± 10
355	606 ± 10
400	683 ± 10
450	769 ± 10
500	855 ± 10

Note — For typical illustration of 90° fabricated bend see Fig.1 of the standard.

2.2 Outside diameters and wall thicknesses of pipes out of which 90° bends are fabricated shall comply with those given in IS 8360 (Part 1) : 1977. Wall thickness of fabricated bend shall not be less than that of the pipe to which it is to be less than that of the pipe to which it is to be welded.

Note—For general requirements regarding material, sizes, methods of test and sampling refer to IS : 8360 (Part 1) :1977. Fabricated high density polyethylene (HDPE) fittings for potable water supplies : Part 1 General Requirements.

For detailed information, refer to IS 8360 (Part 3) :1977. Specification for fabricated high density polyethylene (HDPE) fittings for potable water supplies : Part 3 Specific requirements for 90° bends.

SUMMARY OF
IS 10124 (PART 1) : 1988 FABRICATED PVC FITTINGS FOR
POTABLE WATER SUPPLIES
PART 1 GENERAL REQUIREMENTS
(First Revision)

1. Scope — General requirements for materials, sizes methods of test and inspection, and marking of all types of fabricated PVC fittings for jointing with solvent cement to the PVC pipes covered in IS 4985 : 1988 for portable water supplies. This specification covers the sizes of fittings from 63 to 315 mm.

2. Material — The pipes used for the fabrication of PVC fittings for portable water supplies shall conform to IS 4985 : 2000*

3. Size of Fitting — The size of fittings shall be designated by the nominal diameters of the pipe given in IS 4985 : 2000 with which they are to be used.

4. Socket Length and Diameter at Mid-Point of Socket Length

4.1 Minimum socket length 'L' of any fitting shall be given by $L=0.5D + 6$ mm where D is the nominal inside diameter of the fitting. The minimum socket lengths based on the above formula for different socket diameters are given in Table 1.

4.2 Out-of-Roundness Tolerances of Socket Inside Diameter: the maximum of out-of-roundness tolerances (maximum diameter-minimum diameter) shall be :

a) Equal to 0.007 D, or

b) Equal to 0.2 mm (if 0.007D is less than 0.2 mm),

Note— Out of roundness tolerances of socket inside diameter shall not apply to fittings of nominal pressure rating 0.25 MPa (Class1), 0.4 MPa

5. Tests and performance requirements

5.1 Opacity — The wall of the fitting shall not transmit more than 0.2 percent of the visible light falling on it.

* Unplasticized PVC pipes for potable water supplies (third revision)

5.2 Short term Hydraulic Test — The fittings shall withstand a pressure of 4.2 ± 0.2 times the working pressure for one hour without failure

TABLE 1. SOCKET DIMENSIONS

All dimensions in millimetres			
Nominal Size	Minimum Socket Length	Mean Socket Diameter of Socket Min	Internal at Mid-Point Length Max
(1)	(2)	(3)	(4)
16	14.0	16.1	16.3
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 methods of tests, refer to Appendices A and B of the standard.

For detailed information, refer to, IS 10124 (Part 1) 1988 Specification for fabricated PVC fittings for potable water supplies: Part 1 General requirements (first revision).

SUMMARY OF
**IS 10124 (PART2) : 1988 FABRICATED PVC FITTINGS FOR
 POTABLE WATER SUPPLIES**
PART 2 SPECIFIC REQUIREMENTS FOR SOCKETS
(First Revision)

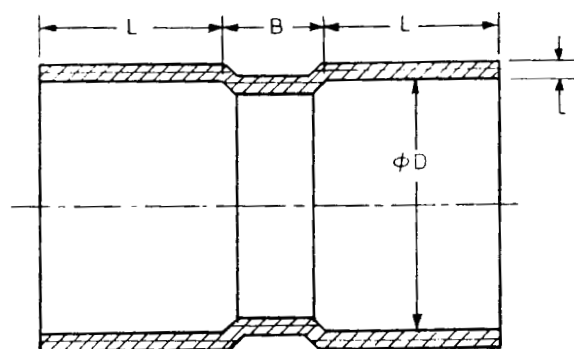
1. Scope — Requirements for manufacture, dimensions and marking for fabricated PVC sockets for potable water supplies.

2. Requirements — The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions — See Table 1

4. Marking — The socket shall be marked in colour as indicated below for different classes of fittings :

<i>Class of Fitting</i>	<i>Colour</i>
Class 1 (0.25 MPa)	Red
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow



Note—This figure is only intended to define the terms used in Table 1 and is not intended to illustrate specific design features.

FIG. 1 SOCKET

TABLE 1 ALL DIMENSIONS IN MILLIMETRES

Size	<i>B</i> Min	Minimum wall thickness (<i>t</i>) For Working Pressure			
		0.25 MPa Class 1	0.4 MPa Class 2	0.6 MPa Class 3	1.0 MPa Class 4
(1)	(2)	(3)	(4)	(5)	(6)
63	20	—	1.4	2.0	3.2
75	20	—	1.7	2.4	3.8
90	35	1.2	1.9	2.8	4.5
110	35	1.5	2.3	3.4	5.5
125	35	1.7	2.7	3.9	6.3
140	45	1.8	2.9	4.4	7.0
160	45	2.1	3.4	4.9	8.0
180	45	2.4	3.8	5.5	9.0
200	45	2.7	4.2	6.2	10.0
225	55	3.0	4.7	6.9	11.2
250	55	3.3	5.2	7.7	12.5
280	55	3.7	5.8	8.6	13.9
315	55	4.2	6.5	9.7	15.6
355	65	4.6	7.3	10.8	17.7
400	65	5.3	8.2	12.2	19.8
450	65	5.9	9.3	13.7	22.4
500	65	6.5	10.3	15.3	24.8
560	75	7.3	11.6	17.2	27.8
630	75	8.2	13.0	19.2	31.3

For detailed information, refer to IS 10124 (Part 2):1998 Specification for fabricated PVC fittings for potable water supplies Part 2 Specific requirements for sockets (first revision)

SUMMARY OF

**IS 10124 (PART 3) : 1988 FABRICATED PVC FITTINGS FOR
PORTABLE WATER SUPPLIES**

PART 3 SPECIFIC REQUIREMENTS FOR STRAIGHT REDUCER

(First Revision)

1. Scope—Requirements of manufacture, dimensions and marking for fabricated PVC straight reducers for portable water supplies.

2. Requirements — The general requirements for material, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions — See Table 1

4. Marking —The straight reducers shall be marked in colour as indicated below for different classes of fittings

Class of Fitting	Colour
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

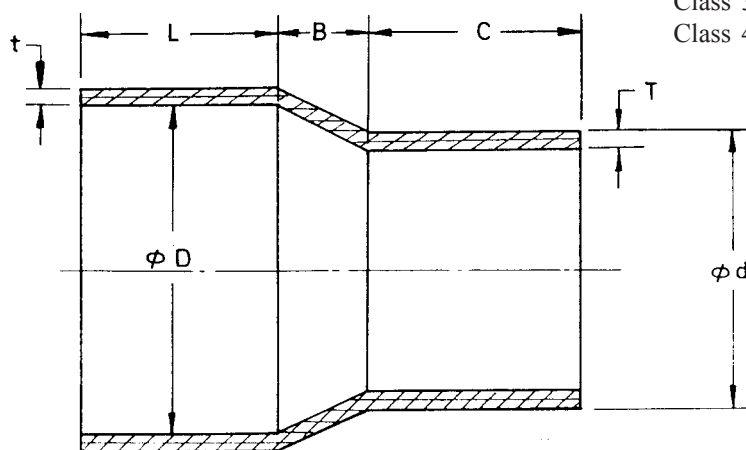


FIG. 1 STRAIGHT REDUCER

D—Mean socket internal diameter at mid-point of socket length as specified in IS 10124 (Part 1) : 1988*.

d—mean outside diameter of a spigot portion, that is mean outside diameter of pipe used for making reducer.

L—minimum socket length in accordance with IS 10124 (Part 1) : 1988*.

C—minimum length of spigot portion (plain end) calculated from $0.5 d_{nom} + 10\text{mm}$ where d_{nom} is nominal outside diameter of pipe from which the reducer is fabricated.

T—minimum wall thickness of spigot portion (corresponds to minimum wall thickness of pipe of the same nominal size as that of the socket and the corresponding pressure class).

t—minimum wall thickness of socket portion calculated on the basis of 90 percent of the minimum wall thickness at spigot portion rounded off to the next higher 0.1 mm.

Note—This figure is only intended to define the terms used in Table 1 and is not intended to illustrate specific design features.

* Specification for fabricated PVC fittings for potable water supplies.

TABLE 1 DIMENSIONS OF STRAIGHT REDUCERS

All dimensions in millimetres										
Size	<i>d</i>		<i>B</i> <i>Min</i>	<i>C</i> <i>Min</i>	Minimum Wall Thickness (<i>t</i>) For Working Pressure					
	<i>Min</i>	<i>Max</i>			0.4 MPa (Class 2)		0.6 MPa (Class 3)		1.0 MPa (Class 4)	
					<i>T</i>	<i>t</i>	<i>T</i>	<i>t</i>	<i>T</i>	<i>t</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
20-15	16.0	16.3	10	18	—	—	—	—	1.1	1.0
25-20	20.0	20.3	10	20	—	—	—	—	1.1	1.0
32-25	25.0	25.3	10	23	—	—	—	—	1.4	1.3
40-32	32.0	32.3	10	26	—	—	—	—	1.8	1.6
50-40	40.0	40.3	15	30	—	—	1.4	1.3	2.2	2.0
63-50	50.0	50.3	15	35	—	—	1.7	1.5	2.8	2.5
75-63	63.0	63.3	20	42	1.5	1.4	2.2	2.0	3.5	3.2
90-75	75.0	75.3	35	48	1.8	1.7	2.6	2.4	4.2	3.8
110-90	90.0	90.3	35	55	2.1	1.9	3.1	2.8	5.0	4.5
125-110	110.0	110.4	35	65	2.5	2.3	3.7	3.4	6.1	5.5
140-125	125.0	125.4	45	73	2.9	2.7	4.3	3.9	6.9	6.3
160-140	140.0	140.5	45	80	3.2	2.9	4.8	4.4	7.7	7.0
180-160	160.0	160.5	45	90	3.7	3.4	5.4	4.9	8.8	8.0
200-180	180.0	180.6	45	100	4.2	3.8	6.1	5.5	9.9	9.0
225-200	200.0	200.6	55	110	4.6	4.2	6.8	6.2	11.0	10.0
250-225	225.0	225.7	55	123	5.2	4.7	7.6	6.9	12.4	11.2
280-250	250.0	250.8	55	135	5.7	5.2	8.5	7.7	13.8	12.5
315-280	280.0	280.9	55	150	6.4	5.8	9.5	8.6	15.4	13.9
355-315	315.0	316.0	65	168	7.2	6.5	10.7	9.7	17.3	15.6
400-355	355.0	356.1	65	188	8.1	7.3	12.0	10.8	19.6	17.7
450-400	400.0	401.2	65	210	9.1	8.2	13.5	12.2	22.0	19.8
500-450	450.0	451.4	65	235	10.3	9.3	15.2	13.7	24.8	22.4
560-500	500.0	501.5	75	260	11.4	10.3	16.9	15.5	27.5	24.8
630-560	560.0	561.7	75	290	12.8	11.6	18.9	17.2	30.8	27.8

For detailed information, refer to IS 10124(Part 3): 1988 Specification for Fabricated PVC fittings for potable water supplies: Part 3 Specific requirements for straight reducers (first revision).

SUMMARY OF
IS 10124 (PART 4) : 1988 FABRICATED PVC FITTINGS FOR
POTABLE WATER SUPPLIES
PART 4 SPECIFIC REQUIREMENTS FOR CAPS
(First Revision)

1. Scope—Requirements of manufacture, dimensions and marking for fabricated PVC caps for potable water supplies.

2. Requirements—The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions—See Table 1

4. Marking—The cap shall be marked in colour as indicated below for different class of fittings—

<i>Class of Fitting</i>	<i>Colour</i>
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

**TABLE 1 DIMENSIONS FOR CAPS ALL
DIMENSIONS IN MILLIMETRES**

<i>Size</i>	<i>Minimum Wall Thickness (t) For Working Pressures</i>	
	<i>0.6 MPa (Class 3)</i>	<i>1.0 MPa (Class 4)</i>
(1)	(2)	(3)
63	2.0	3.2
75	2.4	3.8
90	2.8	4.5
110	3.4	5.5
125	3.9	6.3
140	4.4	7.0
160	4.9	8.0
180	5.5	9.0
200	6.2	10.0
225	6.9	11.2
250	7.7	12.5
280	8.6	13.9
315	9.7	15.6
355	10.8	17.7
400	12.2	19.8
450	13.7	22.4
500	15.3	24.8
560	17.2	27.8
630	19.2	31.3

Note — For pipes of 0.25 MPa and 0.4 MPa pressure class, there are no caps and for these, the caps designed for 0.6 MPa working pressure may be used.

For detailed information, refer to IS 10124 (Part 4) : 1988 Specification for fabricated PVC fittings for potable water supplies: Part 4 Specific requirements for caps (first revision).

SUMMARY OF
IS 10124 (PART 5) : 1988 FABRICATED PVC FITTINGS FOR
PORTABLE WATER SUPPLIES
PART 5 SPECIFIC REQUIREMENT FOR EQUAL TEES
(First Revision)

1. Scope—Requirements of manufacture, dimensions and marking for fabricated PVC tees for potable water supplies.

2. Requirements—The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1): 1988.

3. Dimensions—See Table 1

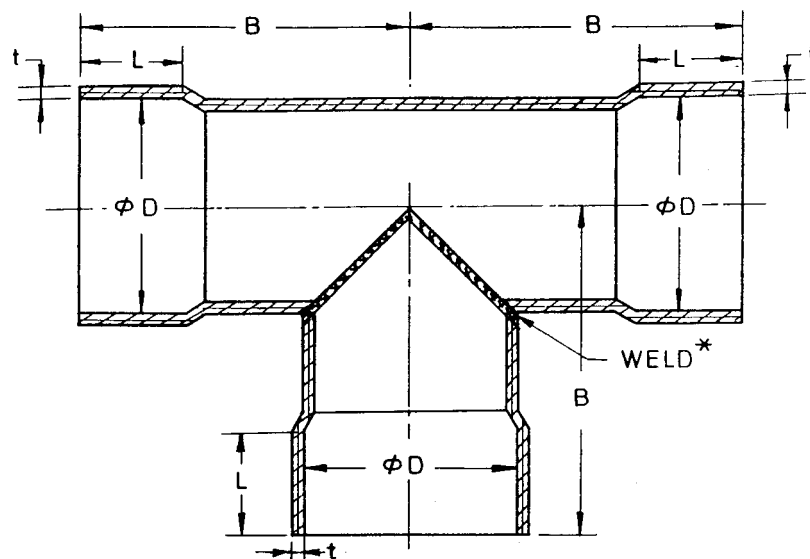
4. Marking—The equal tee shall be marked in colour as indicated below for different class of fittings:

Class of Fitting	Colour
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

TABLE 1 DIMENSION OF EQUAL TEES ALL DIMENSIONS IN MILLIMETRES

Size	<i>B</i> <i>Min</i>	<i>Minimum Wall Thickness (t) For Working Pressures</i>		
		0.4 MPa (Class 2)	0.6 MPa (Class 3)	1.0 MPa (Class 4)
(1)	(2)	(3)	(4)	(5)
63	98	1.4	2.0	3.2
75	115	1.7	2.4	3.8
90	137	1.9	2.8	4.5
110	166	2.3	3.4	5.5
125	188	2.7	3.9	6.3
140	209	2.9	4.4	7.0
160	238	3.4	4.9	8.0
180	267	3.8	5.5	9.0
200	296	4.2	6.2	10.0
225	333	4.7	6.9	11.2
250	369	5.2	7.7	12.5
280	412	5.8	8.6	13.9
315	463	6.5	9.7	15.6
355	521	7.3	10.8	17.7
400	586	8.2	12.2	19.8
450	659	9.3	13.7	22.4
500	731	10.3	15.3	24.8
560	818	11.6	17.2	27.8
630	920	13.0	19.2	31.3

Note — For pipes of 0.25 MPa pressure class, there are no equal tees for these, equal tees designed for 0.4 MPa may be used.



* PVC welded by solvent or welding rod and with fibre glass reinforcement of 40 m width and 3 mm minimum thickness.

D = mean socket internal diameter at mid-point of socket length as specified in IS : 10124 (Part 1) - 1988*.

L = minimum socket length in accordance with IS : 10124 (Part 1) 1988*.

B = $1.45 \times$ nominal outside diameter of the pipe + 6 mm.

t = minimum wall thickness of equal tees calculated on the basis of 90 percent of the minimum wall thickness of the corresponding size and pressure class of pipe rounded off to the next higher 0.1 mm.

Note — The figure is only intended to define the terms used in Table 1 and is not intended to illustrate specific design features.

FIG. 1 EQUAL TEE

* General requirements

For detailed information, refer to IS 10124 (Part 5) : 1988 Specification for fabricated PVC fittings for potable water supplies : Part 5 Specific requirements for equal tees (first revision).

SUMMARY OF
**IS 10124 (PART 6) : 1988 FABRICATED PVC FITTINGS FOR
 POTABLE WATER SUPPLIES**
**PART 6 SPECIFIC REQUIREMENTS FOR FLANGED TAIL
 PIECES WITH METTALLIC FLANGES**
(First Revision)

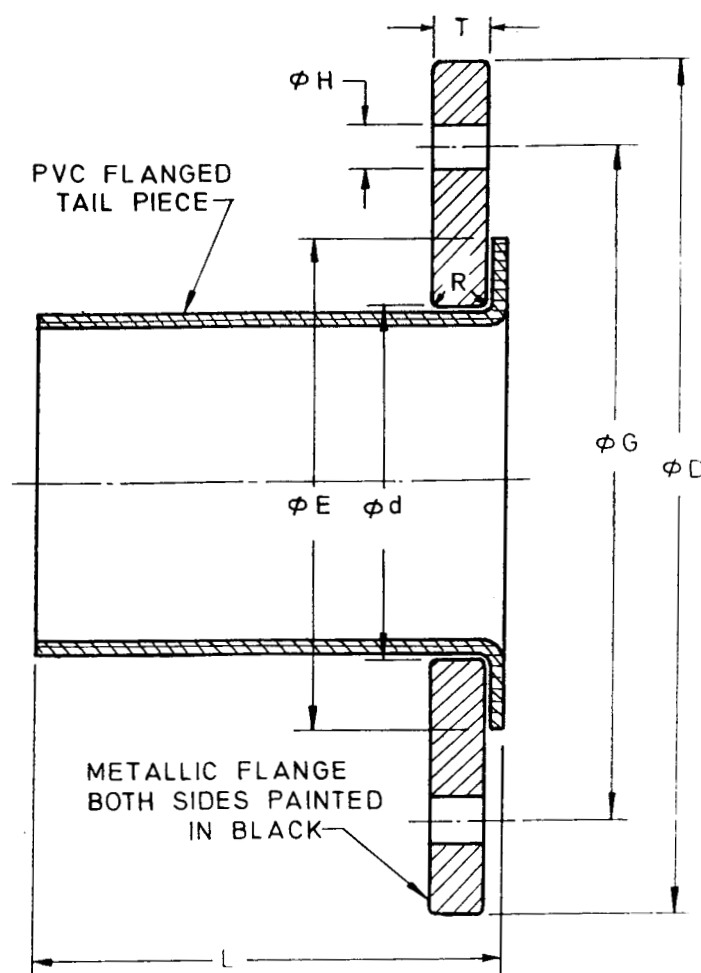
1. Scope—Requirements of manufacture, dimensions and marking for fabricated PVC flanged tail pieces with metallic flange for portable water supplies.

2. Requirements —The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions — See Table 1

4. Marking— The flanged tail piece with metallic flange shall be marked in colour as indicated below for different classes of fittings :

Class of Fitting	Colour
Class 1 (0.25 MPa)	Red
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow



Note— This figure is intended to define the terms used in Table 1 and is not intended to illustrate specific design features

FIG 1 PVC FLANGED TAIL PIECE WITH METALLIC FLANGE

TABLE 1. DIMENSIONS OF PVC FLANGED TAIL PIECE WITH METALLIC FLANGES

All dimensions in millimetres.										
Size	Dia, G	Dia, D	Dia, d	T	Dia H	No. of Holes	R Min	L Min	Dia E Max	Bolt Size
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
63	125	165	64 +1.0 -0	7.0	19	4	2.5	68	101	M 16
75	145	185	76 +1.0 -0	7.0	19	4	2.5	80	121	M 16
90	160	200	91 +1.0 -0	9.5	19	4	3.0	95	136	M 16
110	180	220	112 +1.0 -0	9.5	19	8	3.0	115	156	M 16
125	210	250	127 +1.0 -0	11.0	19	8	3.0	130	186	M 16
140	210	250	142 +1.0 -0	12.5	19	8	4.0	145	186	M 16
160	240	285	162 +1.0 -0	12.5	23	8	4.0	165	212	M 20
180	240	285	183 +1.0 -0	12.5	23	8	4.0	185	212	M 20
200	295	340	203 +1.0 -0	16.0	23	8	4.0	205	267	M 20
225	295	340	228 +1.0 -0	20.0	23	8	4.0	230	267	M 20
250	350	395	253 +1.0 -0	20.0	23	12	5.0	255	322	M 20
280	350	395	284 +1.0 -0	20.0	23	12	5.0	285	322	M 20
315	400	445	319 +1.0 -0	24.5	23	12	5.0	320	372	M 20
355	460	505	359 +1.0 -0	24.5	23	16	5.0	360	432	M 20
400	515	565	405 +2.0 -0	24.5	28	16	6.0	405	483	M 24
450	565	615	455 +2.0 -0	28.0	28	16	6.0	455	533	M 24
500	620	670	506 +2.0 -0	28.0	28	20	6.0	505	588	M 24
560	685	740	566 +2.0 -0	32.0	33	20	6.0	565	649	M 24
630	755	810	637 +2.0 -0	32.0	33	20	7.0	635	719	M 27

Note — Fabricated tail pieces for sizes 225 mm and above are not generally recommended. For 0.25 MPa pressure class, fabricated tail pieces should not be made from 0.25 MPa (Class 1) pressure class pipes. For this, tail pieces made from 0.4 MPa (Class 2) pressure class pipe should be used.

For detailed information, refer to IS : 10124 (Part 6) : 1988 Specification for fabricated PVC fittings for potable water supplies: Part 6 Specific requirements for flanged tail pieces with metallic flanges (first revision).

SUMMARY OF
**IS 10124 (PART 7) : 1988 FABRICATED PVC FITTINGS
 FOR POTABLE WATER SUPPLIES**
PART 7 SPECIFIC REQUIREMENT FOR THREADED ADAPTERS
(First Revision)

1. Scope – Requirements of manufacture, dimensions and marking for fabricated PVC threaded adaptors for potable water supplies.

4. Marking— The threaded adaptors shall be marked in colour as indicated below for different class of fittings:

2. Requirements – The general requirements for sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

Class of Fitting

Class 3 (0.6 MPa)

Class 4 (1.0 MPa)

Colour

Green

Yellow

3. Dimensions – See Table 1

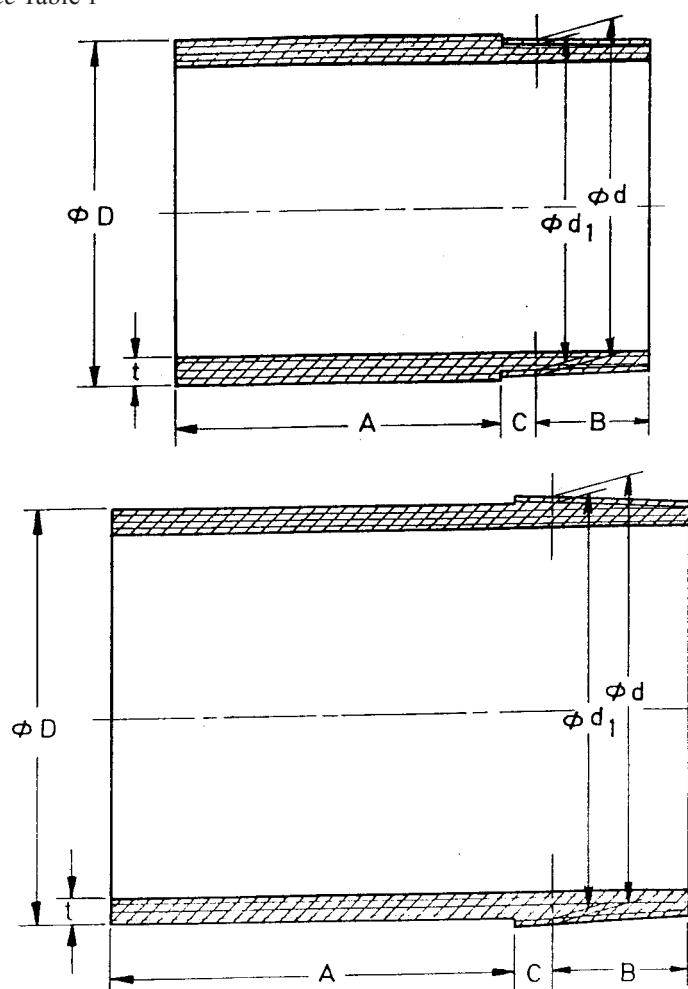


FIG. 1 THREADED ADAPTORS

TABLE 1 DIMENSIONS OF THREADED ADAPTORS

All dimensions in millimetres.												
Nominal Size	Outside Diameter At Plain Portion of threaded Adaptor. Dia		Length of Plain portion of Threaded	Thickness at Plain Portion of Threaded Adaptor		Thread Designing of Threaded	Dimensions Pitch	Length of Useful Thread For Basic Gauge Length	Dimensions of Pipe Required for Making Threaded Adaptor			
			A					B	Outside Diameter		Wall Thickness	
	Max	Min	Min	Class 3 6MPa Min	Class 4 10MPa Min			Min	Min	Max	Class 3	Class 4 0.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
63	63.0	63.3	68.0	5.5	6.8	2	2.309	23.4	63.0	63.3	5.6	6.9
75	75.0	75.3	74.0	4.1	5.7	2. 1/2	2.309	26.7	75.0	75.3	4.2	5.8
90	90.0	90.3	86.0	5.7	7.6	3	2.309	29.8	90.0	90.3	5.8	7.7
110	110.0	110.4	106.0	3.8	6.2	4	2.309	35.8	114.1	114.5	6.0	8.4

Note — For pipes of 0.25 MPa and 0.4 MPa, threaded adaptors for 0.6 MPa shall be used.

For detailed information, refer to IS 10124 (Part 7) : 1988 Specification for fabricated PVC fittings of potable water supplies: Part 7 Specific requirements for threaded adaptors (first revision).

SUMMARY OF

**IS 10124 (PART 8) : 1988 FABRICATED PVC FITTING
FOR POTABLE WATER SUPPLIES
PART 8 SPECIFIC REQUIREMENTS FOR 90° BENDS.
(First Revision)**

1. Scope—Requirements of manufacture, dimensions and marking for fabricated PVC 90° bends for potable water supplies.

2. Requirements — The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions—See Table 1.

4. Marking—The bend shall be marked in colour as indicated below for different class of fittings—

Class of Fitting	Colour
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

TABLE 1 DIMENSIONS FOR 90° BENDS

All Dimensions in millimetres.

Size	Y Min	L Min	R Min (Only for Plain Bends)	Minimum Wall Thickness(t) for Working Pressure		
				0.4 MPa (Class 2)	0.6 MPa (Class 3)	1.0 MPa (Class 4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
63	297	63	189	1.4	2.0	3.2
75	354	75	225	1.7	2.4	3.8
90	424	90	270	1.9	2.8	4.5
110	519	110	330	2.3	3.4	5.5
125	589	125	375	2.7	3.9	6.3
140	660	140	420	2.9	4.4	7.0
160	754	160	480	3.4	4.9	8.0
180	848	180	540	3.8	5.5	9.0
200	942	200	600	4.2	6.2	10.0
225	1060	225	675	4.7	6.9	11.2
250	1178	250	750	5.2	7.7	12.5
280	1319	280	840	5.8	8.6	13.9
315	1484	315	945	6.5	9.7	15.6
355	1673	355	1065	7.3	10.8	17.7
400	1884	400	1200	8.2	12.2	19.8
450	2120	450	1350	9.3	13.7	22.4
500	2355	500	1500	10.3	15.3	24.8
560	2638	560	1680	11.6	17.2	27.8
630	2968	630	1890	13.0	19.2	31.3

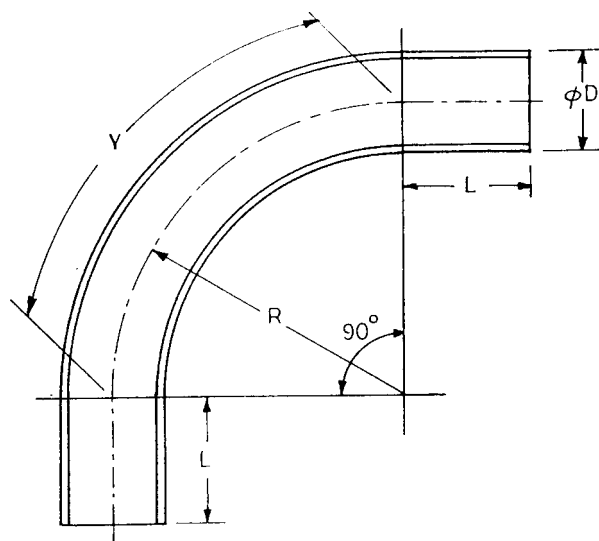


FIG. 1 90° BEND

Note 1— For 0.25 MPa pressure class, fabricated bends should not be made from 0.25 MPa pressure class pipes. For this, bends made from 0.4 MPa pressure class pipe should be used.

Note 2—Y is calculated from $\frac{90^\circ}{360^\circ} \times 2\pi r$, where r, radius of the bend is equal to 3 times the nominal outside diameter (D)

For detailed information, refer to IS 10124 (Part 8) : 1988 Specification for fabricated PVC fittings for potable water supplies: Part 8 Specific requirements for 90° bends. (first revision).

SUMMARY OF

**IS 10124 (PART 9) : 1988 FABRICATED PVC FITTING
FOR POTABLE WATER SUPPLIES
PART 9 SPECIFIC REQUIREMENTS FOR 60° BENDS.**

(First Revision)

1. Scope — Requirements of manufacture, dimensions and marking for fabricated PVC 60° bends for potable water supplies.

2. Requirements — The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions — See Table 1.

4. Marking — The bend shall be marked in colour as indicated below for different class of fittings:

Class of Fitting	Colour
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

TABLE 1 DIMENSIONS FOR 60° BENDS

All Dimensions in millimetres.						
Size	Y	L	R	Minimum Wall Thickness(t) for Working Pressure		
	Min	Min	Min	(Only for Plain Bends)		
				0.4 MPa (Class 2)	0.6 MPa (Class 3)	1.0 MPa (Class 4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
63	198	63	189	1.4	2.0	3.2
75	236	75	225	1.7	2.4	3.8
90	283	90	270	1.9	2.8	4.5
110	346	110	330	2.3	3.4	5.5
125	393	125	375	2.7	3.9	6.3
140	440	140	420	2.9	4.4	7.0
160	503	160	480	3.4	4.9	8.0
180	566	180	540	3.8	5.5	9.0
200	629	200	600	4.2	6.2	10.0
225	707	225	675	4.7	6.9	11.2
250	786	250	750	5.2	7.7	12.5
280	880	280	840	5.8	8.6	13.9
315	990	315	945	6.5	9.7	15.6
355	1115	355	1065	7.3	10.8	17.7
400	1256	400	1200	8.2	12.2	19.8
450	1413	450	1350	9.3	13.7	22.4
500	1570	500	1500	10.3	15.3	24.8
560	1759	560	1680	11.6	17.2	27.8
630	1979	630	1890	13.0	19.2	31.3

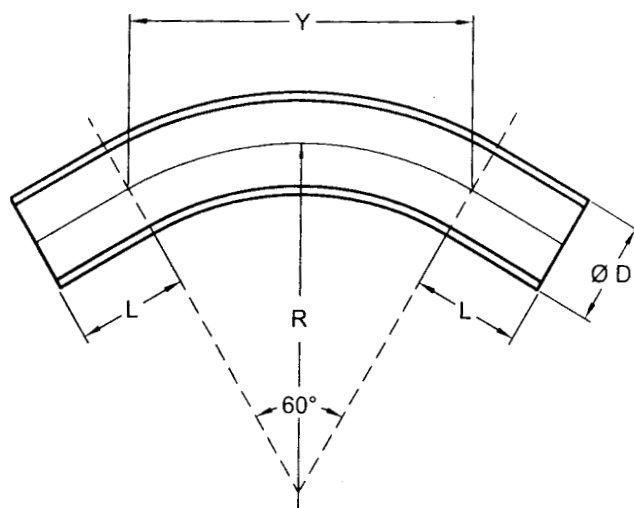


FIG. 1 60° BEND

Note 1— For 0.25 MPa pressure class, fabricated bends should not be made from 0.25 MPa pressure class pipes. For this, bends made from 0.4 MPa pressure class pipe should be used.

Note 2— Y is calculated from $\frac{90^\circ}{360^\circ} \times 2 \pi R$, where R, radius of the bend is equal to 3 times the nominal outside diameter (D)

For detailed information, refer to IS 10124 (Part 9) : 1988 Specification for fabricated PVC fittings for potable water supplies: Part 9 Specific requirements for 60° bends. (first revision).

SUMMARY OF

**IS 10124 (PART 10) : 1988 FABRICATED PVC FITTING
FOR POTABLE WATER SUPPLIES.
PART 10 SPECIFIC REQUIREMENTS FOR 45° BENDS.
(First Revision)**

1. Scope—Requirements of manufacture, dimensions and marking for fabricated PVC 45° bends for potable water supplies.

2. Requirements—The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions—See Table 1.

4. Marking—The bend shall be marked in colour as indicated below for different class of fittings:

Class of Fitting	Colour
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

TABLE 1. DIMENSIONS FOR 45° BENDS

All dimensions in millimetres.

Size	Y	L	R	Minimum Wall Thickness(t) for Working Pressure		
	Min	Min	Min			
	<i>(Only for Plain Bends)</i>					
				0.4 MPa (Class 2)	0.6 MPa (Class 3)	1.0 MPa (Class 4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
63	149	63	189	1.4	2.0	3.2
75	177	75	225	1.7	2.4	3.8
90	212	90	270	1.9	2.8	4.5
110	259	110	330	2.3	3.4	5.5
125	295	125	375	2.7	3.9	6.3
140	330	140	420	2.9	4.4	7.0
160	377	160	480	3.4	4.9	8.0
180	424	180	540	3.8	5.5	9.0
200	471	200	600	4.2	6.2	10.0
225	530	225	675	4.7	6.9	11.2
250	589	250	750	5.2	7.7	12.5
280	660	280	840	5.8	8.6	13.9
315	742	315	945	6.5	9.7	15.6
355	837	355	1065	7.3	10.8	17.7
400	842	400	1200	8.2	12.2	19.8
450	1060	450	1350	9.3	13.7	22.4
500	1178	500	1500	10.3	15.3	24.8
560	1319	560	1680	11.6	17.2	27.8
630	1484	630	1890	13.0	19.2	31.3

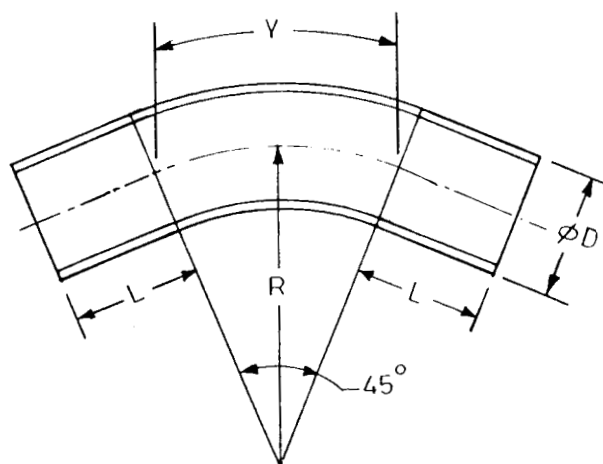


FIG. 1 45° BEND

Note 1— For 0.25 MPa pressure class, fabricated bends should not be made from 0.25 MPa pressure class pipes. For this, bends made from 0.4 MPa pressure class pipe should be used.

Note 2— Y is calculated from $\frac{90^\circ}{360} \times 2 \pi R$, where R, radius of the bend is equal to 3 times the nominal outside diameter (D)

For detailed information, refer to IS 10124 (Part 10) : 1988 Specification for fabricated PVC fittings for potable water supplies Part 10 Specific requirements for 45° bends. (first revision).

SUMMARY OF

**IS 10124 (PART11) : 1988 FABRICATED PVC FITTING
FOR POTABLE WATER SUPPLIES.
PART 11 SPECIFIC REQUIREMENTS FOR 30° BENDS.
(First Revision)**

1. Scope— Requirements of manufacture, dimensions and marking for fabricated PVC 30° bends for potable water supplies.

2. Requirements — The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions—See Table 1.

4. Marking —The bend shall be marked in colour as indicated below for different class of fittings:

Class of Fitting	Colour
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

TABLE 1 DIMENSIONS FOR 30° BENDS

All dimensions in millimetres.

Size	Y Min	L Min	R Min	Minimum Wall Thickness(t) for Working Pressure		
	(Only for Plain Bends)			0.4 MPa (Class 2)	0.6 MPa (Class 3)	1.0 MPa (Class 4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
63	99	63	189	1.4	2.0	3.2
75	118	75	225	1.7	2.4	3.8
90	142	90	270	1.9	2.8	4.5
110	173	110	330	2.3	3.4	5.5
125	197	125	375	2.7	3.9	6.3
140	220	140	420	2.9	4.4	7.0
160	252	160	480	3.4	4.9	8.0
180	283	180	540	3.8	5.5	9.0
200	314	200	600	4.2	6.2	10.0
225	354	225	675	4.7	6.9	11.2
250	393	250	750	5.2	7.7	12.5
280	440	280	840	5.8	8.6	13.9
315	495	315	945	6.5	9.7	15.6
355	558	355	1065	7.3	10.8	17.7
400	628	400	1200	8.2	12.2	19.8
450	707	450	1350	9.3	13.7	22.4
500	785	500	1500	10.3	15.3	24.8
560	880	560	1680	11.6	17.2	27.8
630	990	630	1890	13.0	19.2	31.3

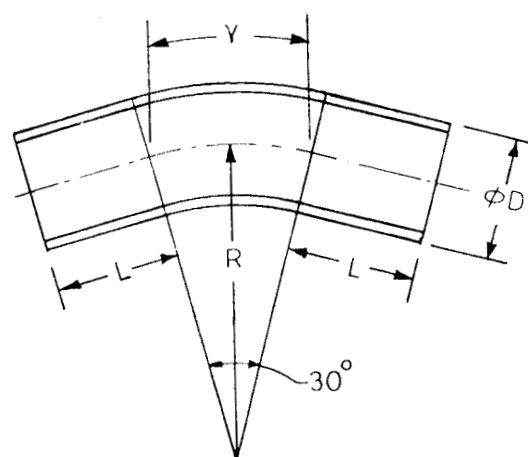


FIG. 1 30° BEND

Note 1— For 0.25 MPa pressure class, fabricated bends should not be made from 0.25 MPa pressure class pipes. For this, bends made from 0.4 MPa pressure class pipe should be used.

Note 2— Y is calculated from $\frac{90^\circ}{360^\circ} \times 2 \pi r$, where r, radius of the bend is equal to 3 times the nominal outside diameter (D)

For detailed information, refer to IS 10124 (Part 11) : 1988 Specification for fabricated PVC fittings for potable water supplies Part 11 Specific requirements for 30° bends. (first revision).

SUMMARY OF

**IS 10124 (PART 12) : 1988 FABRICATED PVC FITTING
FOR POTABLE WATER SUPPLIES
PART 12 SPECIFIC REQUIREMENTS FOR 22½° BENDS
(First Revision)**

1. Scope — Requirements of manufacture, dimensions and marking for fabricated PVC 22½° bends for potable water supplies.

2. Requirements — The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions—See Table 1.

4. Marking —The bend shall be marked in colour as indicated below for different class of fittings:

<i>Class of Fitting</i>	<i>Colour</i>
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

TABLE 1. DIMENSIONS FOR 22½° BENDS

Size	All Dimensions in millimetres					
	Y	L	R	Minimum Wall Thickness (t) for Working Pressure		
	Min	Min	Min			
	(Only for Plain Bends)			0.4 MPa (Class 2)	0.6 MPa (Class 3)	1.0 MPa (Class 4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
63	75	63	189	1.4	2.0	3.2
75	89	75	225	1.7	2.4	3.8
90	106	90	270	1.9	2.8	4.5
110	130	110	330	2.3	3.4	5.5
125	148	125	375	2.7	3.9	6.3
140	165	140	420	2.9	4.4	7.0
160	189	160	480	3.4	4.9	8.0
180	213	180	540	3.8	5.5	9.0
200	236	200	600	4.2	6.2	10.0
225	266	225	675	4.7	6.9	11.2
250	295	250	750	5.2	7.7	12.5
280	330	280	840	5.8	8.6	13.9
315	371	315	945	6.5	9.7	15.6
355	419	355	1065	7.3	10.8	17.7
400	471	400	1200	8.2	12.2	19.8
450	530	450	1350	9.3	13.7	22.4
500	589	500	1500	10.3	15.3	24.8
560	660	560	1680	11.6	17.2	27.8
630	742	630	1890	13.0	19.2	31.3

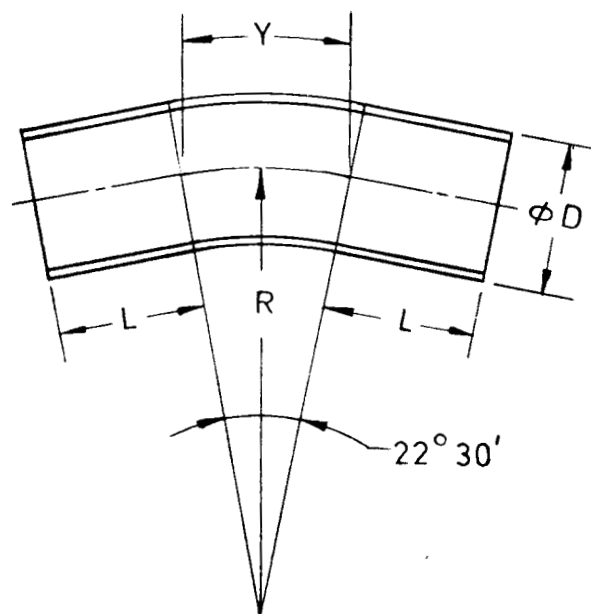


FIG. 1 22°-30' BEND

Note 1— For 0.25 MPa pressure class, fabricated bends should not be made from 0.25 MPa pressure class pipes. For this, bends made from 0.4 MPa pressure class pipe should be used.

Note 2 — Y is calculated from $\frac{22 \frac{1}{2}^{\circ}}{360^{\circ}} \times 2 \pi r$, where r , radius of the bend is equal to 3 times the nominal outside diameter (D)

For detailed information, refer to IS 10124 (Part 12) : 1988 Specification for fabricated PVC fittings for potable water supplies Part 12 Specific requirements for 22½° bends. (first revision).

SUMMARY OF

**IS 10124 (PART 13) : 1988 FABRICATED PVC FITTING
FOR POTABLE WATER SUPPLIES
PART 13 SPECIFIC REQUIREMENTS FOR 11¼° BENDS
(First Revision)**

1. Scope — Requirements of manufacture, dimensions and marking for fabricated PVC 11¼° bends for potable water supplies.

2. Requirements — The general requirements for materials, sizes, methods of test, sampling and criteria for conformity shall conform to IS 10124 (Part 1) : 1988.

3. Dimensions—See Table 1.

4. Marking —The bend shall be marked in colour as indicated below for different class of fittings:

Class of Fitting	Colour
Class 2 (0.4 MPa)	Blue
Class 3 (0.6 MPa)	Green
Class 4 (1.0 MPa)	Yellow

TABLE 1 DIMENSIONS FOR 11¼° BENDS

All dimensions in millimetres.						
Size	Y	L	R	Minimum Wall Thickness (t) for Working Pressure		
	Min	Min	Min			
	(Only for Plain Bends)			0.4 MPa (Class 2)	0.6 MPa (Class 3)	1.0 MPa (Class 4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
63	38	63	189	1.4	2.0	3.2
75	45	75	225	1.7	2.4	3.8
90	53	90	270	1.9	2.8	4.5
110	65	110	330	2.3	3.4	5.5
125	74	125	375	2.7	3.9	6.3
140	83	140	420	2.9	4.4	7.0
160	95	160	480	3.4	4.9	8.0
180	106	180	540	3.8	5.5	9.0
200	118	200	600	4.2	6.2	10.0
225	133	225	675	4.7	6.9	11.2
250	148	250	750	5.2	7.7	12.5
280	165	280	840	5.8	8.6	13.9
315	186	315	945	6.5	9.7	15.6
355	209	355	1065	7.3	10.8	17.7
400	236	400	1200	8.2	12.2	19.8
450	265	450	1350	9.3	13.7	22.4
500	295	500	1500	10.3	15.3	24.8
560	330	560	1680	11.6	17.2	27.8
630	371	630	1890	13.0	19.2	31.3

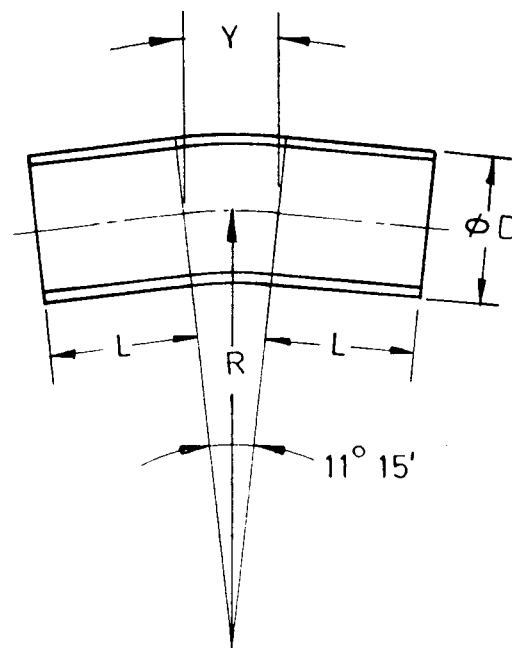


FIG 1 11°-15' BEND

Note 1— For 0.25 MPa pressure class, fabricated bends should not be made from 0.25 MPa pressure class pipes. For this, bends made from 0.4 MPa pressure class pipe should be used.

Note 2 — Y is calculated from $11\frac{1}{4}^\circ \times \frac{2\pi r}{360^\circ}$, where r , radius of the bend is equal to 3 times the nominal outside diameter (D).

For detailed information, refer to IS 10124 (Part 13) : 1988 Specification for Fabricated PVC fittings for potable water supplies. Part 13 specific requirements for 11¼° bends. (first revision).

SUMMARY OF
IS 12709 : 1994 GLASS FIBRE REINFORCED PLASTICS (GRP)
PIPES, JOINTS AND FITTINGS FOR USE FOR
POTABLE WATER SUPPLY
(First Revision)

1. Scope—Requirements for materials, dimensions, classification, testing and type of joints of machine-made pipes with glass fibre reinforced thermosetting resin with or without aggregate filler having nominal diameter from 200 mm to 3000 mm for use at pressure up to 1500 kPa for conveyance of potable water. Provisions relating to fittings fabricated from GRP pipes or by moulding process and joints covered in this standard are for guidance only.

2. Classification

2.1 Pressure Classes (PN) : Five pressure classes of pipes namely, PN 3, PN 6, PN 9, PN 12 and PN 15 correspond to the working pressure rating of 300, 600, 900, 1 200 and 1500 KPa respectively.

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

2.2 Stiffness Class (SN) — Four stiffness classes of pipes namely A, B, C and D correspond to minimum pipe stiffness values of 62, 124, 248 and 496 kPa respectively at 5% deflection.

3. Size designation— is based on nominal diameters, DN Summary of — which are 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1 000, 1 100, 1 200, 1 400, 1 600, 1 800, 2 000, 2 200, 2 400, 2 600, 2 800 and 3 000 mm.

4. Materials

4.1 Resin — Appropriate type of unsaturated polyester resin systems conforming to IS 6746 : 1994[@]. The resin and additives used shall be such that they contain no ingredients, in an amount that has been demonstrated to migrate into water in quantities that are considered to be toxic; satisfying the potability of water.

4.2 Glass Fibre Reinforcement — Glass fibre reinforcement shall be of commercial grade E type and shall conform to IS 11273:1992⁺, IS 11320 : 1985^{*} or IS 11551: 1986⁺⁺, as appropriate.

4.3 Other Materials

Note—For other materials, see 6.3 of the standard.

5. Dimensions

5.1 Diameters— See Tables 1 and 2.

TABLE 1 SPECIFIED INSIDE DIAMETERS AND TOLERANCES

All Dimensions in Millimetres			
Nominal Diameter, DN	Inside Diameter Range		Tolerances on Declared ID
	ID		
	Min	Max	
200	196	204	±1.5
250	246	255	±1.5
300	296	306	±1.8
350	346	356	± 2.0
400	396	408	± 2.4
450	446	459	± 2.7
500	496	510	± 3.0
600	596	612	± 3.6
700	695	714	± 4.2
800	795	816	
900	895	918	
1000	995	1 020	± 5.0
1100	1 095	1 120	
1200	1 195	1 220	
1400	1 395	1 420	
1600	1 595	1 620	
1800	1 795	1 820	± 6.0
2000	1 995	2 020	
2200	2 195	2 220	
2400	2 395	2 420	
2600	2 595	2 620	
2800	2 795	2 820	
3000	2 995	3 020	

⁺ Woven roving fabrics of 'E' glass fibre (*first revision*)

^{*} Glass fibre roving for the reinforcement of polyester and of epoxide resin systems (*first revision*).

⁺⁺ Glass fibre chopped strand mat for reinforcement of epoxy, phenolic and polyester resin systems (*first revision*).

[@] Unsaturated polyester resin system (*first revision*)

5.2 Lengths— 6 m, 9 m, and 12 m effective lengths with a tolerance of ± 25 mm.

5.3 Out of squareness of pipe—All points around each end of a pipe unit shall fall within ± 6.5 mm or ± 0.5 percent of the nominal diameter of the pipe which ever is greater, to a plane perpendicular to the longitudinal axis of the pipe.

5.4 Wall Thickness— Shall be such as to satisfy the outside and inside diameter and the tests specified

6. Joints

6.1 Unrestrained

(a) Coupling or socket and spigot Gasket Joints.

(b) Mechanical Couplings

6.2. Restrained— Similar to 6.1 (a) with supplemental restraining elements. Butt Joint - with laminate over lay. Socket-and spigot with laminated overlay. Socket-and-Spigot-adhesive bounded, flanged and mechanical.

6.3 Gasket— Elastomeric gaskets when used with the pipe shall conform to the requirements of IS 5382 : 1985.**

7. Workmanship— Shall meet the acceptance specified in table 3

TABLE 2 SPECIFIED OUTSIDE DIAMETERS AND TOLERANCES

All dimensions in millimetres.			
Nominal Diameter,	Inside Diameter	Tolerance	
<i>DN</i>	<i>OD</i>		
200	208	+2.0	} - 0.2
250	259	+2.1	
300	310	+2.3	
350	361	+2.4	
400	412	+2.5	
450	463	+2.7	
500	514	+2.8	
600	614	+3.0	
700	718	+3.3	
800	820	+3.5	
900	922	+3.8	
1000	1024	+4.0	
1100	1126	+4.3	
1200	1228	+4.5	
1400	1432	+5.0	
1600	1636	+5.5	
1800	1840	+6.0	
2000	2044	+6.5	
2200	2248	+7.0	
2400	2452	+7.5	
2600	2656	+8.0	
2800	2830	+8.5	
3000	3064	+9.0	

TABLE 3 ALLOWABLE DEFECTS

Name	Definition	Visual acceptance Level
Chip	A small piece broken off an edge or surface	Maximum dimension of break 6.5 mm
Crack	An actual separation of the laminate, Visible on opposite surfaces, and extending through the thickness	None
Crack, surface	Crack existing only on the surface of the laminate	Maximum length, 6.5 mm
Crazing	Fine cracks at or under the surface of a laminate	Maximum dimension of crazing 2.5 mm
Delamination, edge	Separation of the layers of material at the edge of a laminate.	Maximum dimension, 6.5 mm
Delamination internal	Separation of the layer of material in a laminate	None
Dry-spot	Area of incomplete surface film where the reinforcement has not been wetted with resin	Maximum diameter, 14 mm
Foreign inclusion (metallic)	Metallic particles included in a laminate which are foreign to its composition.	Maximum dimension, 1.5 mm
Foreign inclusion (non-metallic)	Non-metallic particles of substance included in a laminate which seem foreign to its composition	Maximum dimension, 1.5 mm

** Rubber sealing rings for gas mains, water mains and savers (*first revision*)

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Fracture	Rupture of laminate surface without complete penetration.	Maximum diameter, 29 mm
Air bubble (void)	Air entrapment within and between the plies of reinforcement.	Maximum diameter, 3.0 mm
Blister	Rounded elevation of the surface of a laminate, with boundaries that may be more or less sharply defined, some what resembling in shape side drawing tolerance.a blister on the human skin.	Maximum diameter, 6.5 mm; Height from surface not to be side tolerance.
Burned	Showing evidence of thermal decomposition through some discolouration, distortion, or destruction of the surface of the laminate.	None
Fish-eye	Small globular mass which has not blended completely into the surrounding material and is particularly evident in a transparent or translucent material.	Maximum diameter, 13 mm
Lack of fillout	An area, occuring usually at the edge of a laminated plastic where the reinforcement has not been wetted with resin.	Maximum diameter, 9.5 mm
Orange-peel	Uneven surface somewhat resembling an organge-peel	Mamimum diameter, 29 mm
Pimple	Small, sharp, or conical elevation of the surface of a laminate.	Maximum diameter, 3.0 mm
Pit (pinhole)	Small crater in the surface of the laminate, with its width approximately of the same order magnitude as its depth.	Maximum diameter 0.8 mm; depth less than 20 percent of wall thickness
Porosity Pinhole pre-gel	Presence of numerous visible pits (Pinholes) An unintentional extra layer of cured resin on part of the surface of the laminate (The condition does not include gel coats)	Maximum of 50 pits (Pinholes) Maximum dimension, 13 mm; above surface not to be outside drawing tolerance.
Resin-pocket	An apparent accumulation of excess resin in a small localized area witnin the laminate	Maximum diameter, 6.5 mm
Resin-rich edge	Insufficient reinforcing material at the edge of molded laminate	Maximum 0.8 mm from the edge
Shrink-mark (sink)	Depression in the surface of a moulded laminate where it has retracted from the mould thickness	Maximum diameter, 14 mm; epth greater than 25% of wall
Wash	Area where the reinforcement of moulded plastic has moved inadvertently during closure of the mould resulting in resin rich areas	Maximum dimension, 29 mm
Wormhole	Elongated air entrapment which is either in or near the surface of a laminate and may be covered by a thin film of cured resin	Maximum diameter, 6.5 mm
Wrinkles	In a laminate, an imperfecting that has the appearance of a wave moulded into one or more plies of fabric or other reinforcement material	Maximum length surface side, 25 mm, Maximum length opposite material side, 25 mm. Depth less than 15% of wall thickness.
Scratch	Shallow Mark, groove, furrow, or channel caused by improper handling or storage	Maximum length, 25 mm; maximum depth, 0.225 mm
Short	In a laminate, an incompletely filled out condition	None

8. Pipe stiffness — Each length of pipe shall have sufficient strength to exhibit the minimum pipe stiffness (F/rY) specified in Table 4.

TABLE 4 PIPE STIFFNESS AT 5 PERCENT DEFLECTION

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

where

F = load per unit length in kN per metre length, and
 ry = vertical pipe deflection, in metres.

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

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

9.1 Fittings may be made :

- from straight pipes
- by moulding

10. Hydraulic Test

10.1 General — Working pressure P_w in the system shall not exceed the pressure class of the pipe, i.e. $P_w \leq P_N$. When surge pressure is considered, the maximum pressure class of pipe $P_w + P_N > 1.4 P_N$.

10.2 Soundness — Shall withstand without leakage or cracking the internal hydrostatic test pressures specified in Table 4 of the standard.

11. Longitudinal strength — Shall withstand without failure the beam loads specified in Table 5 of the standard.

12. Hoop tensile strength — Shall meet or exceed the hoop tensile strength shown in Table 6 of the standard.

13. Long term hydrostatic design pressure test — Pressure classes specified shall be based on long term hydrostatic design pressure data categorised in accordance with Table 7 of the standard.

14. Test to establish portability of water — shall satisfy the prescribed tests.

Note — For methods of tests refer to Appendices A to F of the standard.

For detailed information, refer to IS 12709 : 1994 Specification for glass fibre reinforced plastic (GRP) pipes, joints and fittings for use for potable water supply (first revision)

SUMMARY OF

IS 12818 : 1992 UNPLASTICISED PVC SCREEN AND CASING
PIPES FOR BORE/TUBE WELL

(First Revision)

1. Scope — Requirements of ribbed screen, plain screen and plain casing pipes of nominal diameter 40 to 400 mm produced from unplasticized polyvinyl chloride for bore/tubewell for water supply.

2. Composition — The pipe shall be produced from material consisting substantially polyvinyl chloride conforming to IS 10151 : 1982* which may be added only those additives as are needed to facilitate manufacture of sound pipe with good surface finish, mechanical strength and opacity under conditions of use.

3. Colour — Shall be of regular blue colour throughout. Slight colour deviation is permissible.

4. Designation — Pipe shall be designated by its type whether ribbed screen (RS), plain screen (PS) or casing (CS or CM) followed by its nominal diameter DN, slot width and length of the pipe.

Example — Ribbed Screen pipe of DN 200 with slot width 1.5 mm and length 2000 mm shall be designated as RS 200 × 1.5 × 2000.

5. Dimensions

5.1. Screen Pipes — See Table 1 and 2 and also Fig. 1 of the Standard.

5.2. Casing Pipe — See Tables 3 and 4.

5.3. Ribs — Minimum number of ribs provided shall be three ribs per centimetre of the slotted segments on the circumference. Minimum height, *h* of the rib

5.4. Lengths — See Tables 5 and 6.

5.5. Slots — See Table 7

Tolerances on overall length and segmental lengths of pipes shall be as follows :

- i) Effective length: l_2 — not less than the specified value.
- ii) Effective Thread length, l_3 —
 - a) For DN up to and including 200 shall be 2mm. The ribs should not have sharp edges - spigot end + 0, - 4mm- socket end + 4, - 0 mm
 - b) For DN above 200- spigot end +0.6 mm- socket end + 6,- 0 mm
- iii) Segmental length, l_4 ± 25 mm (screen portion)
- iv) Segmental length, l_5 + 25, - 0 mm

TABLE 1 DIMENSIONS OF SCREEN PIPES WITH RIBS

Nominal Diameter DN	Mean Outer Diameter of pipe <i>d</i> Min	Outer Diameter of Pipe at any Point Min	Outer Diameter Over Connection, <i>ds</i> Max	Wall Thickness, <i>s</i> (Under Ribs)	
				Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
40	52.0	51.9	56.0	3.5	4.0
50	64.0	63.9	69.0	4.0	4.6
80	92.0	91.8	98.0	4.0	4.6
100	117.0	116.8	124.0	5.0	5.7
125	144.0	143.7	154.0	6.5	7.3
150	169.0	168.6	182.0	7.5	8.5
175	204.0	203.6	219.0	8.8	9.8
200	229.0	228.5	247.0	10.0	11.2
250	284.0	283.4	302.0	12.5	14.0
300	334.0	333.3	356.0	14.5	16.2
350	404.0	403.2	432.0	17.5	19.5
400	454.0	453.1	483.0	19.5	21.7

TABLE 2 DIMENSIONS OF PLAINS SCREEN PIPES

All dimensions in millimetres.							
Nominal Diameter	Mean Outer Diameter of Pipe, <i>d</i>		Outer Diameter of Pipe at Any Point		Mean Outer Diameter Over Connection, <i>ds</i>	Wall Thickness, <i>s</i>	
DN	Min	Max	Min	Max	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
250	280.0	280.5	279.6	280.8	298.0	12.5	14.0
300	330.0	330.6	329.6	331.0	352.0	14.5	16.2
350	400.0	400.7	399.6	401.2	428.0	17.5	19.5
400	450.0	450.8	449.5	451.3	479.0	19.5	21.7

*Polyvinyl chloride PVC and its copolymer for its safe use in contact with food stuffs, pharmaceuticals and drinking water.

TABLE 3 DIMENSIONS OF 'CM' CASING PIPES

All dimensions in millimetres.							
Nominal Diameter	Mean Outer Diameter of Pipe, <i>d</i>		Outer Diameter of Pipe at Any Point		Mean Outer Diameter Over Connection <i>ds</i>	Wall Thickness, <i>s</i>	
DN	Min	Max	Min	Max	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
40	48.0	48.2	47.9	48.3	52.0	3.5	4.0
50	60.0	60.2	59.9	60.3	65.0	4.0	4.6
80	88.0	88.3	87.9	88.4	94.0	4.0	4.6
100	113.0	113.3	112.9	113.4	120.0	5.0	5.7
125	140.0	140.4	139.9	140.5	150.0	6.5	7.3
150	165.0	165.4	164.8	165.6	178.0	7.5	8.5
175	200.0	200.5	199.8	200.6	215.0	8.8	9.8
200	225.0	225.5	224.8	225.8	243.0	10.0	11.2
250	280.0	280.5	279.6	280.8	298.0	12.5	14.0
300	330.0	330.6	329.6	331.0	352.0	14.5	16.2
350	400.0	400.7	399.6	401.2	428.0	17.5	19.5
400	450.0	450.8	449.5	451.3	479.0	19.5	21.7

TABLE 4 DIMENSIONS OF 'CS' CASING PIPES

All dimensions in millimetres							
Nominal Diameter	Mean Outer Diameter of Pipe, <i>d</i>		Outer Diameter of Pipe at Any Point		Mean Outer Diameter Over Connection <i>ds</i>	Wall Thickness, <i>s</i>	
DN	Min	Max	Min	Max	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
150	165.0	165.4	164.8	165.6	174.0	5.7	6.5
175	200.0	200.5	199.8	200.6	211.0	7.0	7.8
200	225.0	225.5	224.8	225.8	238.0	7.6	8.8
250	280.0	280.5	279.6	280.8	292.0	9.6	11.0
350	330.0	300.6	329.6	331.0	346.0	11.2	13.3
400	400.0	400.7	399.6	401.2	420.0	14.0	15.5
450	450.0	450.8	449.5	451.3	470.0	16.0	17.5

TABLE 5 EFFECTIVE AND SEGMENTAL LENGTHS OF SCREEN PIPES

<i>Nominal Diameter</i>	<i>Effective Length, mm</i>	<i>Segmental Length</i>	<i>Lengths</i>	<i>m m</i>
<i>DN</i>	<i>l₂</i>	<i>l₃</i>	<i>l₄</i>	<i>l₅</i>
(1)	(2)	(3)	(4)	(5)
40	1000	25	880	60
	2000	25	1880	60
	3000	25	2880	60
50	1000	30	870	70
	2000	30	1870	70
	3000	30	2870	70
80	1000	40	860	80
	2000	40	1860	80
	3000	40	2860	80
100	1000	45	850	90
	2000	45	1850	90
	3000	45	2850	90
125	2000	60	1800	160
	3000	60	2800	160
150	2000	60	1770	170
	3000	60	2770	170
175	2000	60	1770	170
	3000	60	2770	170
200	2000	70	1760	180
	3000	70	2760	180
250	2000	85	1720	220
	3000	85	2720	220
300	2000	85	1720	220
	3000	85	2720	220
400	2000	95	1700	240
	3000	95	2700	240

TABLE 6 EFFECTIVE AND SEGMENTAL LENGTHS OF CASING PIPES

<i>Nominal Diameter</i>	<i>Effective Length, mm</i>	<i>Segmental Length, mm</i>
<i>Nominal DN</i>	<i>effective l₂</i>	<i>Segmental l₃</i>
(1)	(2)	(3)
40	2000	25
	3000	25
	4000	25
50	2000	30
	3000	30
	4000	30
80	2000	40
	3000	40
	4000	40
100	2000	45
	3000	45
	4000	45
125	2000	60
	3000	60
	4000	60
150	2000	60
	3000	60
	4000	60
175	2000	60
	3000	60
	4000	60
200	2000	70
	3000	70
	4000	70
250	2000	85
	3000	85
	4000	85
300	2000	85
	3000	85
	4000	85
350	2000	85
	3000	85
	4000	85
400	2000	95
	3000	95
	4000	95

TABLE 7 DIMENSIONS AND LAYOUT OF SLOTS ON SCREEN PIPE

Nominal

Diameter $n \sum a \pm 5\%$ Free passage Area, in % (Mean Value) for Width of Slot (w), mm

of DN	mm		0.2	0.3	0.5	0.75	1.0	1.5	2.0	3.0
40	3	85	3.5	5.0	6.0	8.5	9.0	9.5	12.0	—
50	3	108	3.5	5.0	6.0	8.5	9.0	9.5	12.0	—
80	3	168	3.5	5.0	6.0	8.5	9.0	9.5	12.0	—
100	5	216	3.5	5.0	6.0	8.5	9.0	9.5	12.0	—
125	5	240	—	4.5	5.5	7.5	8.0	8.5	11.0	—
150	5	285	—	—	5.5	7.5	8.0	8.5	11.0	13.5
175	5	335	—	—	5.5	7.5	8.0	8.5	11.0	13.5
200	6	390	—	—	—	7.5	8.0	8.5	11.0	13.5
250	6	450	—	—	—	7.0	7.5	8.0	10.0	12.5
300	6	530	—	—	—	7.0	7.5	8.0	10.0	12.5
350	8	640	—	—	—	—	7.5	8.0	10.0	12.5
400	8	720	—	—	—	—	7.5	8.0	10.0	12.5
Width of material between slots (b) ± 0.5 (see Note 3)			4.0	4.0	5.5	5.5	6.5	9.5	9.5	11.0

Notes

1. $\sum a$ is the summation of slot lengths over the internal circumference of the cross section.
2. n is the minimum number of slots on the circumference of the cross section.
3. In each metre of screen 10 wider pieces between slits up to 2 mm in width are permitted.
4. Percentages of opening given in the table are based on internal surface area versus internal open area of pipe.

Tolerance on width of slot (w), given in Table 7 shall be as under:

Slot width (w) in mm	0.2	0.3	0.5	0.75	1.0	1.5	2.0	3.0
Tolerance,	+ 0.06 - 0.0	+ 0.06 - 0.0	+ 0.10 - 0.0	+ 0.20 - 0.0	+ 0.20 - 0.0	+ 0.20 - 0.0	+ 0.20 - 0.0	+ 0.30 - 0.0

6. Threading of Screen and Casing Pipes—The screen and casing pipe shall have male threads at spigot end and female threads at the socket end. Screen and casing pipe of nominal diameter from 40 to 80 mm shall have threads in accordance with IS 554 : 1985*.

Screen and casing pipes of nominal diameters of 100 to 400 mm shall have threads in accordance with basic profile for metric trapezoidal threads. Rubber element should be used with the trapezoidal threads shall be of shore hardness 165 \pm 5

7. Tests

7.1 Visual Appearance—The internal and external surfaces of each pipe shall be smooth, clean and free

*Dimensions of pipe threads where pressure tight joints are required on the threads (third revision)

from any defects. The ends shall be clean and square with the axis of the pipe.

7.2 Internal Dia—Test mandrel of diameter as specified below of 100 mm length shall pass smoothly through the pipe.

7.3 Specific gravity— Between 1.4 to 1.45 g/cm³

7.4 Impact Strength at 0°C— Shall not fracture or crack through its complete wall thickness.

7.5 Tensile Strength— Shall not be less than 45 MPa.

7.6 Vicat Softening Temperature— Not less than 76°C.

7.7 Effect on Water— Shall meet the specified requirements.

Note—For methods of test, refer to Appendix A of the standard, IS 8543 (Part 1/Sec 2) : 1979 Methods of testing plastics, Part 1: Characterization of polymer structure and size, section 2 : Determination of density of solid plastics; IS 8543 (Part 4/sec 1) : 1984 Methods of testing plastics, Part 4 : Short term mechanical properties, Section 1 Determination of tensile properties; and IS 12235 : 1986 Methods of test for unplasticized PVC pipes for potable water supplies.

For detailed information, refer to IS 12818 : 1992 Specification for unplasticized PVC screen and casing pipes for bore tube well (first revision)

SUMMARY OF

**IS 13592 : 1992 UNPLASTILIZED POLYVINYL CHLORIDE (UPVC)
PIPES FOR SOIL AND WASTE DISCHARGE SYSTEM FOR INSIDE
AND OUTSIDE BUILDINGS INCLUDING VENTILATION
AND RAIN WATER SYSTEM**

1. Scope – Requirements for plain and socket end unplasticized polyvinyl chloride (UPVC) pipes with nominal outside diameters 40 mm to 160 mm for soil and waste discharge system inside buildings including ventilating and rain water applications.

2. Types –

Type A : for use in ventilation pipe work and rain water applications.

Type B : for use in soil and water discharge systems.

3. Size – Normal outside diameter DN of pipes as covered are 40, 50, 63, 75, 90, 110, 125, 140 and 160 mm.

4. Colour of Pipe — Shall be dark shade of grey.

5. Materials – Shall consist essentially polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of sound pipes of good surface finish, mechanical strength, and opacity under condition of use. None of these additives

shall be used separately or together in quantities sufficient to constitute a toxic hazard, impair the fabrication, welding, chemical and physical properties of the fittings. The material should also consist of sufficient quantity of stabilizer to withstand thermal ageing and exposure to ultra-violet light. The addition of the manufacturer's own rework material produced during the manufacture and work testing of pipes complying with this standard is permissible upto 10 percent. No other rework material shall be used.

6. Dimensions

6.1. Diameter and Wall Thickness — See Table 1.

6.2 Length — Pipe shall be supplied in nominal lengths of 2, 3, 4 or 6 metres either plain or with sliding/grooved socket. Tolerances on specified length shall be + 10 mm and – 0 mm.

6.3 Socket of pipe — See Tables 2, 3, 4 and

Figs. 2 & 3 of the standard.

TABLE 1 DIAMETER AND WALL THICKNESS

All dimensions in millimetres								
<i>Nominal Outside Diameter</i>	<i>Mean Outside Diameter</i>		<i>Outside Diameter at Any Point</i>		<i>Wall Thickness</i>			
					<i>Type A</i>		<i>Type B</i>	
<i>DN</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min,</i>	<i>Max</i>	<i>Min,</i>	<i>Max</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
40	40.0	40.3	39.5	40.5	1.8	2.2	3.2	3.8
50	50.0	50.3	49.4	50.6	1.8	2.2	3.2	3.8
63	63.0	63.3	62.2	63.8	1.8	2.2	3.2	3.8
75	75.0	75.3	74.1	75.9	1.8	2.2	3.2	3.8
90	90.0	90.3	88.9	91.2	1.9	2.3	3.2	3.8
110	110.0	110.4	108.6	111.4	2.2	2.7	3.2	3.8
125	125.0	125.4	123.5	126.5	2.5	3.0	3.2	3.8
140	140.0	140.5	138.3	141.7	2.9	3.4	3.6	4.2
160	160.0	160.5	158.0	162.0	3.2	3.8	4.0	4.6

TABLE 2 MINIMUM WALL THICKNESS OF SOCKETS ON PIPES

All dimensions in millimetres				
Nominal Outside Diameter DN	S2,Min		S3,Min	
	Type A	Type B	Type A	Type B
(1)	(2)	(3)	(4)	(5)
40	1.6	2.9	1.0	2.4
50	1.6	2.9	1.0	2.4
63	1.6	2.9	1.0	2.4
75	1.6	2.9	1.0	2.4
90	1.7	2.9	1.1	2.4
110	2.0	2.9	1.2	2.4
125	2.3	2.9	1.4	2.4
140	2.6	3.2	1.6	2.7
160	2.9	3.6	1.8	3.0

TABLE 3. DIMENSIONS FOR SLIDING SOCKETS

All dimensions in millimetres			
Nomina Outside Diameter	Socket Depth, C Min	Mean Inside Diameter of Socket at Midpoint, D ₁	
(1)	(2)	Max (3)	Min (4)
40	26.0	40.1	40.3
50	30.0	50.1	50.3
63	36.0	63.1	63.3
75	40.0	75.1	75.3
90	46.0	90.1	90.3
110	48.0	110.1	110.4
125	51.0	125.1	125.4
140	54.0	140.2	140.5
160	58.0	160.2	160.5

TABLE 4 DIMENSIONS OF GROOVED SOCKET

All dimensions in millimetres						
Nominal Outside	Inside Diameter of Socket D ₁		Inside Diameter of Beading D ₂		Length of Beading and Neck A	Neck of Socket B
	Min (2)	Max (3)	Min (4)	Max (5)	Min (6)	Max (7)
(1)						
40	40.3	41.1	49.6	50.6	18	5
50	50.3	51.1	59.6	60.6	18	5
63	63.3	64.1	72.9	73.9	18	5
75	75.3	76.1	84.5	85.5	20	5
90	90.3	91.2	99.5	100.5	23	5
110	110.4	111.2	120.3	121.3	26	6
125	125.4	126.3	137.1	138.2	28	7
140	140.5	141.4	152.1	153.2	30	8
160	160.5	161.5	173.8	175.0	32	9

7. Tests

7.1. Visual Appearance – The internal and external surface of the pipes shall be smooth and clean, and free from groovings and other defects. the end shall be clearly cut and shall be square with the axis of the pipe.

7.2. Reversion Test—A length of pipe of approximately 300 mm shall not in length by more than 5 percent.

7.3 Stress Relief Test—This test shall be carried out for socket end pipes only. When tested the test specimens shall not show blisters, excessive delamination or cracking or signs of weld line splitting.

7.4 Vicat Softening Temperature—Not less than 79°C.

7.5 Effect of Sunlight—When exposed to sun for atleast 1600 h at ambient temperature it shall not show any difference in colour or physical appearance.

8 Resistance to Sulphuric Acid—The mass of specimen shall neither increase by more than 0.32 g, nor decrease by more than 0.13 g when tested as per IS 12235 (Part 7) : 1986.

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9. Mechanical

9.1. Impact Strength at 0°C — When tested by the method in IS : 12235 (Part 9) : 1986, the pipe sample shall not fracture or crack through its complete wall thickness.

9.2. Tensile Strength and Elongation—Not less than 45 MPa and 80 percent.

9.3 Axial Shrinkage (for Type B Pipes Only) — The axial shrinkage shall not exceed 2 percent.

10. Water Tightness of Joints — Assemble the fittings with the scaling devices, fill with water ensuring all air is removed. Jointing of solvent cementing joints is to be created out using solvent conforming to IS 14182

Note— For methods of tests refer to Appendix A of the standard, IS 6307 : 1985 Rigid PVC sheets (*first revision*), IS 8543 (Part 4/sec 1) 1984 Methods of testing plastics, Part 4 Short term mechanical properties, Section 1 Determination of tensile properties and relevant parts of IS 12235 : 1986 Methods of test for unplasticized PVC pipes for potable water supplies.

For detailed information, refer to IS 13592 : 1992 Specification for unplasticized polyvinyl chloride (UPVC) pipes for soil and waste discharge system for inside and outside buildings including ventilation and rain water system.

SUMMARY OF

IS 14333 : 1996 HIGH DENSITY POLYETHYLENE PIPES FOR SEWERAGE

1. Scope—Requirements for high density polyethylene pipes from 63 mm to 630 mm nominal diameter of pressure rating from 0.25 MPa to 1.6 MPa in material grades of PE63, PE80 and PE100 for sewerage applications.

2. Designation

2.1 Pipes shall be designated according to the pressure rating (*see* 2.2) and nominal diameter (*see* 2.3). For example, PN 10 DN 200 indicates a pipe having a pressure rating 1.0 MPa and outside nominal diameter 200 mm.

2.2 *Grade of material* — Pipes shall be classified as

Material Grade	MRS (Minimum Required Strength) of Material in MPa, at 20°C at 50 years	(Maximum Allowable Hydrostatic) Design stress, MPa, for Sewage and industrial effluent		
		At 20°	at 30°	
PE63	6.3	5.0	4.0	3.0
PE63	8.0	6.3	5.0	4.0
PE63	6.3	8.0	6.3	5.0

2.3 *Pressure Rating* — Pipes shall be classified by pressure rating (PN) as follows :

Pressure Rating of Pipe	Maximum Permissible Working Pressure, MPa
PN 2.5	0.25
PN 4	0.40
PN 6	0.60
PN 8	0.8
PN 10	1.00
PN 12.5	1.25
PN 16.0	1.60

2.4 *Nominal Diameter (DN)* — The nominal diameter of pipes covered in this standard are:

63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 335, 400, 450, 500, 560 and 630 mm.

3. Colour — Shall be black.

4. Materials

4.1 *High Density Polyethylene*—High density Polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA -45- T-006 or PEEWA -45- T-003 or PEEWA -50- T-003 or PEEWA -50-T-006 or PEEWA -57-T-003 or PEEWA-57-T-006 or

of IS 7328 : 1992*, HDPE conforming to designation PEEWA -45-T-012 PEEWA -50-T-012 or PEEWA -57 - T - 012 of IS 7328 : 1992 may also be used with the exception that melt flow rate (MFR) shall be between 0.20 g/10 min to 1.10 g/10 min (both inclusive)

4.1.1 Base density between 940 kg/m³ and 958.4 kg/m³ (both inclusive) at 27°C.

4.1.2 The MFR (Melt Flow Rate) of the material shall be between 0.20 g/10 min and 1.10 g/10 min (both inclusive) when tested at 190°C.

4.1.3 The resin shall be compounded with carbon black. The carbon black content in the material shall be within 2.5 ± 0.5 percent and the dispersion of carbon black shall be satisfactory.

4.2 *Anti-Oxidant* — Shall not be more than 0.3 percent by mass of finished resin.

4.3 *Reworked Material* — The addition of not more than 10 percent of the manufacturer's own rework material resulting from the manufacture of pipes of this standard is permissible.

5. Dimensions of Pipes

5.1 *Outside Diameter* — See Table 1.

*High density polyethylene material for moulding and extrusion

**TABLE 1 OUTSIDE DIAMETER,
TOLERANCE AND OVALITY OF PIPES**

<i>Nominal Diameter;</i>	<i>Outside Diameter;</i>	<i>Tolerance (only positive tolerances)</i>	<i>Ovality</i>
DN (1)	mm (2)	mm (3)	mm (4)
63	63.0	0.6	1.5
75	75.0	0.7	1.6
90	90.0	0.9	1.8
110	110.0	1.0	2.2
125	125.0	1.2	2.5
140	140.0	1.3	2.8
160	160.0	1.5	3.2
180	180.0	1.7	3.6
200	200.0	1.8	4.0
225	225.0	2.1	4.5
250	250.0	2.3	5.0
280	280.0	2.6	9.8
315	315.0	2.9	11.1
355	355.0	3.2	12.5
400	400.0	3.6	14.0
450	450.0	4.1	15.6
500	500.0	4.5	17.5
560	560.0	5.0	19.6
630	630.0	5.7	22.1

Note 1 — For chemical resistance classification table for HDPE pipes and fittings see Appendix D of the standard.

Note 2 — For methods of tests, refer to Appendices B and C of the standard.

For detailed information, refer to IS 14333 : 1996 Specification for high density polyethylene pipes for sewerage.

5.2. Wall Thickness — Shall be as given in Tables 3,4 and 5 of the standard.

5.3. Length — 5 to 20 mm.

5.4. Coiling — The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented.

6. Visual Appearance — The internal and external surfaces of the pipes shall be smooth, clean and free from grooving and other defects.

7. Performance Characteristics

7.1 Hydraulic Characteristics — Shall not show signs of localized swelling, leakage or weeping and shall not burst during the prescribed test duration.

7.2 Reversion Test — Longitudinal reversion shall not be greater than 3 percent.

SUMMARY OF

IS 14402 : 1996 GLASS FIBRE REINFORCED PLASTICS (GRP) PIPES JOINT AND FITTINGS FOR USE FOR SEWERAGE, INDUSTRIAL WASTE AND WATER (OTHER THAN POTABLE)

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

2. Classification

2.1. Pressure Classes (PN) — Five pressure classes of pipes namely, PN3, PN6, PN9, PN12 and PN15 correspond to the working pressure ratings of 300, 900, 1200 and 1500 kPa respectively.

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

Notes –

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

2. The above pressure classes correspond to the long term hydrostatic design pressure categories.

3. Nominal Diameter — 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000, 1 100, 1 200, 1 400, 1 600, 1 800, 2 000, 2 200, 2 400, 2 600, 2 800, 3 000 mm.

4. Materials

4.1 Resins — Appropriate type of unsaturated polyester resin systems conforming of IS 6746 : 1994* shall be used.

4.2 Glass Fibre Reinforcement — Glass fibre reinforcement shall be of commercial grade E type and shall conform to IS 11273 : 1992[†], IS 11320 : 1997[‡] or IS 11551 : 1996[§], as appropriate.

Note— For details of other materials, see 6.3 of the standard.

5. Dimensions

5.1 Inside Diameters and Tolerances — See Table 1

TABLE 1 SPECIFIED INSIDE DIAMETERS AND TOLERANCES

Nominal Diameter	Inside Diameter Range		Tolerances on Declared
DN	ID		ID
	Min	Max	
200	196	204	±1.5
250	246	255	±1.5
300	296	306	±1.8
350	346	356	±2.0
400	396	408	±2.4
450	446	459	±2.7
500	496	510	±3.0
600	596	612	±3.6
700	695	714	±4.2
800	795	816	
900	895	918	
1000	995	1 020	±5.0
1100	1 095	1 120	
1200	1 195	1 220	
1400	1 395	1 420	
1600	1 595	1 620	
1800	1 795	1 820	
2000	1 995	2 020	±6.0
2200	2 195	2 220	
2400	2 395	2 420	
2600	2 595	2 620	
2800	2 795	2 820	
3000	2 995	3 020	

* Unsaturated polyester resin system (first revision)

† Woven roving fabrics of 'E' glass fibre (first revision)

‡ Glass fibre rovings for the reinforcement of polyester and epoxidiseresin systems (first revision)

§ Glass fibre chopped strand mat for the reinforcement of epoxy, phenolic and polyester resinsystems (first revision)

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

TABLE 2 SPECIFIED OUTSIDE DIAMETERS AND TOLERANCES

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

2.0

5.3. Lengths — Pipes shall be supplied in effective lengths of 6 m, 9 m and 12 m. The tolerance on effective length shall be within ± 15 mm.

5.4. Out of squareness of Pipe — All points around each end of a pipe unit shall fall within ± 6.5 mm or ± 0.5 percent of the nominal diameter of the pipe whichever is greater, to a plane perpendicular to the longitudinal axis of the pipe.

5.5 Wall Thickness — Shall be such as to satisfy inside and outside diameter specified.

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

6.1. Unrestrained

- Coupling or Socket and Spigot Gasket Joints.
- Mechanical couplings

6.2. Restrained

- Joints similar to those in **6.1.1** with supplemental restraining elements.
- Butt joint, with laminated overlay.
- Socket-and-spigot, with laminated overlay.
- Socket-and-spigot, adhesive bonded.
- Flanged
- Mechanical.

6.3. Gaskets — Elastomeric gaskets when used with this pipe shall conform to the requirements of IS 5382 : 1995*.

7. Workmanship — Shall meet the acceptance criteria specified in Table 3

TABLE 3 ALLOWABLE DEFECTS

Name	Visual Acceptance Levels		
Chip	Maximum dimension of break, 6.5 mm	Pit (pinhole)	Maximum diameter, 0.8 mm; depth less than 20 percent of wall thickness.
Crack	None	Porosity (pinhole)	Maximum of 50 pits (pinholes)
Crack, surface	Maximum length, 6.5 mm	Pre-gel	Maximum dimension, 13 mm; height above surface not to be outside drawing tolerance.
Crazing	Maximum dimension of crazing, 25 mm	Resin-pocket	Maximum diameter, 6.5 mm
Delamination, edge	Maximum dimension, 6.5 mm	Resin-rich edge	Maximum 0.8 mm from the edge.
Delamination, internal	None	Shrink-mark (sink)	Maximum diameter 14 mm; depth not greater than 25 percent of wall thickness.
Dry-spot	Maximum diameter, 14 mm	Wash	Maximum dimension, 29 mm
Foreign inclusion (metallic)	Maximum dimension, 1.5 mm	Wormhole	Maximum diameter, 6.5 mm
Foreign inclusion (non-metallic)	Maximum dimension, 1.5 mm	Wrinkles	Maximum length surface side, 25 mm maximum length opposite side, 25 mm depth less than 15 percent of wall thickness.
Fracture	Maximum dimension, 29 mm	Scratch	Maximum length, 25 mm; maximum depth, 0.255 mm
Air bubble (void)	Maximum diameter, 3.0 mm	Short	None
Blister	Maximum diameter, 6.5; height from surface not to be outside drawing tolerance.	Note — For definitions of defects see Table 3 of the standard.	
Burned	None		
Fish-eye	Maximum diameter, 13 mm		
Lack of fillout	Maximum diameter, 9.5 mm		
Orange-peel	Maximum diameter, 29 mm		
Pimple	Maximum diameter, 3.0 mm		

* rubber sealing rings for gasd Mains, water mains and sewers (first revision)

8. Pipe Stiffness — Each length of pipe shall have sufficient strength to exhibit the minimum pipe stiffness (f/Δ_y) specified in Table 4.

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

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

Δ_y = vertical pipe deflection, in metres.

TABLE 4 PIPE STIFFNESS AT 5 PERCENT DEFLECTION

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

9. Fittings

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

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

9.2 Fittings may be made :

- from straight pipes, or
- by moulding

9.3. Tolerances for GRP Fittings :

9.3.1 Except for flanged pipe work, which may require closer tolerances, the permissible deviations from the stated value of the angle of change of direction of a fittings such as a bend, tee or junction shall not exceed $\pm 1^\circ$.

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

10. Hydraulic Test

10.1 General — Working pressure P_w in the system shall not exceed the pressure class of the pipe, that is $P_w < P_N$.

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

$$P_w + P_s \geq 1.4 P_N$$

10.2 Soundness — Shall withstand without leakage or cracking the internal hydrostatic test pressure specified in Table 5 of the standard.

10.3 Longitudinal strength — Shall withstand without failure, the beam loads specified in Table 6 of the standard.

10.4 Hoop tensile strength — Shall meet or exceed the hoop tensile strength shown in Table 7 of the standard.

11. Chemical Requirements — Shall be capable of being deflected, without failure, at the 50 year strain level given in Table 9 of the standard. When exposed to I.ON. sulphuric acid.

For detailed information, refer to IS 14402 : 1996 Specification for glass fibre reinforces plastics (GRP) pipes, joints and fittings for use for sewerage, industrial waste and water (other than potable).

SUMMARY OF

IS 14735 : 1999 UNPLASTICIZED POLYVINYL CHLORIDE (UPVC) INJECTION MOULDED FITTING FOR SOIL AND WASTE DISCHARGE SYSTEM FOR INSIDE AND OUTSIDE BUILDINGS INCLUDING VENTILATION AND RAIN WATER SYSTEMS

1. Scope— Requirements for Unplasticized Polyvinyl chloride (upvc) injection moulded fittings for jointing with solvent cement or elastomeric sealing ring to the UPVC pipes for soil and waste discharge system for inside and out side building including ventilation and rain water system covered in IS 13592 : 1992*.

2. Type of Fittings — Fitting shall be of one of the following types :

- a) tee (87.5°), Wye (45°) single, double (cross) or reducing, with or without inspection doors;
- b) Bend, with or without inspection doors (87.5°, 45° and 22½°);
- c) Reducer ;
- d) Coupler;
- e) Socket plug ;
- f) Cleansing pipe;
- g) Adaptor (for connecting UPVC pipes to other materials);
- h) Vent cowl;
- j) Pipe clip; and
- k) Waste trap with strainer (Nahani trap with Jali).

3. Size Designation — Shall be designated by the diameters of their sockets. The nominal inside diameter of the fitting shall correspond to the nominal outside diameter of the pipes given in IS 13592 : 1992.

4. Colour of Fittings— Shall be uniform dark shade of grey.

5. Materials — Shall consist essentially of polyvinyl chloride , to which may be added only those additive that are needed to facilitate the manufacture of sound and durable fittings of good surface finish , mechanical strength and opacity under conditions of use , together

with such pigments as are necessary to meet the requirements of 4. The material shall contain not less than 2.5 percent by mass of titanium dioxide.

The addition of the manufacturer's own clean rework material produced during manufacturer and work testing, complying with this standard is permissible upto 10 percent .

6. Dimensions

6.1 Wall Thickness — See Table 1.

TABLE 1 WALL THICKNESS

SI No. DN	Nominal Diameter	Wall Thickness			
		At Plain End		At Socket	
		<i>e</i>		<i>e</i> ₂	<i>e</i> ₃
		Min	Max	Min	Max
	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)
i)	40	3.2	3.8	2.9	2.4
ii)	50	3.2	3.8	2.9	2.4
iii)	63	3.2	3.8	2.9	2.4
iv)	75	3.2	3.8	2.9	2.4
v)	90	3.2	3.8	2.9	2.4
vi)	110	3.2	3.8	2.9	2.4
vii)	125	3.2	3.8	2.9	2.4
viii)	140	3.6	4.2	3.2	2.7
ix)	160	4.0	4.6	3.6	3.0

Note — For both solvent cement fittings and ring seal fittings a reduction of 5 percent of the wall thickness resulting from core shifting is permitted. In such a case, the average of two opposite wall thickness shall be equal to or exceed the values given in this table.

6.2 Socket Dimensions — See table 2 and 3

* UPVC pipes for soil and waste discharge systems inside buildings including ventilation and rain water system.

TABLE 2 SOCKET AND SPIGOT DIMENSIONS FOR SOLVENT CEMENT FITTINGS

Sl No.	Nominal Diameter	Socket Depth	Mean Inside Diameter of Socket at Mid Point		Mean Outside Diameter of Spigot Portion	
	DN	u	D1		D2	
	Min	Max	Min	Max	Min	Max
	mm (2)	mm (3)	mm (4)	mm (5)	mm (6)	mm (7)
(1)						
i)	40	26.0	40.1	40.3	40.0	40.3
ii)	50	30.0	50.1	50.3	50.0	50.3
iii)	63	36.0	63.1	63.3	63.0	63.3
iv)	75	40.0	75.1	75.3	75.0	75.3
v)	90	46.0	90.1	90.3	90.0	90.3
vi)	110	48.0	101.1	110.4	110.0	110.4
vii)	125	51.0	125.1	125.4	125.0	125.4
viii)	140	54.0	140.1	140.5	140.0	140.5
ix)	160	58.0	160.2	160.5	160.0	160.5

Note—See also sketches of table 2 and 3.

TABLE 3 SOCKET AND SPIGOT DIMENSIONS FOR RING SEAL FITTING

Sl. No.	Nominal Diameter DN	Mean Inside Diameter of Socket at Midpoint D1		Length of Beading Neck A	Neck of Socket B	Length beyond Beading C	Mean outside Diameter of Spigot Portion D2	
		Min	Max	Max	Min	Min	Min	Max
	mm	mm	mm	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	40	40.1	41.1	18	5	18	40.0	40.3
ii)	50	50.1	51.1	18	5	20	50.0	50.3
iii)	63	63.1	64.1	18	5	23	63.0	63.3
iv)	75	75.1	76.2	20	5	25	75.0	75.3
v)	90	90.1	91.2	23	5	28	90.0	90.3
vi)	110	110.1	111.3	26	6	32	110.0	110.4
vii)	125	125.1	126.4	28	7	35	125.0	125.4
viii)	140	140.2	141.4	30	8	38	140.0	140.5
ix)	160	160.2	161.5	32	9	42	160.0	160.5

Note — The minimum dimensions D1 in this table for grooved sockets shall be maintained same as that of sliding sockets (D1) in table 2.

6.3 Dimensions for Waste Trap (Nahani Trap)

Maximum diameter of rim of bowl	=	135.0 mm
Maximum depth of bowl	=	80.0 mm
Minimum water seal	=	10.0 mm
Minimum spigot length	=	70.0 mm
Spigot end outside	=	75.0 ⁺² ₋₀ mm

6.4. Chamfer – The spigot ends of fittings shall be chamfered to an angle of $15^\circ \pm 1^\circ$; to the axis of the pipe.

7. Sealing Rings – As per IS 5382 : 1985* with IRHD hardness of 50 ± 5 .

*Specification for rubber rings for gas mains, water mains and sewers.

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8. Workmanship — Both the inner and outer surface of the fitting shall be cleanly finished, smooth and free from grooving, blistering or other deleterious defects, when viewed without magnification. Each end of the fitting shall be square to the axis of the approximate line.

9. Requirements

9.1 Sockets of fittings shall be either of solvent cement type or rubber ring type.

9.2 Socket and Spigot Configurations — A fitting shall have any of the following configurations of socket and spigot.

- Asolvent cement type of socket at each end of the fittings;
- A rubber ring type of socket at each end of fitting;
- A solvent cement type socket at one or two ends, and a spigot at the other end, or at each of the other ends (as applicable) of the fitting;
- A rubber ring type socket at one or two ends, and a spigot at the other end, or at each of the other ends (as applicable) of the fittings; and
- A solvent cement type socket at one or two ends, and a rubber ring Type socket at the other end, or at each of the other nds (asapplicable) of the fitting.

9.3 Access Openings— When so required, fittings shall be supplied with an access opening, with threaded caps. Dimensions of access opening shall be as follows—

Nominal Diameter mm	Minimum Clear Opening (Diameter) mm
40 to 50	Equal to inside diameter of fitting
63 to 90	54.0
110 to 140	63.0
160	75.0

9.4 Vent Cowl—Vent cowls maybe of suitable length with perforations/openings. The dimentions of wall thickness and socket depth may be as follows

Nominal Diameter mm	Socket Depth Min mm	Wall Thickness of Socket, Min mm
(1)	(2)	(3)
40 to 63	20.0	1.8
75 to 90	22.0	2.0
110 to 160	24.0	2.0

9.5 Pipe Clips—Pipes clips may be of G1/Anti-corrosive material. The dimensions of pipe clips may be follows:

Nominal Diameter mm	Minimum Stand off Distance mm	Mean Inside Diameter	
		Min mm	Max mm
40	50.0	40.0	40.4
50	55.0	50.0	50.4
63	61.0	63.0	63.4
75	67.0	75.0	75.5
90	75.0	90.0	90.6
110	85.0	110.0	110.7
125	92.0	125.0	125.7
140	100.0	140.0	140.8
160	110.0	160.0	168.0

10. Physical Test Requirements

10.1 Visual Appearance — The internal and external surfaces of fittings shall be smooth and clean, and free roovings and other defects. The ends shall be clean and shall be square with the exisof the appropriate line.

10.2 Stress Relief Test— Shall not show blisters, excessive delamination or cracking or signs of weld line splitting.

10.3 Vicat Softening Temperature —Shall not be less than 78°C

11. Resistance to Sulphuric Acid — The mass of the specimen shall neither increase by more than 0.32 g not decrease by more than 0.13 g.

12. Sulphated Ash Content—Not more than 10 oercent by mass.

13. Mechanical Properties

13.1 Impact Test (Drop Test) — Shall not fracture or crack through its complete wall thickness.

14. Water Tightness of Joint — Assembly of fitting with the pipe shall show no leakage.

15. Titanium Dioxide Content— Shall not be less than 2.5 percent by mass.

Note – For methods of tests refer to Appendices A to D of the standard and IS 6307 : 1985 Rigid PVC sheets and IS 12235 : 1986 Methods of test for unplasticized PVC pipes for potable water supplies Part 6 Stress relief test: Part 7 resistance to Sulphuric acid.

For detailed information, refer to IS 14735 :1999 Specification for unplasticized polyvinyl chloride (UPVC) injection moulded fittings for soil and waste discharge system for inside and outside buildings including ventilation and rain water system.

SUMMARY OF
IS 1239 (PART 1) : 2004 STEEL TUBES, TUBULARS AND OTHER
WROUGHT STEEL FITTINGS
PART 1 STEEL TUBES
(Sixth Revision)

1. Scope — Requirement for welded and seamless plain end or screwed and socketed steel tubes intended for the use in water, gas pipelines and steam. Medium and heavy tubes only are recommended for carrying steam services. The maximum permissible pressure and temperatures for different sizes of tubes are given in Annex A of the standard for guidance only.

2. Designation — Shall be designated by their nominal bore, and shall be further classified as light, medium and heavy depending on the wall thickness; and screwed and socketed or plain-ended to denote end condition, and black or galvanized to denote surface condition.

3. Manufacture

3.1 Seamless — Seamless steel tubes shall be made from tested quality steel manufactured by any approved process and shall be fully killed. The Sulphur and phosphorus requirement in steel shall not exceed 0.04 percent each.

3.2 Steel tubes shall be manufactured by one of the following processes:

- a) Hot finished seamless (HFS)
- b) Electric resistance welded (ERW)
- c) High frequency induction welded (HFIW)
- d) Hot finished welded (HFW) and
- e) Cold finished seamless (cfs)

4. Dimensions

TABLE 1 DIMENSIONS OF STEEL TUBES—LIGHT

Nominal Bore	Outside Diameter		Thickness	Mass of Tube	
	Maximum	Minimum		Plain End (kg/m)	Screwed and Socketed
mm	mm	mm	mm		
(1)	(2)	(3)	(4)	(5)	(6)
6	10.1	9.7	1.8	0.360	0.363
8	13.6	13.2	1.8	0.515	0.519
10	17.1	16.7	1.8	0.670	0.676
15	21.4	21.0	2.0	0.947	0.956
20	26.9	26.4	2.3	0.138	0.139
25	33.8	33.2	2.6	1.98	2.00
32	42.5	41.9	2.6	2.54	2.57
40	48.4	47.8	2.9	3.23	3.27
50	60.2	59.6	2.9	4.08	4.15
65	76.0	75.2	3.2	5.71	5.83
80	88.7	87.9	3.2	6.72	6.89
100	113.9	113.0	3.6	9.75	10.00

TABLE 2 DIMENSIONS OF STEEL TABLES MEDIUM

Nominal Bore	Outside Diameter		Thickness	Mass of Tube	
	Maximum	Minimum		plain end (kg/m.)	Screwed and Socketed
mm	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)
6	10.6	9.8	2.0	0.404	0.407
8	14.0	13.2	2.3	0.641	0.645
10	17.5	16.7	2.3	0.839	0.845
15	21.8	21.0	2.6	1.21	1.22
20	27.3	26.5	2.6	1.56	1.57
25	34.2	33.3	3.2	2.41	2.43
32	42.9	42.0	3.2	3.10	3.13
40	48.8	47.9	3.2	3.56	3.60
50	60.8	59.7	3.6	5.03	5.10
65	76.6	75.3	3.6	6.42	6.54
80	89.5	88.0	4.0	8.36	8.53
100	115.0	113.1	4.5	2.2	12.5
125	140.8	138.5	4.8	15.9	16.4
150	166.5	163.9	4.8	18.9	19.5

TABLE 3 DIMENSIONS OF STEEL TUBES HEAVY

Nominal Bore	Outside Diameter		Thickness	Mass of Tube	
	Maximum	Minimum		Plain end (kg/m.)	Screwed and Socketed
mm	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)
6	10.6	9.8	2.6	0.487	0.490
8	14.0	13.2	2.9	0.765	0.769
10	17.5	16.7	2.9	1.02	1.03
15	21.8	21.0	3.2	1.44	1.45
20	27.3	26.5	3.2	1.87	1.88
25	34.2	33.3	4.0	2.93	2.95
32	42.2	42.0	4.0	3.79	3.82
40	48.8	47.9	4.0	4.37	4.41
50	60.8	59.7	4.5	6.19	6.26
65	76.6	75.3	4.5	7.93	8.05
80	89.5	88.0	4.8	9.90	10.40
100	115.0	113.1	5.4	14.5	14.8
125	140.8	138.5	5.4	17.9	18.4
150	166.5	163.9	5.4	21.3	21.9

Note— Thickness is applicable to both black and galvanized tubes

5. Tolerances

a) Thickness—

- | | |
|------------------------|---------------------------------|
| 1) Welded tubes: | |
| Light tubes | + not limited
– 8 percent |
| Medium and heavy tubes | + not limited
– 10 percent |
| 2) Seamless tubes | + not limited
– 12.5 percent |

a) Mass:

- | | |
|--|------------------------------|
| 1) Single tube (light series) | + 10 percent
– 8 percent |
| 2) Single tube (medium and heavy series) | ± 10 percent |
| 3) For quantities per load of 10 tonnes, Min (light series) | + 7.5 percent
– 5 percent |
| 4) For quantities per load of 10 tonnes, Min (medium and heavy series) | ± 7.5 percent |

Note: For the purpose of minimum weighment of 15 tonnes lot, the weighment may be done in convenient lots at the option of the manufacturer.

6. Joints – All screwed tubes shall be supplied with pipe threads conforming to IS554 : 1999*

7. Lengths— 4 to 7 m including one socket for screwed and socketed tubes.

7.1. Tolerances on Length : mm on exact length and ±150 mm of approximate length.

8. Galvanizing— All tubes shall be galvanized. Coating shall be as per IS 4736 : 1986†. Tubes which are to be screwed shall be galvanized before screwing.

*Pipe threads where pressure - tight joints are made on the threads dimensions tolerance and designation (fourth revision)

†Hot-dip zinc coatings on steel tubes (fourth revision)

9. Leak Tightness Test – Eddy current test may be done in place of hydrostatic test subject to mutual agreement between the purchaser and the manufacturer.

Hydrostatic test when carried out a pressure of 5 MPa, maintained for at least 3 seconds and shall not show any leakage in the pipe.

10. Test on Finished Tubes

10.1. Tensile strength — Not less than 320 MPa,

10.2. Elongation — The elongation percentage on a gauge length of $5.65 \sqrt{S_0}$, where S_0 is the original cross-sectional area of the test specimen, shall be as follows :

Nominal Bore	Elongation Percent Min
a) For steam services for all sizes	20 percent
b) For other services	
Up to and including 25 mm	12 percent
Over 25 mm up to and including 150 mm	20 percent

10.3 Bend Test – (Upto 50 mm nominal dia.)— Shall be capable of withstanding the bend test without showing any signs of fracture or failure.

10.4 Flattering Test— (for tubes above 50 mm nominal bore) - No opening shall occur by fracture in the weld until the distance between the plates is less than 75 percent of the original outside diameter of the pipe and no crack on breaks in the metal elsewhere than in the weld shall occur until the distance between the plates is less than 60 percent of the original outside diameter.

See 14.3 of the standard.

11. Workmanship — All pipes shall be cleanly finished and reasonably free from injurious defects. The ends shall be cleanly cut and reasonably square with axis of the pipe. The tubes shall be reasonably straight.

Note — For methods of tests refer to IS 1608 : 1995 Mechanical testing of metals Tensile testing (*second revision*) and IS 2329 : 1985 Methods of bend test on metallic tubes (in full section) (*first revision*).

For detailed information, refer to IS:1239 (Part 1) : 2004 Specification for steel tubes, tubulars and other wrought steel fittings Part 1 Steel tubes (sixth revision).

SUMMARY OF
IS : 1239 (PART 2) 1992 STEEL TUBES, TUBULARS AND OTHER
WROUGHT STEEL FITTINGS
PART 2 – STEEL SOCKETS, TUBULAR AND OTHER WROUGHT
STEEL FITTINGS
(Fourth Revision)

1. Scope — Requirements for butt welded and seamless, plain ended, screwed and socketed steel tubulars and other welded and seamless wrought steel pipe fittings. The requirements of backnuts are covered in IS 3468 : 1991⁺

2. Designation — Mild steel sockets and tubular shall be designated by their nominal bore. Other wrought steel fittings shall be designated giving the following particulars in the sequence shown :

- a) Type of fittings, and
- b) Size designation

3. Manufacture

3.1 Tubulars shall be made from tubes which comply with all the appropriate requirement of IS 1239 (Part 1): 1990.

3.2 Sockets shall be manufactured from any of the following processes :

- a) Hot- finished seamless (HFS)
- b) Electric resistance welded (ERW)
- c) High frequency induction welded (HFIW) and
- d) Hot finished welded (HFW)

3.3 The steel from which the fittings are made shall show a minimum tensile strength of 320 MPa. The percentage elongation shall not be less than 9500 divided by the tensile strength.

4. Chemical Composition — Shall not show Sulphur and Phosphorus is amounts exceeding 0.06 percent each.

5. Dimensions of Tubulars — Pieces, Nipples (close Tape, running and barrel nipples) long screws, bends, springs, return bends and mild steel sockets having, nominal bore 6, 0, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125 and 150mm.

Note— For details of dimensions and figures see tables 1 to 6 of the standard.

6. Dimensions of Wrought Steel Fittings (other than tubulars)

6.1 *Screwed ends of fittings* — Nominal size of outlet 6, 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150.

6.2 *Elbows, tees and crosses, equal* — Nominal size of outlet 6, 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 150.

6.3 *Elbows, Tees and crosses, equal* — Nominal size of outlet 8×6, 10×6, 10×8, 15×8, 15×10, 20×8, 20×10, 20×15, 25×10, 25×15, 25×20, 32×15, 32×20, 32×25, 40×15, 40×20, 40×25, 40×32, 50×15, 50×20, 50×25, 50×32, 50×40, 65×50, 80×25, 80×50, 100×50, 100×80.

6.4 *Tees, Reducing (on the branch)* — Nominal size of outlet 8×6, 10×6, 10×8, 15×10, 20×8, 20×10, 20×15, 25×10, 25×8, 25×15, 25×20, 32×10, 32×15, 32×10, 32×15, 32×20, 32×25, 40×10, 40×25, 40×32, 50×15, 50×20, 50×20, 50×20, 50×25 and 50×32.

6.5 *Tees, Reducing (on the run and branches, or on the run only)* — Nominal size of outlet 20×15×15, 20×15×20, 25×20×15, 25×20×20, 25×20×25, 32×25×20, 32×25×25, 32×25×32, 32×25×40, 40×32×25, 40×32×32, 40×32×40, 40×32×50, 50×32×50, 50×40×25, 50×40×40, 50×50×50, 50×50×65, 80×50×50, 80×50×80, and 100×80×80.

6.6 *Tees (increasing on the branch)* — Nominal size of the outlet 6×8, 8×10, 10×15, 15×20, 15×20, 15×25, 20×25, 25×32, 25×40, 32×40, 40×50, 50×65, 50×80, 65×80, 80×100.

6.7 *Crosses, Reducing* — Nominal size of outlet 8×6, 10×8, 15×10, 20×15, 25×15, 25×20, 32×15, 32×25, 40×15, 125×100, 150×80, 150×100.

6.9 *Elbows, round, male and female equal* — Nominal size of outlet — 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100.

⁺ Pipe nuts (*second revision*)

6.10 Elbows, equal, 135° — Nominal size of outlet 6, 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100.

6.11 Y- Pieces, Female, equal — Nominal size of outlet 15, 20, 25, 32, 40, 50, 65, 80, 100.

6.12 Socket, reducing — Nominal size of outlet 8×6, 10×6, 10×8, 15×6, 15×8, 15×10, 20×8, 20×10, 20×15, 25×8, 25×10, 20×15, 25×8, 25×10, 25×15, 25×20, 32×10, 32×15, 32×15, 32×20, 32×25, 40×15, 40×20, 40×25, 40×32.

6.13 Caps, Plugs — Nominal size 6, 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150.

6.14 Elbows, Tees and Crosses, Male, Equal — Y- Pieces and angle tees, male equal, twin elbows and sweep tees, male, equal. Nominal size of outlet 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150.

6.15 Socket Unions, Pipe Unions, Nipples, Hexagon, Equal — Nominal size 6, 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150.

6.16 Union bends — Nominal size of outlets 6, 8, 10, 15, 20, 25, 32, 40, 50, 65, 80.

6.17 Hexagon bushes

6.18 Nominal Size

External Threads	Internal Threads
8	6
10	8
15	8, 10
20	15
25	15, 20
32	15, 20, 25
40	20, 25, 32
50	25, 32, 40
65	32, 40, 50
80	40, 50, 65
100	50, 65, 80
125	80, 100
150	81, 100

Note 1 — All dimensions are in millimeters.

Note 2 — For details of dimensions see tables 7 to 28 of the standard.

7. Tolerance

Dimensions mm		Tolerance mm
Above	Upto and including	
(1)	(2)	(3)
—	30	± 1.5
30	50	± 2.0
50	75	± 2.5
75	100	± 3.0
100	175	± 3.5

7.1 Tolerance for the Alignment of Threads — The axes of the threads shall be coincident with the theoretical axes of the fittings within a tolerance of ± 0.50 on the run and on the branches.

8. Joints — Unless otherwise specified, sockets for tubulars shall have parallel threads. All threads shall be in accordance with IS 554 : 1985*.

9. Tests on Fittings and Socket

9.1 Pressure Test — Either of the following:

- The application of an internal hydraulic pressure of not less than 5 MPa, or
- The application of an internal air pressure of 0.7 MPa whilst the fittings is completely immersed in water or light oil. The ends of fittings and sockets when subjected to the required pressure, after having been made up wrench tight with the prior application of lubricant, or sealant, or by any other appropriate method shall not show any leakage.

9.2. Expansion Test on Sockets — At the option of Manufacturer- either drift expanding test or Taper screw plug test shall be carried out.

10. Galvanizing — Where tubulars sockets and fittings are required to be galvanised, the zinc coating shall be in accordance with IS 4736 : 1986+

11. Workmanship — Tubulars, sockets fitting shall be clearly finished and reasonably free from scale, surface flaws, laminations and other defects. The screw threads of tubulars, sockets and fittings shall be clean and well cut. The ends shall be cut clearly and square unless otherwise specified.

*Pipes threads where pressure tight joints are made on threads dimensions tolerances and designation (fourth revision)

*Hot dip zinc coating on mild steel tubes (fourth revision)

For detailed information, refer to IS : 1239 (Part 2) 1992 Specification for steel tubes, tubulars and other wrought steel fittings Part 2 Mild Steel sockets, tubulars and other wrought steel pipe fittings (fourth revision)

SUMMARY OF

**IS 3589 : 2001 SEAMLESS OR ELECTRICALLY WELDED STEEL
PIPES FOR WATER, GAS AND SEWAGE
(168.3 TO 2540 mm OUTSIDE DIAMETER)
(Third Revision)**

1. Scope – Applies to seamless or electric fusion welded, electric resistance welded and induction welded carbon steel pipes for water, gas and sewage of outside diameter from 168.3 to 2032 mm and having joints with plain or bevelled ends for butt welding or sleeve welded joints (swelled and plain end).

This standard does not cover steel pipes with screwed joints and requirements for specials, such collars, tees and bends, etc.

2. Designation – By the methods of manufacture followed by the number corresponding to the minimum specified tensile strength in MPa.

Example – EFW - Fe 410 indicates electric fusion (arc) welded steel pipe having a minimum tensile strength of 410 MPa

3. Quality of Steel – Pipes shall be manufactured from steel produced by the open hearth or electric or one of the basic oxygen processes.

4. Manufacture – Any of the following processes shall be employed for manufacture of pipes:

<i>Seamless</i>	<i>Method of</i>	<i>Reference</i>
<i>Hot Finished</i>	<i>Manufacture</i>	<i>HFS</i>
<i>Welded</i>		
a) Electric Resistance welded and induction welded		ERW
b) Electric Fusion (Arc) welded		EFW
i) Automatic submerged arc welded		
ii) Automatic metal arc welded with covered electrodes		
iii) Automatic metal arc welded with bare electrode any Co ₂		
iv) Manual metal arc welding		

5. Chemical Composition

5.1 Ladle Analysis

<i>Steel Grade</i>	<i>Chemical Composition (Ladle Analysis)</i>		
	<i>C</i>	<i>P</i>	<i>S</i>
	<i>Max</i>	<i>Max</i>	<i>Max</i>
Fe 330	0.17	0.055	0.055
Fe 410	0.25	0.055	0.055
Fe 450	0.30	0.050	0.050

Note—In case of non-availability of ladle analysis, the finished product may be checked to verify the chemical composition, if so agreed to by the producer.

5.2 Product Analysis—The permissible variation from the limits specified shall be as given below:

<i>Element</i>	<i>Permissible Deviation on</i>
<i>Products</i>	<i>Analysis, Percent</i>
Carbon	+ 0.02
Sulphur	+ 0.005
Phosphorous	+ 0.005

6. Tensile Strength

<i>Steel Grade</i>	<i>Tensile Strength MPa, Min</i>	<i>Elongation Percentage 5.65 $\sqrt{S_0}$ Min</i>
Fe 330	330	20
Fe 410	410	18
Fe 450	450	12

S_0 - Original cross sectional area of the specimen.

7. Random Length — Single random lengths from 4 to 7 m or double random lengths of 7 to 14 m. Where length specified as 'exact' or 'cut lengths' the permissible

variation shall be $\pm \frac{10}{0}$ mm for length up to and including

6 m. For above 6 m, the plus tolerances shall be increased, by 2 mm with maximum of 20 mm.

8. Outside Diameters —Outside diameters of the finished pipes shall be as given below :

<i>Outside Diameter</i>	<i>Outside Diameter</i>
(mm)	(mm)
168.3	864.0
193.7	914.0
219.1	965.0
244.5	1016.0
273.1	1067.0
323.9	1118.0
355.6	1168.0
406.4	1219.0
457.0	1321.0
508.0	1422.0
559.0	1524.0
610.0	1626.0
660.0	1727.0
711.0	1829.0
762.0	2032.0
813.0	

9. Tolerances

9.1 Outside Diameter – on pipe body

Outside Diameter mm	Tolerance	
	Welded Pipe	Seamless Pipe
Upto 508	±0.75 percent	±1 Percent
Over 508	±1 percent	±1.5 percent

9.2 Wall thickness

ERW Pipe	± 10 percent
EFW Pipe and	± 20 percent
Seamless Pipe	–12.5 percent

9.3 Straightness – Finished pipe shall not deviate from straightness by more than 0.2 per cent of the total length.

10. Wall Thickness

Pipes	Outside Dia	Minimum Specified Thickness of
	168.3 to 406.6 mm	4 mm
Above	406.6 to 599.0 mm	5 mm
Above	599.0 to 914.0 mm	6 mm
Above	914.0 to 1219.0 mm	7 mm
Above	1219.0 to 1620.0 mm	8 mm
Above	1620.0 to 2032.0 mm	10 mm

11. Hydraulic Pressure Test – The hydraulic test pressure shall be the pressure calculated from the following formula, except that the maximum test pressure shall not exceed 5 MPa.

$$P = \frac{2S}{D}t$$

where

P = test pressure in MPa,

S = Stress in MPa which shall be taken as 40 percent of the specified minimum tensile strength

t = specified thickness in mm.

D = specified outside diameter in mm.

Test pressure shall be applied and maintained for sufficiently long time for proof and inspection.

Note — Normally 5 seconds are sufficient for the purpose of the test. NDT test may be carried out in place of hydraulic pressure test. Method of NDT and the acceptance level shall be as agreed to between the manufacturer and the purchaser

12. Joints and Ends

- Plain ends or bevelled ends for butt welding (see Fig. 1A and 1B of the Standard) unless otherwise agreed, bevelled ends shall be bevelled to an angle of 30° measured from a line drawn perpendicular to the axis of the pipe. The root face shall be 1.6 ± 0.8 mm.
- Joints with sleeve joint or swelled and plain ends for welding (see Fig. 2 of the Standard)

12.1 Depth of Sleeve, X (for Welded Tubes)

Dimension mm	Outside Diameter of Pipe mm		Tolerance mm
50	168.3	upto 406.4	± 6
60	457.0	upto 1219.0	± 6
75	1321.0	upto 2032.0	± 6
Clearance Y between Plain Ends.	168.3	upto 1219.0	4
Max	1321.0	upto 2032.0	6

13. Tests

13.1. Tensile Test Not less than the values specified under 6.

13.2 Flattering test

13.2.1 For ERW pipes — No opening shall occur by fracture in the weld until the distance between the plates is less than 75 percent of the original outside diameter of the pipe and no cracks or breaks on the metal elsewhere than in the weld shall occur until the distance between the plates is less than 60 percent of the original outside diameter.

13.2.2 For seamless pipes — Shall be flattened when cold between two parallel flat surfaces without showing either crack or flaw, until when the pressure is released, the interior surfaces remain at middle of a distance apart not greater than that for Fe 450 and Bt Fe 330 & Fe 410.

13.3 Guided Bend Test (For EFW Pipes) — Shall not fracture completely.

Note — For details see 16 of the standard.

14. Workmanship — All pipes shall be cleanly finished and when visually inspected, shall be free from defects such as cracks, surface flaws, laminations, etc. The ends shall be cleanly cut and reasonably square with the axis of the pipe.

For detailed information, refer to IS 3589 : 2001 Specification for seamless or electrically welded steel pipes for water, gas and sewage (168.3 to 2032 mm outside diameter) (third revision)

SUMMARY OF

IS 4270 : 2001 STEEL TUBES USED FOR WATER WELLS

(Third Revision)

1. Scope — Requirements for steel tubes used for water wells, such as, casing, drive pipe and housing, having the following types of joints

- a) Screwed and socketed butt joints,
- b) Screwed flush butt joints, and
- c) Plain bevelled end pipes for butt welded joints.

2. Types and Grades— Tubes shall be one of the following types and grades of steel:

Type of Tube	Grade of Steel
Hot Finished Seamless (HFS)	<div style="display: flex; align-items: center; justify-content: center;"> <div style="font-size: 4em; margin-right: 10px;">}</div> <div> Fe 410 Fe 450 </div> </div>
Electric Automatic/semi-automatic Fusion Welded (EFW)	
Electric resistance welded (ERW) and	
High frequency induction welded (HFIW)	

3. Manufacture — Steel used shall be made by open-hearth, electric or basic oxygen process, having not more than 0.06 percent each of sulphur and phosphorous.

4. Dimensions

4.1 Length — Random lengths of 4 to 7 m.

Dimensions of Screwed and Socketed Casing Pipes

All dimensions in millimetres.

Nominal Bore of Pipe	Outside Diameter of Pipe	Thickness of Pipe	Socket Outside Diameter	Overall Length of Socket,
Min				
100	114.3	5.4	130.0	114.3
125	141.3	5.4	157.0	120.6
		7.1		
150	168.3	5.4	184.0	27.0
		7.1		
175	193.7	6.4	211.6	152.4
		8.0		
200	219.1	6.4	237.0	152.4
		8.0		
225	244.5	7.1	262.5	165.1
		9.0		
250	273.1	8.0	291.0	177.8
		10.0		
300	323.9	8.0	346.0	177.8
		10.0		

Dimensions of Plain Casing Pipes

Nominal Bore of Pipe	Outside Diameter of Pipe	Thickness of Pipe
(mm)	(mm)	(mm)
100	114.3	5.0
125	141.3	5.0
150	168.3	5.0
175	193.7	5.4
200	219.1	5.4
225	244.5	6.0
250	273.0	7.1
300	323.9	7.1
350	355.6	8.0, 10.0 and 12.0
400	406.4	8.0, 10.0, 12, 14.0
400	406.4	10.0, 12.0 and 14.0
450	457.2	10.0

Dimensions and Masses of Drive Pipes for Screwed Flush Butt Joints (Square Threads)

Nominal Bore	Outside Diameter	Thickness
mm	mm	mm
(1)	(2)	(3)
100	114.3	6.0
125	141.3	6.0
150	168.3	8.0
175	193.7	8.0
200	219.0	10.0
225	244.5	10.0
250	273.0	10.0
300	323.9	10.0
350	355.6	10.0
400	406.4	12.0 and 14.0
450	457.2	12.0 and 14.0
500	508.0	12.0 and 14.0
550	558.8	14.0
625	635.0	14.0

Dimensions of Plain End Drive Pipes

Nominal Bore	Outside Diameter	Thickness
(mm)	(mm)	(mm)
(1)	(2)	(3)
300	323.9	10.0 and 12.0
350	355.6	10.0, 12.0 and 14.0
400	406.4	10.0, 12.0 and 14.0
450	457.2	10.0, 12.0 and 14.0
475	482.6	14.0
500	508.0	10.0 and 14.0
550	558.8	14.0
625	635.0	14.0

Note— For masses see Tables 1 to 4 of the standard.

5. Tolerances

5.1 Outside Diameter — Permissible tolerances on outside diameter of pipe and socket shall be ± 1 percent but not greater than 3 mm in the case of socket.

5.2 Thickness — The permissible tolerances on the tube thickness shall be as follows :

Seamless tube	+ 20 percent - 12.5 percent
Welded tube	
Up to and including 406.4 mm outside diameter	+ 15 percent - 12.5 percent
Over 406.4 mm outside diameter	+ 15 percent - 10 percent

5.3 Straightness — Tubes shall not deviate from straightness by more than 1 in 600 of any length.

6. Joints

6.1 Screwed and socketed butt joints shall have right-handed V-form threads in accordance with the particulars given in Fig. 4 and Table 6 of the Standard

6.2 Screwed flush butt joints shall have right handed square form threads in accordance with the particulars given Fig. 5 and Table 7 of the Standard.

6.3 The plain-end pipes shall be supplied with both ends bevelled or both ends square cut or one end bevelled and one square cut.

7. Condition of Pipes — All pipes shall be, free from harmful defects, of good commercial finish and free from loose scale and rust. When required, the ends shall be cut square with the axis of the pipe.

8. Tests

8.1 Tensile Test—Tensile strength and elongation.

Grade	Tensile strength	Yield strength	Elongation Min $5.65 \sqrt{S_0}$
MPa	MPa (N/mm ²)	MPa	Percent (N/mm ²)
Fe	450	275	13
Fe	410	235	15

8.2 Flattening Test — Shall not show crack or flaw.

8.3 Alignment Test — When two tubes are screwed together till they butt, and their axes shall not then be out of line by more than 100 mm in each 6 metre length.

Note — This test is not applicable to the plain end pipes.

8.4. Hydraulic Pressure Test — Every pipe shall withstand the test pressure as calculated by the following formula for 3 s.

Grade	Test Pressure N/mm ²
Fe 410	280 t/D
Fe 450	350 t/D

where

t = thickness of pipe in mm, and

D = outside diameter of pipe in mm.

The maximum pressure applied shall be 7 MPa.

9. Coating of Tubes — The tubes shall be externally coated with a bituminous solution or any other protective anti-corrosion coating. Where tubes are required to be galvanized, the zinc coating on the tubes shall be in accordance with IS 4736 :1986*.

10. Protection of ends

10.1 All threads shall be coated with a petroleum jelly or other suitable rust preventing compound.

10.2 All tubes with V-form threads shall have the threads protected with plastic rings or sleeves.

10.3 All tubes with square form threads shall have the exposed male threads protected with steel rings or sleeves and the female threads protected with steel nipples or bushes.

10.4 No protection of the ends shall be provided for tubes for Butt Welding unless specially called for by the purchaser.

* Hot-dip zinc coatings on mild steel tubes (*first revision*)

For detailed information, refer to IS 4270 : 2001 Specification for Steel tubes used for water wells (third revision)

SUMMARY OF
IS 5504 : 1997 SPIRAL WELDED PIPES
(First Revision)

1. Scope — Requirements of spiral seam welded steel pipe over 457 mm dia and upto 2000 mm dia with wall thickness upto 12.5 mm inclusive. The pipe is intended for general use. The suitability of pipe for various purposes is dependent on its dimensions, properties and condition of service. The purpose for which the pipe is intended should be stated in the enquiry and order.

2. Manufacture — Steel used shall be produced by open hearth a electric or one of the basic oxygen processes. The helical seam shall be welded by one of the following processes :

- a) Electric fusion butt welding internally and automatic are welding externally.
- b) Electric resistance welding
- c) Automatic submerged are welding.

3. Chemical Composition

3.1 Ladle analysis

<i>C percent</i>	<i>S percent</i>	<i>P percent</i>
<i>Max</i>	<i>Max</i>	<i>Max</i>
0.25	0.05	0.05

3.2 Product analysis

<i>Element</i>	<i>Variation Over and Above Specified Limit, percent</i>
C	0.02
P	0.005
S	0.005

4. Physical Tests

4.1. Tensile Test

<i>U.T.S Min</i>	<i>Y.S. Min</i>	<i>E Percent Min</i>
		on 5.65 $\sqrt{S_0}$
410 MPa	240 MPa	20

4.2 Flattering Test — Shall withstand the prescribed test.

4.3 Submerged Arc Weld Test — Shall withstand the prescribed test.

5. Hydrostatic Test — Shall be tested at mill to a hydrostatic pressure, equal to a minimum of 150 percent of working pressure required. In no case the maximum stress produced exceeds 40 percent of minimum ultimate tensile strength envisaged in the steel.

Note — Steel tensile strength may be assumed as 410 MPa normally and unless otherwise agreed.

The pressure shall be calculated from the following equation :

$$P = 2 st/D$$

where

P = test pressure MPa,

s = stress in MPa (normally 40 percent of 410 MPa, that is 164 MPa)

t = specified wall thickness in mm, and

D = specified outside diameter in mm.

6. Permissible Variations in Dimensions

6.1 Lengths — Steel pipe shall be supplied in single random length between 4 to 7 m or double random length of 7 to 14 m.

6.2 Thickness and Diameter — The tolerance on wall thickness shall be +15 percent and 12.5 percent.

The tolerance on outside diameter of pipe shall be as follows :

Upto 1,000 mm OD = ± 0.75 percent

Over 1,000 mm OD = ± 1 percent

The ovality of pipe shall be with ± 0.75 percent.

7. Finish — The finished pipe shall be reasonably straight, free from injurious defects.

For detailed information, refer to IS 5504 : 1997 Specification Spiral welded pipes (first revision)

SUMMARY OF

IS 6286 : 1971 SEAMLESS AND WELDED STEEL PIPE FOR SUB-ZERO TEMPERATURE SERVICE

1. Scope – Requirements for 4 grades of seamless and electric welded steel pipe for conveying fluids at sub-zero temperature.

2. Manufacture – Steel used shall be made by open hearth, electric, basic oxygen or a combination of these

2.1 Steel shall be of fully killed type.

3.2 Product Analysis — The maximum permissible variation of various elements in the case of product analysis from the limits stated in 2.1 shall be as follows:

	Percent
Carbon	± 0.02
Manganese	± 0.03
Phosphorus	+ 0.005
Sulphur	+ 0.005

4. Dimensions

Nominal Bore	Outside Diameter	Thickness
mm	mm	mm
6	10.2	1.8, 2.0 and 2.65
8	13.5	1.8, 2.35 and 2.9
10	17.2	1.8, 2.35 and 2.9
15	21.3	2.0, 2.65 and 3.25
20	26.9	2.35, 2.65 and 3.25
25	33.7	2.65, 3.25, 4.05 and 4.85
32	42.4	2.65, 3.25, 4.05 and 5.4
40	48.3	2.9, 3.25, 4.05, 4.85 and 5.9
50	60.3	2.9, 3.65, 4.5, 4.85, 5.6, and 6.35
65	76.1	3.25, 3.65, 4.5, 5.4 and 6.5
80	88.9	3.25, 4.05, 4.85, 5.4, and 6.35
90	101.6	3.65, 4.05, 4.85, and 6.35
100	114.3	3.65, 4.5, 5.4, 5.9, 6.35, and 8.0
125	139.7	3.65, 4.5, 4.85, 5.4, 6.35, 8.0 and 9.5
150	165.1 & 168.3	3.65, 4.5, 4.85, 5.4, 6.35, 7.1,

2.2 Pipes of grades 1, 2 and 3 shall be made either by seamless or electric welded process. Pipes of grade 4 shall be made by seamless process only.

3. Chemical Requirements see Table 1

3.1 Ladle Analysis

175	193.7	8.0 and 9.5
200	291.1	3.65, 4.5, 4.85, 5.4, 6.35, 7.0 and 9.5
225	244.5	4.85, 5.4, 6.35, 7.1, 8.0, 9.5, 11.0, and 12.5
250	273.0	5.9, 7.1, 8.0 and 9.5
398	323.9	5.9, 6.35, 7.1, 8.0, 9.5, 11.0, and 12.5
350	355.6	6.35, 7.1, 8.0, 9.5, 11.0 and 12.5
400	406.4	6.0, 9.5 and 11.0
450	457.2	8.0, 9.5, 11.0 and 12.5

lengths between 1 to 13 m

4.1 Tolerances — The following tolerances shall apply—

a) Outside diameter	± 1	percent
b) Wall thickness	± 15.0	percent
	– 12.5	

5. Workmanship and Finish — Plain-end pipes of 60.3 mm outside diameter and larger shall be furnished

with the ends bevelled to an angle $30^{\circ} \begin{smallmatrix} +5^{\circ} \\ -0^{\circ} \end{smallmatrix}$ of

measured from a line drawn perpendicular to the pipe and with a root face of 1.60 ± 0.8 mm. The end finish for pipes smaller than 60.3 mm outside diameter shall be as specified by the purchaser.

5.1 All defects shall be explored for depth when the depth is in excess of 12.5 percent of the nominal wall thickness or encroaches on the minimum wall thickness, such defects shall be considered injurious.

TABLE 1 CHEMICAL REQUIREMENTS

	GRADE 1	GRADE 2	GRADE 3	GRADE 4
Carbon percent <i>Max</i>	0.30	0.30	0.19	0.12
Manganese percent	0.40 to 1.06	0.29 to 1.06	0.90 <i>Max</i>	0.50 to 10.5
Phosphorus percent <i>Max</i>	0.05	0.05	0.05	0.04
Sulphur percent <i>Max</i>	0.05	0.05	0.05	0.04
Silicon percent	-	0.10 <i>Min</i>	0.13 to 0.32	0.08 to 0.37
Nickel percent	-	-	2.03 to 2.57	0.47 to 0.98
Chromium percent	-	-	-	0.44 to 1.01
Copper percent	-	-	-	0.40 to 0.75
Aluminum percent	-	-	-	0.04 to 0.30

Note — For each reduction of 0.01 percent carbon below 0.30 an increase of 0.04 percent manganese above 1.05 shall be permitted to a maximum of 1.30 percent.

6. Physical Tests

6.1 Tensile Test

<i>Tensile Requirements</i>				
	<i>Grade 1</i>	<i>Grade 2</i>	<i>Grade 3</i>	<i>Grade 4</i>
Tensile Strength kgf/mm ² , <i>Min</i>	38.5	42.0	45.5	42.0
Yield point, kgf/mm ² , <i>Min</i>	21.0	24.5	24.5	24.5

Note — Elongation 50.8 mm Min percent shall be computed by using the following equations.

<i>Grade</i>	<i>Direction of Test</i>	<i>Equation</i>
1	Longitudinal	$E = 2.205l + 17.50$
	Transverse	$E = 1.575t + 12.50$
2	Longitudinal	$E = 1.890t + 15.00$
	Transverse	$E = 1.260t + 11.00$
3	Longitudinal	$E = 1.890t + 15.00$
	Transverse	$E = 1.339t + 11.00$
4	Longitudinal	$E = 1.890t + 15.00$
	Transverse	$E = 1.260t + 6.50$

Where

E = percent elongation in 50.8 mm, and

t = Actual thickness of specimen in millimeters.

6.2 Flattening Test — Shall with stand the prescribed test

6.3 Impact Test

<i>Grade</i>	<i>Minimum Impact Test Temperature</i>
1	- 46°C
2	- 46°C
3	- 73°C
4	- 101°C

Impact Properties

<i>Size of Specimen</i>	<i>Minimum Average Notched Bar Impact Value of Each Set of Three Specimen</i>	<i>Minimum Notched Bar Impact Value of one Specimen Only of a set</i>
mm x mm	kgf.m	kgf.m
10 x 10	2.07	1.38
10 x 7.5	1.73	1.17
10 x 5	1.38	0.97
10 x 2.5	0.69	0.48

7. Hydrostatic Test — When subjected to a test pressure P for 5 seconds, there shall be no leakage.

$$P \text{ (kgf/cm}^2\text{)} = 200St/D$$

Where

P = hydrostatic test pressure in kgf/cm

S = fibre stress in kfg/mm²,

t = speceified outside diameter in mm

8. Non-Destructive Tests — Any mutually agreed.

For detailed information, refer to IS 6286 : 1971 Specification for seamless and welded steel pipe for sub-zero temperature service.

SUMMARY OF
IS 651 : 1992 SALT GLAZED STONEWARE PIPES AND FITTINGS
(Fifth Revision)

1. Scope — Covers dimensions and performance requirements for the following glazed stoneware pipes and fittings— Straight pipes and taper pipes; Bends; Taper bend; Junctions; Half-section channels, straight and taper; Channel junctions; Channel bends; Channel interceptors; Gully traps; and Inspection pipes.

The pipes covered in this standard are not meant for potable water applications. Dimensions are grouped into two sections A and B. Section A covers dimensions of straight pipes and all such fittings which normally form part of pipe line and which are subject to same conditions, specifications and tests as straight pipes. Section B includes dimensions of fittings which are commonly used but do not form. Section B being hand rounded articles, their conformity to dimensional specifications is not required to be so accurate as for those in Section 'A'.

2. Right-hand and Left-hand Fittings— A right-hand fitting is such that when viewed from the spigot towards the socket, the arm of a junction or the socket of a bend projects to the right. A left-hand fitting is such that when viewed as above, the arm of socket projects to the left.

3. General Quality — All pipes and fittings shall be sound and free from visible defects which impair the strength, durability and serviceability. The glaze of pipes and fittings shall be free from crazing. The pipes and fittings shall give a sharp clear note when struck with a light hammer. Colour of pipes/fittings may vary from yellow to dark brown/black.

4. Glazing — The interior and exterior surfaces of the pipes and fittings which remain exposed after jointing, shall be glazed. The glaze shall be obtained by the action of fumes of volatilized common salt on the material of the pipes and fittings during the process of burning or glaze shall be ceramic glaze consisting of glazing material, applied prior to firing.

5. Tests

5.1 Hydraulic Test — Straight pipes shall withstand the internal hydraulic test pressure of 0.15 MPa on the barrels and fitting covered in Section A of the standard and 0.075 MPa for fitting covered in Section B of the standard, without showing signs of injury or leakage.

5.2 Absorption Test — Maximum increase in mass shall be as follows :

<i>Thickness of Pipe or Fitting, mm</i>	<i>Increase in Mass Percent</i>
Upto and including 20	6
Over 20 and upto 25	7
Over 25 and upto 32	8
Over 32 and upto 38	9
Over 38	10

5.3 Test for Acid Resistance — The loss in mass shall not exceed 2.5 percent

5.4 Test for Alkali Resistance — There shall be no evidence of pitting, softening, spalling or cracking in the pipe or fitting after the test.

5.5 Crushing Strength Test — Minimum 16 KN/m length.

6. Dimensions of Pipes and Fittings forming Part of Pipe Line.

6.1 Internal Diameter — The internal diameter of the barrels of straight pipes, fuctions and bends shall be 100, 150, 200, 230, 300, 350, 400, 450, 500 and 600 mm. The tolerance shall be ± 5 , ± 6 , ± 6 , ± 6 , ± 8 , ± 8 , ± 8 , ± 10 , ± 10 , ± 12 and ± 12 mm respectively.

6.2 Thickness of Barrels, Sockets, and Bends— Shall be minimum 12, 15, 16, 20, 25, 30, 35, 37, 40 and 43 mm corresponding to each internal diameter specified above.

6.3 Length and Straightness of barrels for straight and taper pipes.

- a) *Length* – 600, 750, or 900 mm
- b) *Tolerance* – ± 100 mm for 600 and 750 mm and ± 15 mm for 900 mm length.
- c) *Permissible deviation from straightness* – Shall be 5mm for 600 mm, 6 mm for 750 mm and 7 mm for pipes of 900 mm length.

6.4 Tapers, Bends and Junctions — Internal diameters of taper pipes, half section straight channels, half section

taper channels and junction shall be selected from 6.1 Dimension of bends shall be in accordance with Table 2 to 6 of the standard.

6.5 Sockets – Minimums table of hmm, measured on the diameter, per 15 mm length. Depth of sockets and shoulder shall be as given in Table 1 of the standard.

Note 1— For dimensions of fittings covered under section B sec. tables 7 to 12 of the standard.

Note 2—For methods of tests refer to Appendices A to C of the standard.

For detailed information, refer to IS 651 : 1992 Specification for salt glazed stoneware pipes and fittings (fifth revision).

SUMMARY OF
IS 3006 : 1979 CHEMICALLY RESISTANT GLAZED STONEWARE
PIPES AND FITTINGS
(Fifth Revision)

1. Scope—Material and performance requirements for chemically resistant glazed stoneware pipes (straight pipes) and fittings (taper pipes; bends, taper bends; junctions; half section channels; straight and taper ; channel junctions; channel bends; channel interceptors; gully traps and inspection pipes). Dimensions of chemically resistant glazed stoneware pipes and fittings are grouped into two sections, A and B. Section A covers dimensions of straight pipes and all such fittings which normally form a part of a pipe line and which are subject to the same conditions, specifications and tests as straight pipes. Section B includes dimensions of fittings which are commonly used and which do not form a part of the normal pipe line. The fittings in Section B being hand-moulded, their conformity to dimensional specifications is not required to be so accurate as for those in Section A.

2. Requirements

2.1 Shall be sound and free from visible defects, such as, cracks, crazing, etc.

2.2 Shall give sharp clear note when struck with light hammer.

2.3 Interior and exterior surfaces of the pipes and fittings which remain exposed after jointing, shall be glazed.

3. Tests

3.1 Pipes shall withstand hydraulic pressure of 0.3 MPa on the barrels and 0.15 MPa on fittings. The pressure shall be maintained for not less than 5 seconds without showing signs of leakage or injury.

3.2 Water absorption shall not exceed the following :

<i>Thickness of Pipe or Fitting</i>	<i>Increase in Mass, Percent</i>
Up to 20 mm	3
20 to 25 mm	4
25 to 32 mm	5
32 to 38 mm	6
Over 38 mm	8

3.3 Acid Resistance — Loss in mass shall not exceed

1.5 percent.

3.4 Alkali Resistance — Shall not show evidence of pitting, softening, spalling or cracking.

4. Dimensions

4.1 Pipes, Barrels and Sockets

<i>Internal Diameter of Pipe</i>	<i>Mean Thickness of the Barrel and of Socket, Min</i>	<i>Internal Depth of Socket Min</i>
100	12	50
150	15	57
200	16	63
250	20	70
300	25	70
350	30	75
400	35	75
450	37	76
500	40	80
600	43	90

4.2 Length of the barrels of straight and taper pipes, junctions and half-section channels, exclusive of the internal depth of the socket, shall be 600, 750 or 900 mm.

4.2.1 Tolerance on length ± 10 mm for 600 mm and 750 mm length and ± 15 mm for 900 mm length pipes.

4.2.2 Deviation from straightness shall not exceed 5 mm for 600 mm length of pipes, 6 mm for 750 mm length and 7 mm for pipes of 900 mm length.

4.3 Sockets — The interior of the sockets shall be conical, having a minimum taper of 1 mm, measured on the diameter, per 15 mm length.

4.4 Tapers, Bends and Junctions.

4.4.1 Internal diameters of taper pipes, half-section straight channel half-section taper channels, bends (one quarter, one eighth and one sixteenth).

4.4.2 Barrels and branches of half-section channel junctions may be any of the diameters given in 4.1, but the diameter of branches shall not exceed the barrel diameter. Angle at junction shall be $45 \pm 3^\circ$ or $90 \pm 3^\circ$.

5. Grooving – The interior of the sockets, and the exterior of the spigots shall be grooved circumferentially and such grooving on the spigot shall be for a length equal to one and a half times the depth of the sockets, and the depth of such grooves shall be between 1mm and 2 mm.

6. Gully Traps

6.1 Round Mouth Gully Traps

Type	Size mm
P	100 × 100, 125 × 100, 150 × 100 180 × 100 and 180 × 150
Q	125 × 100
S	125 × 100, 150 × 100 and 180 × 150

6.2 Square Mouth Gully Traps

Type	Size mm
P	100 × 100, 125 × 100, 150 × 100 180 × 100 and 180 × 150
Q	125 × 100
S	125 × 100, 150 × 100 and 180 × 150

Note 1 – For detailed dimensions and sketches refer to the standard.

Note 2 – For test procedures, 6 of the standard

For detailed information, refer to IS 3006 : 1979 Specification for chemically resistant glazed stoneware pipes and fittings (first revision).

SUMMARY OF
IS 771 (PART 1) : 1979 GLAZED FIRE-CLAY SANITARY
APPLIANCES
PART 1 GENERAL REQUIREMENTS
(Second Revision)

1. Scope – General requirements for materials, manufacture, finish, methods of test, sampling and inspection of all glazed fire-clay sanitary appliances.

2. Material and Manufacture

2.1 Fire – Clay bodies are moderately fine, porous, off-white bodies using natural fire clays, ball clays or stoneware clays and clay grogs covered by a glaze properly matured and fitted to the body.

2.2 Permissible defects and blemishes – See Table 1

**TABLE 1 BLEMISHES AND DEFECTS
PERMITTED IN VARIOUS
APPLIANCES**

<i>Sl</i>	<i>LOCATION</i>	<i>BLEMISH OR DEFECT</i>	<i>MAXIMUM PERMITTED</i>
(1)	(2)	(3)	(4)
i)	General	Warpage	Not to exceed $\pm 2\%$ on all planes or 10 mm which ever is less A total of not over 6
		Spots and Blisters	
ii)	Service space, top of rim or slab, inside of bowl	Bubbles, pinholes and specks	A total of not over 8
		Polishing marks and exposed bodies	A total of not over 4
		Spots and blisters	A total of not over 6
iii)	Visible surfaces other than above	Bubbles, Pinholes and square, a specks	Not over 3 in one pottery A total of not over 10
		Polishing marks and exposed bodies.	A total of not over 4

Note — For methods of tests, refer to B of the standard.

2.3 Minimum Thickness — At any place shall not be less than 8 mm

2.4 Glazing — All visible surfaces of the body shall be glazed. Surfaces coming in contact with floor or wall and the underside of sinks, etc, and points where appliances are supported in the kiln may be unglazed. The glaze shall be uniform, free from craze and shall possess an impervious surface. It shall have a high gloss and shall normally be white. In the case of glazes containing lead, the lead content shall not exceed 5 percent of soluble lead.

3. Performance Requirements

a) *Warpage* — See Table 1

b) *Crazing* — None of the test pieces shall show crazing.

c) *Water absorption* — Shall not exceed 15 percent.

d) *Thermal shock* — (See 8.4 of the Standard) -The appliance shall not show any sign of injury.

e) *Chemical Resistance* — See Appendix A of the Standard) - No loss of reflectivity of glaze.

f) *Modulus of Rupture* — Not less than 20 MPa.

g) *Resistance to staining and Burning* — No stain shall remain. (See Appendix B of the Standard).

For detailed information, refer to IS 771 (Part 1) : 1979 Specification for fire-clay sanitary appliances, Part 1 general requirements (second revision)

SUMMARY OF
IS 771 (PART 2) : 1985 GLAZED FIRE – CLAY SANITARY
APPLIANCES
PART 2 SPECIFIC REQUIREMENTS OF KITCHEN AND
LABORATORY SINKS
(Third Revision)

1. Scope – Lays down the pattern and sizes, construction, dimensions and tolerances of kitchen and laboratory sinks made of fire-clay.

2. Requirements

2.1 General requirements for materials, manufacture, methods of test and inspection shall conform to Part-1 (General requirements) of the standard.

2.2 Patterns and Sizes

<i>Pattern</i>	<i>Sizes mm</i>
a) Kitchen sinks	750 × 450 × 250 600 × 450 × 200 600 × 450 × 200
b) Laboratory sinks	600 × 400 × 200 500 × 350 × 150 450 × 300 × 150 400 × 250 × 150

2.3 Thickness — The minimum thickness of the walls and bottom of the sinks of sizes mentioned shall not be less than 25 mm and 15mm, respectively for 2.2(a) and 2.2(b).

3. Tolerances

- a) On dimensions of 50 mm and over ± 4 percent; and
- b) On dimensions less than 50 mm ± 2 mm.

4. Construction

4.1 The kitchen sinks shall be of one piece construction with or without rim but without overflow.

4.2 The laboratory sinks shall be of one piece construction with or without rim and with or without combined over flow.

For detailed information, refer to IS 771 (Part 2) : 1985 Specification for glazed fire-clay sanitary appliances Part 2 of kitchen and laboratory sinks (third revision).

SUMMARY OF
**IS 771 (PART 3/SEC 1) : 1979 GLAZED FIRE-CLAY SANITARY
 APPLIANCES**
PART 3 SPECIFIC REQUIREMENTS OF URINALS, SECTION
1 SLAB URINALS
(Second Revision)

1. Scope — Lays down the patterns, sizes, construction, dimensions and tolerances and finish of slab urinals made of fire-clay.

2. Requirements

2.1 General requirements for materials, manufacture, methods of test and inspection, shall conform to Part 1 (General requirements) of the standard.

2.2 Patterns and Sizes — Slab urinals shall be of one of the following pattern and sizes:

- a) Batter slab (*see* Fig. 1A of the standard)

1000 × 600 mm or
1000 × 450 mm

- b) End slab (*see* Fig 1B of the standard)

1000 × 360 mm

3. Construction — Slab urinals shall be manufactured either as a single urinal or as a range of two urinals. The inside surface of the urinals shall be regular and smooth throughout to ensure efficient flushing.

4. Tolerances

- a) On dimensions of 50 mm and over $\pm 4\%$
 b) On dimensions less than 50 mm ± 2 mm.

Note — For dimensions, *see* Table 1 and Fig. 1 of the Standard.

For detailed information, refer to IS : 771 (Part 3/ Sec 1) : 1979 Specification for glazed fire-clay sanitary appliances, Part 3 Specific requirements of urinals, Section 1 Slab urinals (second revision).

SUMMARY OF
IS 771(PART 3/ SEC 2) : 1985 GLAZED FIRE-CLAY SANITARY
APPLIANCES
PART 3 SPECIFIC REQUIREMENTS OF URINALS
SECTION 2 STALL URINALS
(Third Revision)

1. Scope — Lays down the sizes, construction, dimensions, tolerances and finish of stall urinals made of fire-clay.

2. Requirements

2.1 General requirements for materials, manufacture, methods of test and inspection, shall conform to Part 1 General requirements of the standard.

2.2 *Type and Size*

Type 1	Type 2
mm	mm
1140 × 460 × 400	1500 × 520 × 400
2.2 Construction — Stall urinals shall be manufactured either as a single urinal or as a range of two or more urinals. The inside surface of the urinals shall be regular and smooth throughout to ensure efficient flushing. The bottom of urinals shall have sufficient slope from the front towards the outlet such that there is efficient draining of the urine.	

Note— For details of dimensions and tolerances see Table 2 of the standard

For detailed information, refer to IS 771 (Part 3/ Sec. 2) : 1985 Specification for glazed fire-clay sanitary appliances Part 3 Specific requirements of Section 2 Stall urinals (third revision).

SUMMARY OF
IS 771 (PART 5) : 1979 GLAZED FIRE CLAY APPLIANCES,
PART 5 SPECIFIC REQUIREMENTS OF SHOWER TRAYS
(Second Revision)

1. Scope — Lays down the pattern, size, construction, dimensions, tolerances and finish of shower trays made of fire-clay.

2. Size — $600 \times 600 \times 100$ mm with skirting all around.

2. Requirements

2.1 General requirements for materials, manufacture, methods of test and inspection, shall conform to Part 1 General requirements of the standard.

3. Tolerance

a) On dimensions of 50 mm and over $\pm 4\%$

b) On dimensions less than 50 mm ± 2 mm

4. Construction — Shower trays shall be of one piece construction. The inside surface of the shower trays shall be uniform and smooth except for grooves provided for skid resistance. The shower trays shall have a circular waste hole into which the interior of the tray shall drain. The waste hole shall be rebated or bevelled internally.

For detailed information, refer to IS 771 (Part 5) : 1979 Specification for glazed fire-clay sanitary appliances: Part 5 Specific requirements of shower trays (second revision).

SUMMARY OF
**IS 771 (PART 7) : 1981 GLAZED FIRE CLAY SANITARY
APPLIANCES,**
PART 7 SPECIFIC REQUIREMENTS OF SLOP SINKS
(Second Revision)

1. Scope — Lays down the pattern, sizes, construction, dimensions, tolerances of slop sinks made of fire-clay.

2. Requirements

2.1 General requirements for materials, manufacture, methods of test, sampling and inspection, shall conform to Part 1 General requirements of the standard.

2.2 Pattern and Size — The wall mounted slope sink shall be size 610 × 630 mm. The floor mounted slop sink shall be of size 430 × 460 mm.

3. Construction — The slop sink shall be of one piece construction and shall have a suitable flushing rim which may be boxed or open type. In the case of box rim, adequate number of holes on all sides shall be provided for clean flushing of the bowl of the sink. The rim shall have an inlet or supply horn of dimensions conforming to those given in Fig. 1 and Fig. 2 of the

standard for connecting the flush pipe.

The wall mounted slop sink shall have an integral trap with outlet. The floor mounted slop sink shall have an integral trap with P or S outlet.

The inside surface of the slop sink and trap shall be uniform and smooth in order to ensure efficient flush. The serrated part of the outlet shall not be glazed externally.

4. Tolerances

- a) On dimensions of 50 mm and over $\pm 4\%$ and
- b) On dimensions less than 50 mm ± 2 mm.

Note — For dimensions see Fig. 1 and 2 of the standard.

For detailed information, refer to IS 771 (Part 7) : 1981 Glazed fire-clay sanitary appliances: Part 7 Specific requirements of slop sinks (second revision).

SUMMARY OF
IS 772 : 1973 GENERAL REQUIREMENT FOR ENAMELLED CAST
IRON SANITARY APPLIANCES
(Second Revision)

1. Scope — General requirement of material, thickness, warpage, enamelling, acid and alkali resistance, inspection rules and marking, for enamelled cast iron sanitary appliance like water-closets and commodes.

2. Requirements — Thickness of cast iron base not less than 6.5 mm. Tolerance ± 3 percent on specified dimensions. Warpage shall not exceed 5 mm per metre for edges set against wall or floor and 7.5 mm per metre for other edges. Finishing in vitreous enamel fused to cast iron base; enamel thickness not less than 0.5 mm.

2.1 Defects — Not more than one of the following when examined through inspection window is permitted:

- a) Crazing;
- b) Dimples, rundown, sagging;
- c) Blisters — not more than on interior surface;
- d) Pinholes — not more than two for coloured wares and not more than four for white wares;

e) Specks — less than 1 mm and not exceeding 5 in number. Specks less than 0.25 mm in size shall not be treated as defects unless in sufficient number to form discolouration; and

f) Flaw — The number shall not exceed

Small	:	2, <i>Max</i>
Medium	:	2, <i>Max</i>
Large	:	None.

3. Tests for Enamel

- a) Enamel shall be of acid and alkali resisting quality.
- b) Abrasion test — Shall withstand test for resistance to scratching by Powder no.5 (on Moh's scale).

Note- For test procedures refer to the Standard.

For detailed information, refer to IS 772:1973 Specification for general requirements for enamelled cast iron sanitary appliances (second revision).

SUMMARY OF
IS 773 : 1988 ENAMELLED CAST IRON WATER-CLOSETS,
RAILWAY COACHING STOCK TYPE
(Third Revision)

1. Scope—Requirements for material, workmanship, manufacture, dimensions and finish of enamelled cast iron-railway type water-closets generally used in the coaching stock of the Indian Railways.

2. Requirements — Shall be of one piece construction. Each water closet shall have flushing pipe housed in the water closet casting.

Bottom flange shall not be less than 13 mm thick and shall be provided with not less than six holes of 10 mm

diameter. The inlet or supply horn shall consist of a threaded adapter, nipple fixed to a plain hole of the water closet and secured rigidly by a socket union

3. Finish — The inside and outside surfaces of each fixture shall be coated with vitreous enamel thoroughly fixed to the cast iron base. The enamel shall be uniform, non-crazing and free from discoloration, and shall possess an impervious surface.

Note 1— These shall conform to the requirement of IS 772 : 1973 General requirement of enamelled cast iron sanitary appliances.

Note 2 — For detailed dimensions and tolerances, refer to standard.

For detailed information, refer to IS 773 : 1988 Specification for enamelled cast iron water - closets, railway coaching stock type (third revision).

SUMMARY OF

IS 774 : 2004 FLUSHING CISTERNS FOR WATER-CLOSETS
AND URINALS (OTHER THAN PLASTIC CISTERNS)

PART 1 GENERAL REQUIREMENTS

(Fourth Revision)

1. Scope – Requirements for manually-operated high-level and low-level flushing cisterns of capacities 5 litres and 10 litres, both single flush and dual flush types and 6/3 litres capacity dual flush cisterns, for water-closets, squatting pans and urinals, together with flush pipe details.

2. Terminology

2.1 High-Level Cistern – A cistern intended to operate at a minimum height of 1 250 mm between the top of the pan and the underside of the cistern.

2.2 Low-Level Cistern – A cistern intended to operate at a height not exceeding 300 mm between the top of the pan and the underside of the cistern.

2.3 Coupled Cistern – A cistern intended to operate sitting on flat surface provided at the back portion of wash-down water-closets

2.4 Dual-Flush Cistern – A construction that enables the user to cause a short flush of partial discharge when only urine needs to be flushed away instead of the customary full flush.

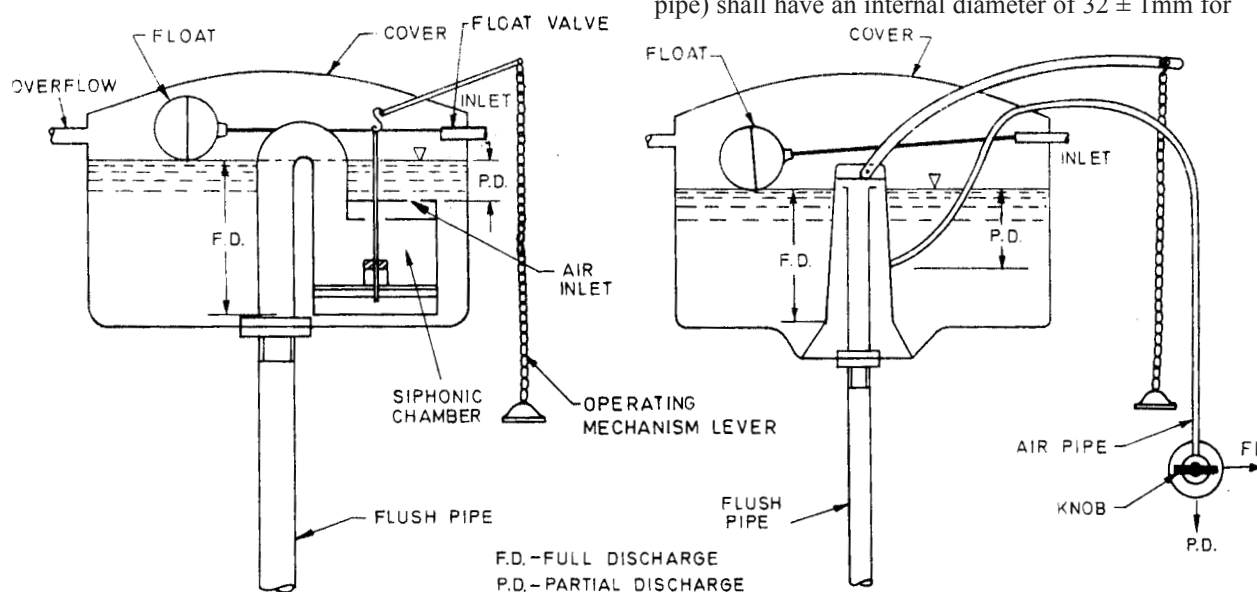
3. Material – For details refer to Table 1 of the standard.

4. Construction

a) Cistern — The thickness of the body including cover shall be not less than 5 mm and 6 mm for cast iron and vitreous china cisterns respectively. The body of the pressed steel cistern shall be of seamless or welded construction. The body and the cover of the pressed steel cistern shall be of thickness not less than 1.6 mm and 1.25 mm respectively before coating and shall be vitreous enamelled or otherwise protected against corrosion by equally efficient coating. The outlet of each siphon or stand pipe shall be securely connected to the cistern by means of a lock-nut. In the case of plastic siphon, it shall be provided with suitable means of ensuring and maintaining water tight and air tight joint to the cistern.

4.2 Cover — The cistern shall be provided with a removable cover which shall fit closely and shall be secured against displacement.

4.3 Flush Pipe — The flush pipe (except plastic flush pipe) shall have an internal diameter of 32 ± 1 mm for



CURVED SIPHONIC TYPE

BELL TYPE

FIG. 1 TYPICAL ILLUSTRATIONS OF SIPHONIC TYPE DUAL - FLUSH CISTERNS

high-level cisterns and 38 ± 1 mm for low-level cisterns. The steel flush pipe shall be not less than 1 mm thick whereas the lead flush pipe shall have a minimum thickness of 3.5 mm. For high density polyethylene and unplasticized PVC pipes, the outside diameter of the pipes shall be 40 mm. When PVC plumbing pipes are used, the outside diameter of the pipe shall be 40 mm for high-level cisterns and 50 mm for low-level cisterns.

5.4 Inlet and overflow holes — The cistern shall be provided with inlet and overflow holes; situated one at each end which shall be capable of accommodating and overflow pipe of the less than 20 mm nominal bore and a 15 mm size float valve.

5.5 Float Valve — The float valve shall be of 15 mm nominal size

5.6 Lever — The lever shall not project beyond the side of the cistern for a distance greater than 350 mm measured from the centre of the cistern to the end of the lever arm. In case of low-level cisterns, where the mechanism is handle operated, the handle, whether situated on the front or at the end of the cistern, shall be within the projection limit for lever.

5.7 Chain — The chain shall be of such a strength as to sustain a dead load of 50 kg without any apparent or permanent deformation of the shape of the links.

5.8 Overflow Pipe — The overflow pipe shall be of not less than 20 mm nominal bore and shall incorporate a non-corrodiable mosquito device secured in a manner which will permit it to be readily cleaned or renewed when necessary. No provision shall be made whereby the overflow from the cistern shall discharge directly into the water-closet or soil pipe without being detected.

5. Finish — Cast iron cisterns shall be painted inside with suitable anti-corrosive paint and with a protective

coat on a outside before delivery.

6. Operational and Performance Requirements

6.1 Flushing Arrangement — The cistern under working conditions and with the ball valve in closed position shall operate on a single operation of the lever without calling for a sudden jerk in pulling.

6.2 Working Water Level — Shall be a minimum of 6.5 cm below the effective top edge of the cistern

6.3 Freedom from Self-Siphonage — The siphonic system shall be capable of being rapidly brought into action when the water is at the working water level, but shall not self-siphon or leak into the flush pipe when the water is up to 1 cm above the invert of the overflow pipe.

6.4 Reduced Water Level — The discharge shall operate satisfactorily when the cistern is filled to a level up to 1 cm below the working water level.

6.5 Discharge Capacity — Cisterns of 5 and 10 litres capacities, when required to give a full flush, shall respectively discharge 5 litres and 10 litres with variation of ± 0.5 litres. Dual flush cisterns of 10/5 litres capacity shall discharge alternatively a short flush of 5 ± 0.5 litres.

6.6 Discharge Rate — The discharge rate shall be 10 ± 0.5 litres in 6 seconds and 5 ± 0.5 litres in 3 seconds for cisterns of capacities 10 litres and 5 litres respectively.

7. Tests — Shall satisfy the following tests:

- a) Test of Discharge Capacity
- b) Test for Discharge rate — Refer to the standard
- c) Endurance Test — After operating for 3000

Note — For methods of tests, refer to the standard.

For detailed information, refer to IS 774 : 2004. Specification for flushing cisterns for water closets and urinals (other than plastic cisterns) (fifth revision).

SUMMARY OF
IS 1726 : 1991 CAST IRON MANHOLE COVERS AND FRAMES
(Third Revision)

1. Scope – Lays down basic and performance requirements for manhole covers and frames in cast-iron, intended for use in drainage and water works.

Suitable for use in service lanes/roads, on pavements for use under medium-duty vehicular traffic including for car parking areas.

2. Grades and Types

<i>Grades Designation</i>	<i>Grade of Covers</i>	<i>Type/Shape</i>
Light-duty	LD-2.5	Rectangular, Square Circular
Medium-Duty	MD-10	Circular Rectangular
Heavy- Duty	HD-20	Circular Lamphole Square Rectangular (Scraper Manhole)
Extra-Heavy Duty	EHD-35	Circular Square Rectangular (Scraper manhole)

HD-20 Circular, Square or Rectangular
(Scraper Manhole) Types

Suitable for use in institutional/commercial areas/ carriage ways/city trunk roads/bus terminals, with heavy-duty vehicular traffic of wheel loads between 5 to 10 tonnes, like buses, trucks and parking areas and where the manhole chambers are located in-between the pavement and the middle of the road.

EHD-35 Circular, Square or Rectangular (Scraper Manhole) Types -

Suitable for use on carriageways in commercial/ industrial/port areas/near warehouses/godowns where frequent loading and unloading of trucks/trailers are common, with slow to fast moving vehicular traffic of the types having wheel loads up to 11.5 tonnes irrespective of the location of the manhole chambers.

2.1 Recommended Locations

LD-2.5 - Rectangular, Square or Circular Solid Types — Suitable for use within residential and institutional complexes/areas with pedestrian but occasional light motor vehicle traffic. These covers are also used for 'Inspection Chambers MD-10 Circular or Rectangular Types –

3. Materials — of appropriate grade of grey cast iron as per prescribed standard.

4. Basic and Performance Requirements

TABLE 1 BASIC AND PERFORMANCE REQUIREMENTS OF MANHOLE COVERS AND FRAMES

GRADE DESIGNATION	TYPE/SHAPE OF COVER	CLEAR OPENING OF FRAME	FRAME		TEST LOAD TONNES
			Depth	Seating	
(1)	(2)	mm (3)	mm (4)	mm (5)	(6)
LD-2.5	Rectangular	450 × 600	35	50	2.5
		Square 450 × 450		30	50
	Circular	400 × 400	30	50	
		370 (dia)	45	40	
MD-10	Circular	370 (dia)	45	40	
		450 (dia)	60	40	10
		480 (dia)	70	40	
		500 (dia)	80	50	
HD-20	Rectangular	450 × 600	80	50	
	Circular	500 (dia)	100	50	20
		560 (dia)	110	60	
		600 (dia)	110	75	
	Lamphole cover	350 (dia)	130	25	
	Square	560 × 560	110	75	
	Rectangular	450 × 900	100	60	
	(Scraper manhole)				
EHD-35	Circular	560 (dia)	130	60	35
		600 (dia)	140	75	
	Square	560 × 560	130	60	
		Rectangular	600 × 900	70	
	(Scraper manhole)				

5. Manufacture

5.1 Covers and Frames — Covers and frames shall be cleanly cast and they shall be free from air and sand holes, cold shuts and warping which are likely to impair the utility of the castings. Covers shall have on its operative top a raised chequered design to provide for an adequate no-slip grip. The rise of the chequer shall be not less than 4 mm.

5.2 Key Holes and Keys — Key holes, keys and lifting devices shall be provided in the manhole covers to facilitate their placement in the frames, and their operative maintenance during use in the field.

5.3 Locking Devices — Suitable locking devices including that with galvanized chain or a lock, or a combination of both shall be provided in the manhole cover system, if so desired by the purchaser.

5.4 Coating — shall be coated with a material having base with a black bitumen composition.

6. Load Test — Shall with stand without fracture, the loads specified in 4 for a minimum period of 30s.

Note 1 — For dimensions and tolerances, see 7 of the standard

Note 2 — For testing procedure see 10.2 of the standard.

For detailed information, refer to IS 1726 : 1991 specification for cast iron manhole covers and frames (third revision) IS 210 : 1993 Grey iron castings (fourth revision).

SUMMARY OF
IS 2326 : 1987 AUTOMATIC FLUSHING CISTERNS FOR URINALS
(OTHER THAN PLASTIC CISTERNS)
(Second Revision)

1. Scope – Lays down the materials, nominal sizes, construction, performance requirements and finish for automatic flushing cisterns of the type used for flushing urinals.

2. Materials – Cast iron, vitreous china or enamelled pressed steel complied with specified requirements.

3. Nominal Sizes – 5 and 10 litres with a tolerance of ± 0.5 litres.

Note — The nominal size of any urinal cistern shall be based on a minimum capacity of 2.5 litres per urinal served.

4. Construction

a) *Cistern* – The thickness of the body and the cover shall not be less than 5 and 6 mm for cast iron and vitreous china cisterns respectively. The body of the pressed steel cistern shall be of seamless or welded construction. The thickness of body and cover shall not be less than 1.60 mm and 1.25 mm respectively before coating and shall be porcelain enamelled or otherwise protected against corrosion by equally efficient coating.

b) *Depth of Cistern Body* — The depth of the body of cistern shall provided for a clearance of not less than 25 mm between the highest level that can be reached by water before siphonage commences and the spillover level of the top of cistern.

c) *Siphonic Apparatus* — Siphons shall be made of vitreous china, HDEP, LDEP, polypropylene, cast iron suitably protected both internally and externally against corrosion or of both smooth finished material which is impervious to liquids, corrosion-resistant and of adequate thickness and rigidity.

d) *Outlet Connection* — The nominal diameter of the outlet of the siphon shall not be less than 25 mm for all sizes of cistern

e) *Lid and Cover* — Cisterns shall be provided with mosquito-proof lids.

f) *Feeding Device* — The outlet of the feeding device shall be so located that it is not less than 3 mm above the highest water-level that can be reached by water before siphonage commences.

5. Finish — Cast iron cisterns shall be painted inside with suitable anti-corrosive paint and with a protective coating on the outside before delivery. Alternately, cast iron cisterns shall be protected against corrosion by a coating of enamel.

6. Performance Requirements

a) Shall deliver not less than 2.5 litres per urinal of not less than 10 minutes and not more than 20 minutes.

b) Shall discharge at an average of not less than 5 litres in 7 seconds when fitted with a straight open ended flush pipe of 20 mm bore and 900 mm length.

7. Endurance Test — Shall be operated for 3000 times and after this test, the cistern and component parts shall not show any damage or defects and all the parts shall be satisfactory

For detailed information, refer to IS 2326 : 1987 Specification for automatic flushing cisterns for urinals (other than plastic cisterns)(second revision).

SUMMARY OF

**IS 2548 (PART 1) : 1996 PLASTIC SEATS AND COVERS FOR
WATER- CLOSETS, PART 1 THERMOSET SEATS AND COVERS**
(Fifth Revision)

1. Scope – Requirements for thermoplastic seats and covers for water-closets.

2. Types – Type PF moulded from phenolic plastics and Type UF moulded from urea- formaldehyde.

3. Materials

Seats and Covers :

- a) Material for type PF seats and covers shall be phenolic plastics conforming to Grade 2 or 3 of IS 1300 : 1994*
- b) Material for Type UF seats and covers shall be urea-for maldehyde conforming to IS 3389 : 1994+

4.4 Finish – The surfaces of the seats, covers and components shall be smooth, free from blisters and delamination and reasonably free from flowlines, contamination, streaking and unintended colour variation.

3.2 Hinging Device — Bronze or brass or mild steel with nickel chromium plating or aluminium alloy with anodic coating or suitable plastic (with reinforcement)

4. Manufacture — See Fig.1 for details.

4.1 Seat — The underside of the seats may be either flat or recessed. Where the underside is flat, the seat shall be a solid moulding, and where the underside is recessed, the section shall be not less than 3 mm at any point. The seats may be of the closed or open front pattern (see Fig. 1).

4.2 Cover — The cover shall completely cover the aperture of the seat and shall be so designed that it is capable of being raised easily from the seat.

4.3 Dimensions — See Table 1

4.5 Hinging Device – The bolts shall have a minimum shank length of 65 mm and a coarse thread of M8 size iwithin 25 mm of the flange of fixing to the pan.

4.6 Buffers – Each seat if not provided with not less than three rubber or plastic buffers of size 25 mm × 40 mm × 10 mm for closed front seats and not less than 4 for open front seats, which shall be securely fixed to underside of the seat.

* Phenolic moulding materials (third revision)

+ Urea-formaldehyde, moulding material (first revision)

TABLE 1 DIMENSIONS OF SEATS AND COVERS

All dimensions in millimetres.

Sl No.	DESCRIPTION	DIMENSION	
		Min	Max
(1)	(2)	(3)	(4)
i)	Distance from centre line of hinge bolts to extreme edge of rim at front, A	445	475
ii)	Length of opening at longest point, B	250	290
iii)	Width of opening at widest point, C	215	240
iv)	Overall width at widest point, D	380	--
v)	Distance between inner and outer rims, E	55	--
vi)	Centre-to-centre distance of seat bolt holes, F	145	175
vii)	Distance from centre line of hinge bolts to inner rim of seat at the back, G	85	--
viii)	Thickness of seat at thinnest point	3	--
ix)	Thickness of cover at thinnest point	3	--

5. Tests

5.1 Strength requirements for seats — Shall withstand, without permanent distortion of the seat or the hinge fittings or damage to any finish, a load of 1 150 N applied for a period of 30 minutes.

5.2 Impact Resistance — When tested for impact, the seat, cover buffers and hinges shall show any visible damage.

5.3 Water Absorption — The increase in mass shall be 0.75 percent, *Max* and on visual inspection after immersion, it shall shown no impairment.

5.4 Rigidity

Seats — The maximum deflection shall be as given below and on visual inspection after the load is removed,

the seats shall not show any fracture

5.4.2 Covers — Maximum deflection shall be as given below and on visual inspection after the load is removed, the cover shall not show any fracture Maximum distortion shall be 3mm.

5.5 Staining by Seats and Covers — There shall not be any visible colour transfer to the white cloth.

5.6 Staining and/or Other Surface Deterioration of Seats and Covers — There shall not be any change of colour or other adverse change in surface characteristics.

5.7 Endurance Test for Seats, Covers and Buffers: Neither seat, cover or buffer should be damaged or dislocated. This is a type test.

Note — For methods of tests refer to Appendices A to K of *the standard*.

For detailed information, refer to IS 2548 (Part 1) 1996 Specification for Plastic seats and covers for water-closets Part 1 Thermoset seats and covers (fifth revision).

SUMMARY OF
IS 2548 (PART 2) : 1996 PLASTIC SEATS AND COVERS FOR
WATER-CLOSETS,
PART 2 – THERMOPLASTIC SEATS AND COVERS
(Fifth Revision)

1. Scope – Requirements for thermoplastic seats and covers for water-closets.

2. Grades – 1 and 2 based on deflection characteristics

3. Materials

3.1 Seats and Covers

a) Polystyrene or

b) Polypropylene conforming to requirements specified

3.2 Hinging Device — Bronze or brass or mild steel with nickel chromium plating or aluminium alloy with anodic coating or suitable plastic (with reinforcement), conforming to the prescribed standards.

4. Manufacture

4.1 Seat — The underside of the seats may be either flat or recessed. Where the underside is flat, the seat shall be a solid moulding, and where the underside is recessed, the section shall be not less than 3 mm at any point. The seats may be of the closed or open front pattern (see Fig. 1).

4.2 The cover shall completely cover the aperture of the seat and shall be so designed that it is capable of being raised easily from the seat. The cover shall be not less than 3 mm in thickness at any point.

4.3 Dimensions — See Table 1

TABLE 1 DIMENSIONS OF SEATS AND COVERS

ALL DIMENSIONS IN MILLIMETRES.

<i>Sl No.</i>	<i>DESCRIPTION</i>	<i>DIMENSION</i>	
		<i>Min</i>	<i>Max</i>
(1)	(2)	(3)	(4)
i)	Distance from centre line of hinge bolts to extreme edge of rim at front, A	445	475
ii)	Length of opening at longest point, B	250	290
iii)	Width of opening at widest point, C	215	240
iv)	Overall width at widest point, D	380	--
v)	Distance between inner and outer rims, E	55	--
vi)	Centre-to-centre distance of seat bolt holes, F	145	175
vii)	Distance from centre line of hinge bolts to inner rim of seat at the back, G	85	--
viii)	Thickness of seat at thinnest point	3	--
ix)	Thickness of cover at thinnest point	3	--

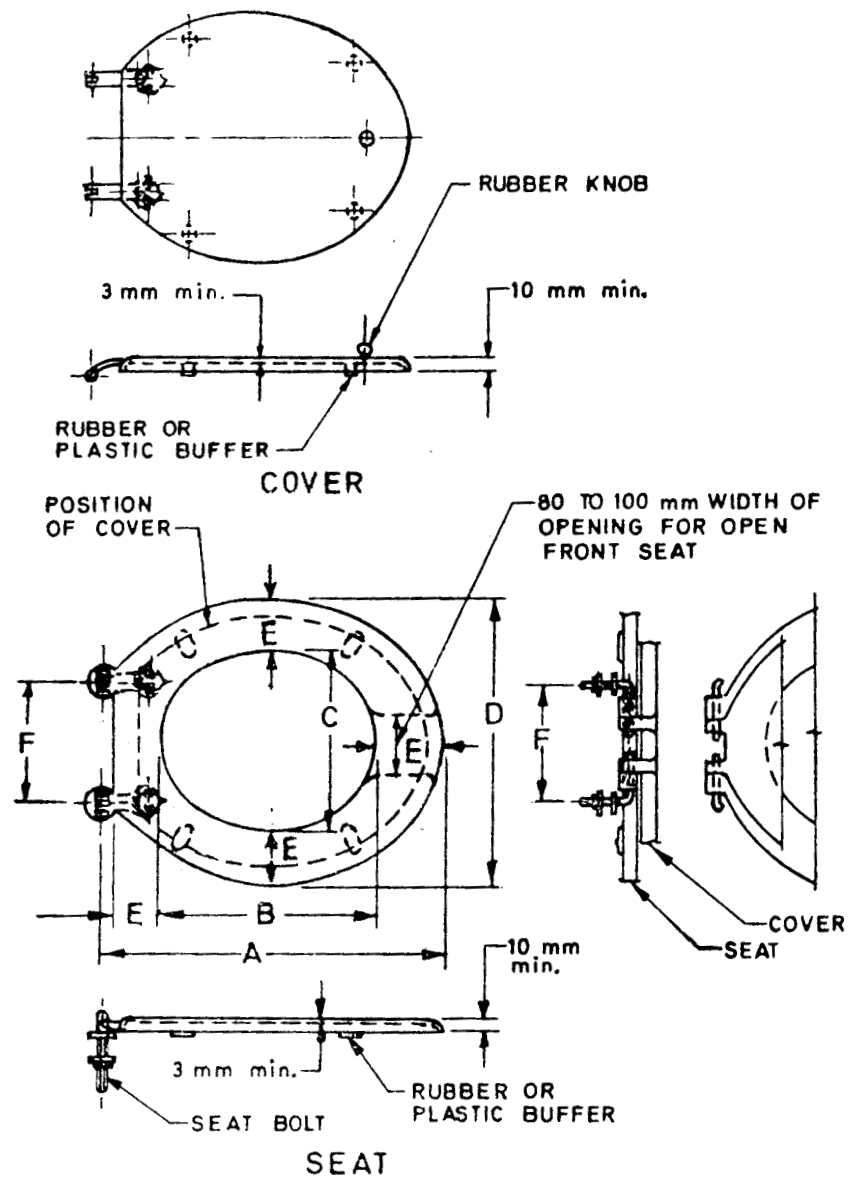


FIG. 1

4.4 Finish – The surfaces of the seats, covers and components shall be smooth, free from blisters and delamination and reasonably free from flowlines, contamination, streaking and unintended colour variation colour variation.

4.6 Hinging Device – The bolts shall have a minimum shank length of 65 mm and a coarse thread of M8 size within 25 mm of the flange of fixing to the pan.

4.7 Buffers and Distance Pieces – Each seat (if not provided with distance pipes) shall be provided with not less than three rubber or plastic buffers of size 25 mm × 40 mm × 10 mm for closed front seats and not less than 4 for open front seats, which shall be securely fixed to underside of the seat.

5. Test

5.1 Strength – The seats shall withstand, without permanent distortion of the seat or the hinge fittings or damage to any finish, a load of 1 150 N applied for a period of 30 minutes.

5.2 Water Absorption – The increase in mass shall be 0.75 percent, Max and on visual inspection after immersion, it shall shown no impairment.

5.3 Impact Resistance

5.3.1 Seats – When tested for impact, the seat, hinges and buffers/distance pieces shall show no visible damage.

5.3.2 Covers – When tested for impact, the cover, cover hinges and cover buffers shall show no visible damage.

5.4 Rigidity

5.4.1 Seats — The maximum deflection shall be as given below and on visual inspection after the load is removed, the seats shall not show any fracture (See Annex F of the standard)

Grade	Deflection, mm
1	12.5
2	20.0

5.4.2 Covers – The maximum deflection shall be as given below and on visual inspection after the load is removed, the cover shall not show any fracture and no part of the edge of the cover shall be pushed through the seat opening

Grade	Deflection, mm
1	25
2	40

5.5 Staining by Seats and Covers — There shall not be any visible colour transfer to the white cloth.

5.6 Staining and/or Other Surface Deterioration of Seats and Covers — There shall not be any change of colour or other adverse change in surface characteristics.

5.7 Surface Hardness - Minimum value of Rockwell Hardness Number (HR) shall be 'L45'.

5.8 Endurance Test for Seats, Covers and Buffers— Neither seat, cover or buffer should be damaged or dislocated. This is a type test.

Note — For method of test, refer to Appendixs B to M of the standard.

For detailed information, refer to IS 2548 (Part 1) : 1996 Specification for plastic seats and covers for water closets: Part 1 Thermoplastic seats and covers (fifth revision).

SUMMARY OF
IS 2556 (PART 1) : 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA) PART 1 GENERAL REQUIREMENTS
(Third Revision)

1. Scope – General requirements relating to terminology, material and manufacture, glazing, defects, minimum thickness, tolerance, performance and methods of test for vitreous sanitary appliances covered by various parts of the standard.

2. Material and Glazing — Vitreous sanitary ware is a strong high grade ceramicware made from a mixture of suitable clays and finely ground minerals, such as quartz and felspar. It shall be coated on all exposed surfaces with an impervious non-crazing vitreous glaze giving a white or coloured finish.

The vitreous glazing medium shall be thoroughly fused to the body. All exposed surfaces of an appliance shall be uniformly glazed, shall be free from craze and discolouration and shall possess an impervious surface. In case of certain coloured glaze, the lead content, if any, shall not exceed 5 percent of the weight of the glaze.

3. Permissible Blemishes and Defects — See Tables 1, 2 and 3.

TABLE 1 BLEMISHES OR DEFECTS PERMITTED IN WC PANS BIDETS, SQUATTING PANS, URINALS, PARTITION PLATES, PEDESTALS AND ACCESSORIES

<i>Location</i>	<i>Blemish of Defect</i>	<i>Maximum Permitted</i>
General	Wavy finish	None on all visible surfaces
	Warpage	
	WC an and bidets	
	Squatting pans	
	Other appliances	Not more than 6 mm a) Not more than 6 mm for long pattern of 580 mm size. b) Not more than 10 mm for long pattern of 630 mm size and Orissa patterns of 580.
	Accessories	Not more than 1 mm per 100 mm; total warpage not more than 6 mm.
	Discoloration	Not to exceed 5 mm on any plane
		None on all visible surfaces
Flushing surface and horizontal face of rims of WC pans, squatting pans bidets urinals	Spots, blisters and pinholes	A total of not over three; no grouping, for coloured appliances, blister and pinhole limited to one each.
	Bubbles and specks	Not over two in one pottery square; a total of not over four. Four coloured appliance, a total not over two.
	Polishing marks	One only; none permitted for coloured appliances.
Visible surfaces other than above	Spots, blisters and pinholes	A total of not over five; no grouping. For coloured appliances no blisters are permitted and pinholes are in to a total of two.
	Bubbles and specks	Not over three in one pottery square; a total of not over ten.
	Polishing marks	Two only ; none permitted for coloured appliances.

**TABLE 2 BLEMISHES OR DEFECTS PERMITTED IN WASH BASINS,
LABORATORY
SINKS AND DRINKING FOUNTAINS**

<i>Location</i>	<i>Blemish of Defect</i>	<i>Maximum Permitted</i>
General	Wavy finish Warpage : Wash basins and drinking fountains	None on all visible Surfaces
	Laboratory sinks Discoloration	Warpage of slab out of horizontal plane not to exceed 6 mm on all sizes (warpage of backs of wash basins which are attached to the wall not to exceed 3 mm). Warpage not to exceed ± 3 percent on all planes. None on all visible surfaces.
Service space, top of slab, inside of bowl, fron of fascia	Spots, blisters and pinholes	A total of not over two; no grouping for coloured appliances no blisters are permitted and pinhole limited to one only.
	Bubbles and specks	A total of not over four; no grouping. For coloured appliances, a total of not over two.
	Polishing marks	One only; one permitted for coloured appliances.
Face of internal, back and side	Spots, blisters and pinholes	One only, no back or on either side; a total of not over three. For coloured appliances no blisters are permitted and pinholes are limited to a total of two.
	Bubbles and specks	A total of not over four; no grouping.
	Polishing marks	Two only; One permitted for coloured appliances.

**TABLE 3 BLEMISHES OR DEFECTS PERMITTED IN FLUSHING CISTERNS,
AUTO CISTERNS AND COVERS WHEN ASSEMBLED**

<i>Location</i>	<i>Blemish of Defect</i>	<i>Maximum Permitted</i>
General	Warpage	Warpage of the flat back portion in case of cisterns not to exceed 5 mm and for bottom portion in case of coupled cistern not to exceed 3 mm.
	Discoloration	None on all visible surfaces.
Visible Surface	Wavy finish Spots, blisters and Pinholes	Not more than 2500 mm ² on one end only. A total of not over four; no grouping. However, a total of not over one on covers. For coloured appliances, blister and pinhole limited to one each, none on covers.
	Bubbles and specks	Not over two in one pottery square; total of not over six; including not over two on cover.
	Polishing marks	One only; none on cover; none permitted for coloured appliance.

4. Minimum Thickness — At any place in an appliance shall not be less than 6 mm.

5. Tolerances

(a) On dimensions 75 mm and more ± 2 percent of the specified dimension or ± 2 mm which ever is more.

(b) On dimensions less than 75 mm ± 5 percent of the specified dimension or ± 2 mm whichever is more.

(c) On the height of the flush outlet of P-Traps, or horizontal outlets ± 5 mm; and

(d) On all angles $\pm 3^\circ$.

6. Performance Requirements

6.1 Warpage — Feeler gauge of maximum thickness specified (see Tables 1, 2 or 3) should not slide under the appliances without application forec.

6.2 Crazing — None of the test pieces shall show crazing.

6.3 Water Absorption — No exceeding 0.5 percent (average) and 0.75 percent (individual)

6.4 Modules of rupture — Shall not be less than 60 MPa.

6.5 Chemical resistance — No loss of reflectivity of glaze when compare with the control sample.

6.6 Resistance to Straining and Burning — No stain shall remain on either of the test pieces.

Note — For method of tests, refer to 10 and Appendices A to C of *the standard*.

For detailed information refer to IS 2556 (Part 1) : 1994 Specification for vitreous sanitary appliances (vitreous china): Part 1 General requirements (third revision).

SUMMARY OF

IS 2556 (PART 2) : 1994 VITREOUS SANITARY APPLIANCES (VITREOUS CHINA) PART 2 - SPECIFIC REQUIREMENTS OF WASHDOWN WATER CLOSETS

(Fourth Revision)

1. Scope — Requirements for patterns, construction, dimensions and tolerances, finish and marking for vitreous washdown water closets (henceforth referred as WC).

2. Patterns

- a) Pattern 1 } Pedestal WC with and independent cistern
Pattern 2 } (See Fig. 1)
- b) Pattern 3 } Pedestal WC with independent cistern and horizontal outlet (See Fig. 2)
- c) Pattern 4 } Pedestal WC with independent cistern and concealed Strap (See Fig. 3)

3. Requirements

3.1 Each water closet shall be provided with not less than four fixing holes having a minimum diameter of 6.5mm.

3.2 Flushing rim may be box rim or open rim type flushing rim and the inlet shall be of self draining type.

3.3 Integral trap with P or S outlet

3.4 Anti-siphonage vent loinat an angle of 45° where required by sanitation authority.

Note— For detailed dimensions and tolerance refer to 5 of the standard.

4. Flushing Tests

4.1 Toilet Paper Test — On repetition of test for the pan shall discharge full charge of the paper at least thrice.

5.2 Smudge Test — Immediately after the flushing, there shall be no smudge left on the bowl.

5.3 Holding Capacity Test — Shall be capable of holding not less than 10 litres of water between the normal water level and the highest possible water level of the water closet as installed.

5.4 Single Ball Test — The ball shall be discharged in the normal manner.

5.5 Fifty Ball Test — A minimum of 85 percent of all balls should be flushed out in the five tests.

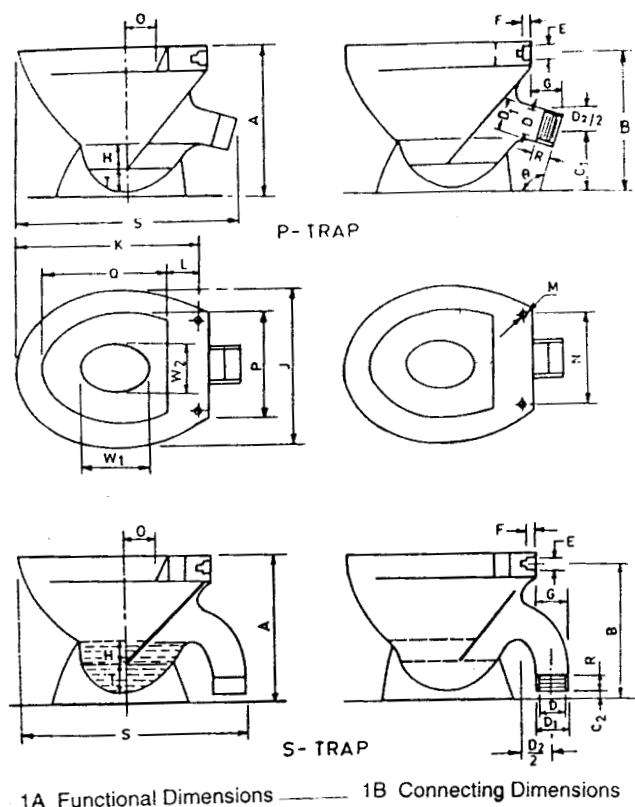


FIG. 1 PATERN 1 AND PATTERN 2 WATER CLOSETS

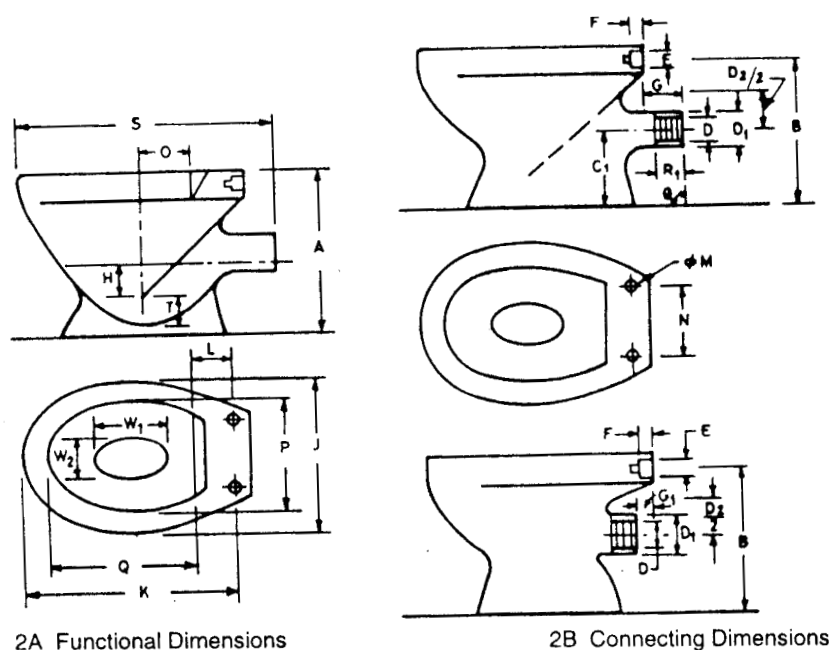


FIG. 2 PATTERN 3 WATER CLOSET WITH HORIZONTAL P-TRAP

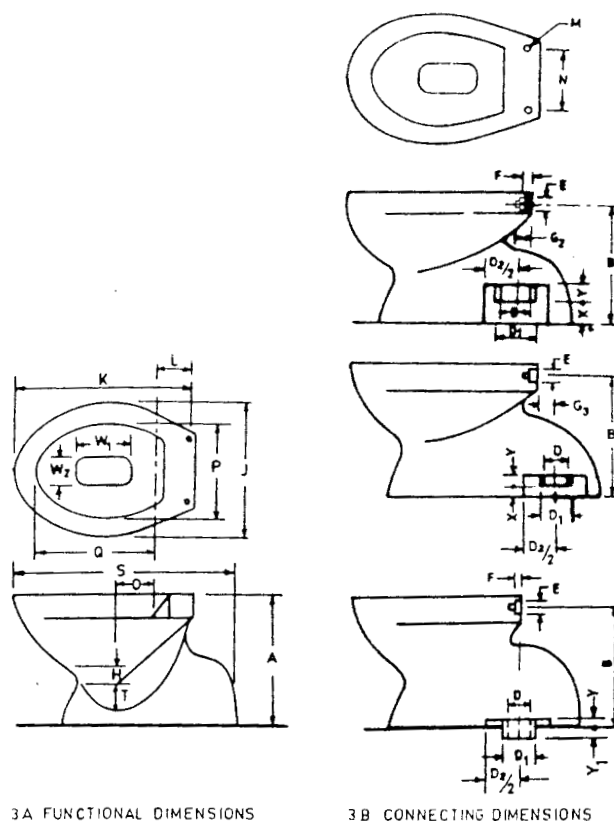


FIG. 3 PATTERN 4 WATER CLOSET WITH CONCEALED S-TRAP

Note 1 — For method of tests refer to 8 of the standard.

Note 2 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS 2556 (Part 2) : 1994 Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down water closets (fourth revision).

SUMMARY OF
IS : 2556 (PART 3) 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA) PART 3 SPECIFIC REQUIREMENTS OF
SQUATTING PANS
(Fourth Revision)

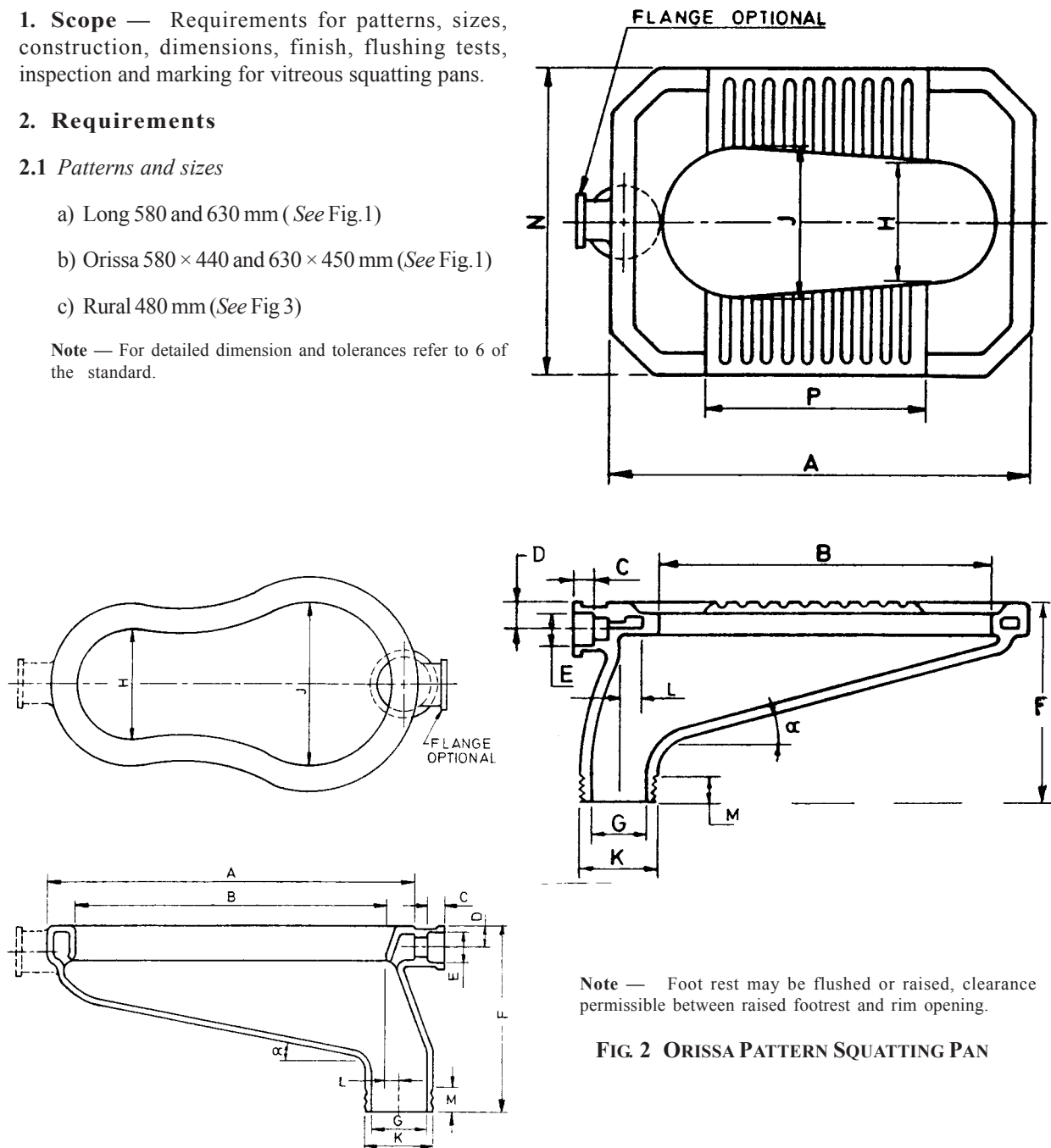
1. Scope — Requirements for patterns, sizes, construction, dimensions, finish, flushing tests, inspection and marking for vitreous squatting pans.

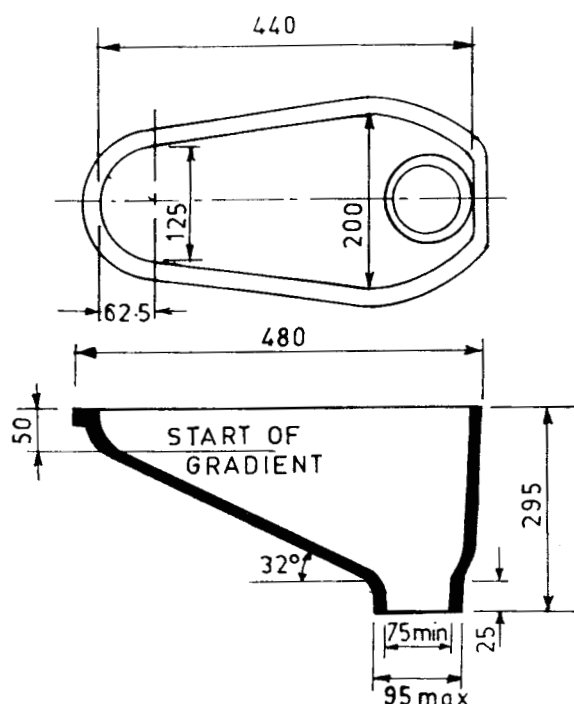
2. Requirements

2.1 Patterns and sizes

- a) Long 580 and 630 mm (See Fig.1)
- b) Orissa 580 × 440 and 630 × 450 mm (See Fig.1)
- c) Rural 480 mm (See Fig 3)

Note — For detailed dimension and tolerances refer to 6 of the standard.





All dimensions in millimetres.

FIG. 3 RURAL PATTERN SQUATTING PAN

2.2 Each pan except the rural pattern shall have an integral flushing rim of the suitable.

2.3 Pan of 630 mm shall be of box rim type. Pan of sizes smaller than 630 mm may be either box rim or open rim type. The flushing rim and inlet shall be of self draining type.

2.4 Trap with P or S outlet (with or without inspection vent) for long and orissa pattern. The trap shall conform to IS 2556 (Part 13) : 1973⁺.

3. Flushing Tests

3.1 Toilet Paper Test — When repeated four times, the pan shall discharge full charge of paper at least thrice.

3.2 Smudge Test — Immediately after flushing there shall be no smudge left on the pan.

3.3 Water Holding Capacity Test — Shall be capable of holding not less than 10 litres of water between the normal water level and highest possible water level of the pan installed.

⁺ Specific requirements of traps for squatting pans.

Note 1 — For method of tests, refer to 8 of the standard.

Note 2 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS 2556 (Part 3) : 1994 Vitreous sanitary appliances (vitreous china): Part 3 Specific requirements of squatting pan (fourth revision).

SUMMARY OF
IS 2556 (PART 4) : 1994 VITREOUS SANITARY APLLIANCES
(VITREOUS CHINA)
PART 4 SPECIFIC REQUIREMENTS OF WASH BASINS
(Third Revision)

1. Scope — Requirements, patterns and sizes, dimensions and tolerances, construction, finish, sampling and marking provisions for vitreous wash basins.

2. Requirements

2.1 Patterns and Sizes

TABLE 1 PATTERNS AND SIZES

<i>Pattern</i>	<i>Size</i>
Flat Back	660 × 460
	(Surgeon's basin)
	630 × 450
	550 × 400
Angle Back	450 × 300
	600 × 480
	400 × 400

Note1 — All dimensions in millimetres

Note 2 — For detailed dimensions and tolerances, refer to 5 of the standard.

2.2 One piece construction with /without a combined overflow and soap holder. Those to be used in surgeons room and operation theatre shall not be provided with soap holder recess and combined overflow.

2.3 Waste hole shall accomodate a waste filling having a flange diameter of 64 mm.

2.4 Overflow slot, if provided, shall have a horizontal dimension not larger than 64 mm and an area not less than 500 mm².

2.5 Glazed pedestal, if required, shall be so designed as to make the height from floor to top of the rim of basin between 750 to 800 mm.

3. Finish — Inside surfaces of wash basins shall be glazed uniform and smooth in order to ensure efficient draining.

Note 2 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS 2556 (Part 4) : 1994 Specification for vitreous sanitary appliances (vitreous china): Part 4 Specific requirements of wash basins (third revision).

SUMMARY OF

IS : 2556 (PART 5) : 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA)

PART 5 SPECIFIC REQUIREMENTS OF LABORATORY SINKS

(Third Revision)

1. Scope — Requirements for sizes, dimensions, finish, and construction for the vitreous laboratory sinks.

2. Requirements

2.1 Sizes

400 × 250 × 150 mm
 450 × 300 × 150 mm
 500 × 350 × 150 mm
 600 × 400 × 200 mm
 600 × 450 × 200 mm

Note— For detailed dimensions and tolerances refer to 3 of the standard

2.2 One piece construction including overflow, where provided.

2.3 Shall have a circular waste hole.

2.4 Where required sink shall be provided with a rim

2.5 When an overflow hole is provided, it shall be of 25mm diameter.

Note 1 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS 2556 (Part 5) : 1994 Specification for Vitreous sanitary appliances (vitreous china): Part 5 Specific requirements of laboratory sinks (third revision).

SUMMARY OF

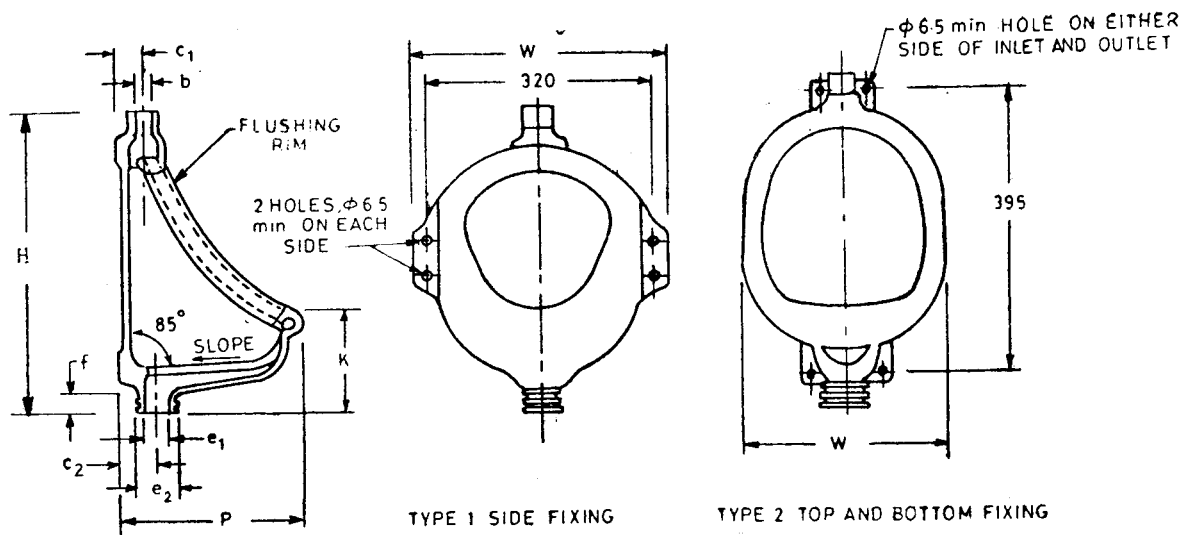
IS : 2556 (PART 6) : 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA)PART 6 SPECIFIC REQUIREMENTS OF URINALS AND
PARTITION PLATES

(Fourth Revision)

1. Scope — Requirements for, patterns and sizes, dimensions, construction, finish, inspection and marking of urinals and partition plates and cleanability test for urinals, made of vitreous china.

2. Requirements**2.1 Patterns and Sizes**

- i) Bowl (flat back) with flushing rim (see Fig.1), of sizes:
 - a) Size 1 — $440 \times 265 \times 355$ mm with side fixing arrangements; and
 - b) Size 2 — $440 \times 265 \times 315$ mm with top and bottom fixing arrangements.
- ii) Bowl (flat back) without flushing rim (see Fig.2), of sizes
 - a) Size 1 — $410 \times 265 \times 305$ mm, and
 - b) Size 2 — $590 \times 375 \times 390$ mm.
- iii) Bowl (angle back) with flushing rim (see Fig.3), of size
 - a) Size 1 — $345 \times 420 \times 270$ mm.
- iv) Bowl (angle back) without flushing rim (see Fig.4), of sizes
 - a) Size 1 — $450 \times 350 \times 275$ mm, and
 - b) Size 2 — $580 \times 500 \times 300$ mm.
- v) Squatting plate (see Fig. 6), of sizes
 - a) Size 1 — 450×350 mm, and
 - b) Size 2 — 600×350 mm.
- vi) Partition plates shall be one of the following sizes
 - a) Size 1 — $675 \times 325 \times 85$ mm,
 - b) Size 2 — $825 \times 450 \times 100$ mm.



Note — Where a closed channel with overflow is not provided a domed grating with perforations starting from the base and the crown of which shall be 25 mm, minimum above surface shall be provided which

All dimension in millimetres

FIG. 1 BOWL PATTERN URINAL (FLAT BACK)

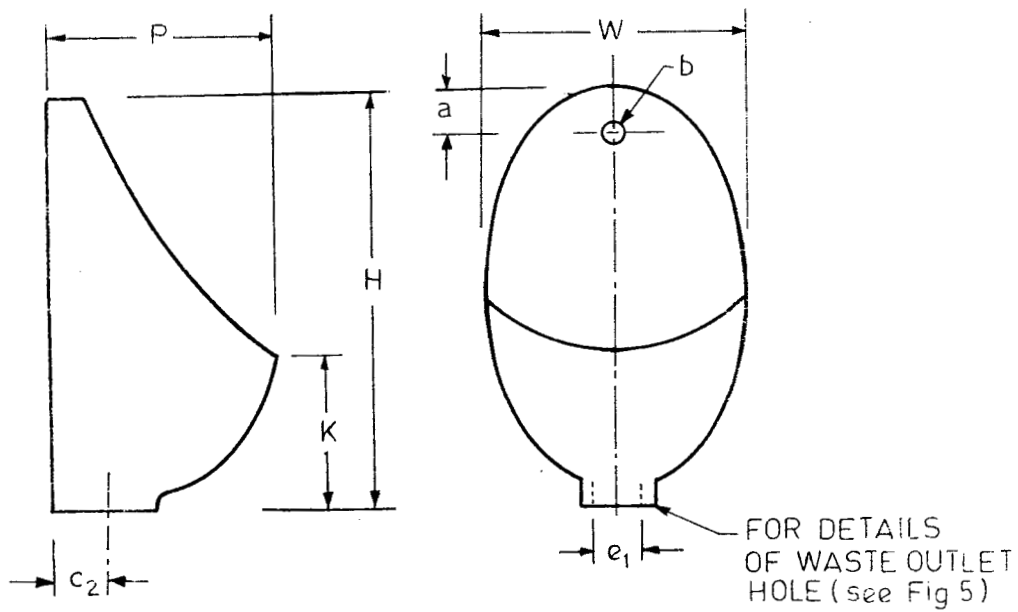
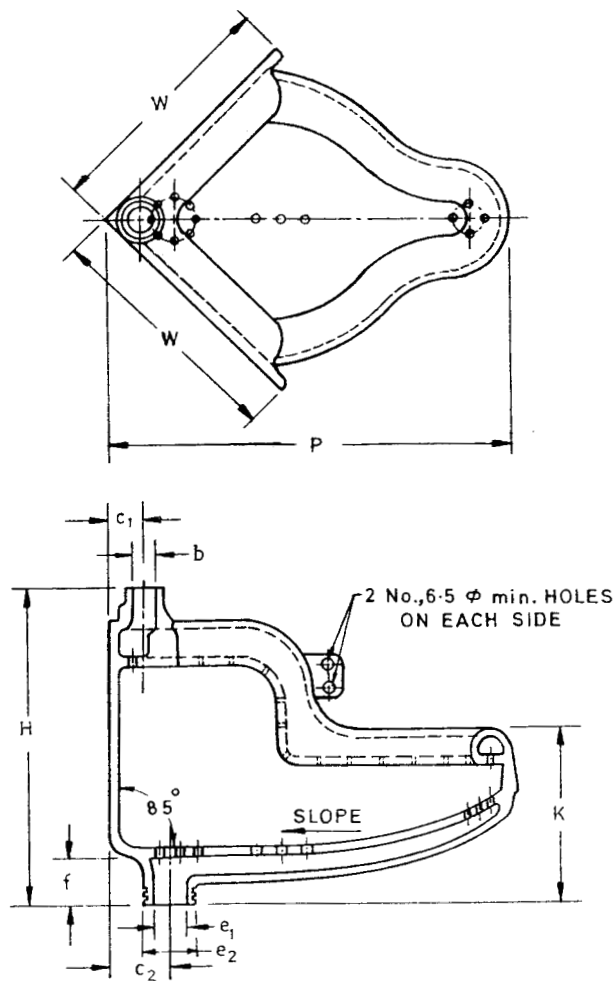


FIG. 2 BOWL PATTERN FLAT BACK (WITHOUT FLUSHING RIM)



Note — Ovality of 5 percent is permissible on inlet and outlet diameters.

FIG. 3 BOWL PATTERN URINAL (ANGLE BACK) WITHOUT FLUSH RIM]

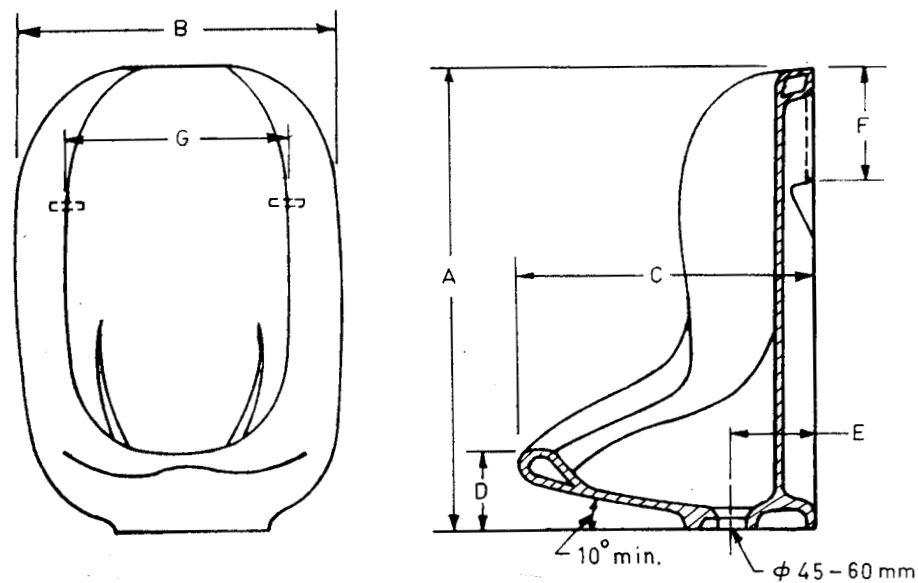


FIG. 4 BOWL TYPE FLAT BACK URINAL WITHOUT RIM

TABLE 1 FUNCTIONAL DIMENSIONS BOWL PATTERN URINALS

Sl. No.	PATTERN	REF To FIG.	DIMENSION			
			Height H	Projection P	Width W	Distance K, Min
1.	Flat back with flushing rim	1				
	Size 1		440	265	355	140
	Size 2		440	265	315	140
2.	Flat back without flushing rim	2				
	Size 1		410	265	305	100
	Size 2		590	375	395	100
3.	Flat back without flushing rim	3	345	420	270	190
4.	Flat back without flushing rim	4				
	Size 1		410	265	305	100
	Size 2		590	375	395	100

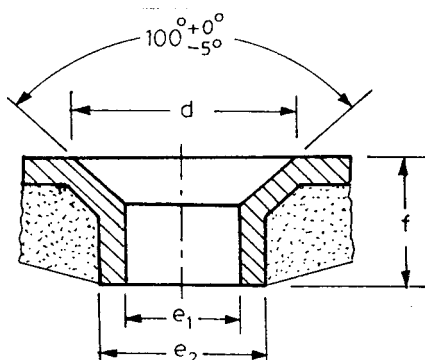


FIG. 5 WASTE OUTLET

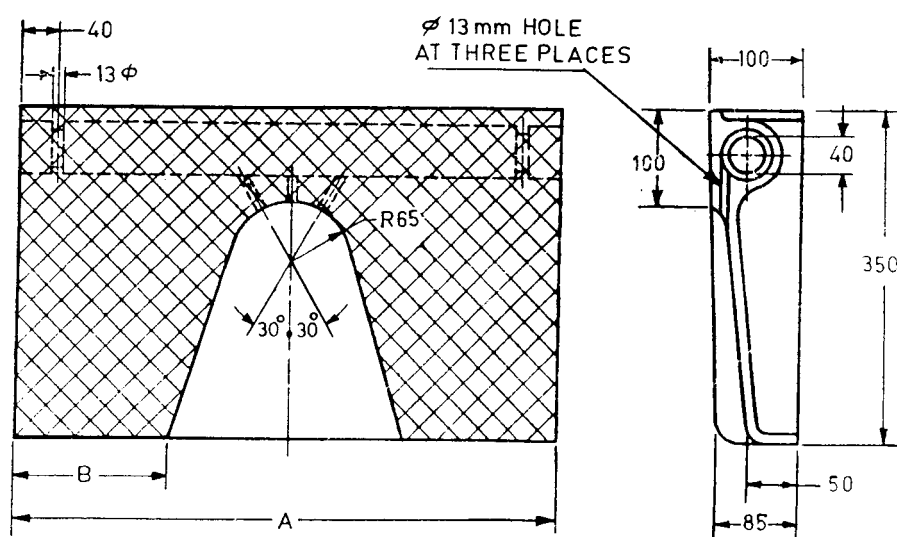


FIG. 6 SQUATTING PLATE URINAL

TABLE 2 CONNECTING DIMENSIONS
OF SQUATTING PLATES, MM

DESCRIPTION	REF IN FIG. 6	SIZE 1 / SIZE 2
Diameter of inlet hole	d ¹⁾	40
Diameter of the inlet socket	d ¹⁾	50
Depth of the inlet socket, Min		

¹⁾ Ovality is permissible within the variation allowed for the dimensions.

TABLE 3 FUNCTIONAL DIMENSIONS
OF PARTITION PLATES, mm

DESCRIPTION	REF IN FIG. 7	SIZE 1	SIZE 2
Size	—	675 × 325 × 85	825 ×
Height	H	675	825
Projection of slab from wall, Min	P	325	450
Width near the centre of the slab, Min	W ₁	85	100
Width at the top end, Min	W ₂	50	75
Width at the bottom end, Min	W ₃	50	55

SP 21 : 2005

2.2 Bowl urinals shall be provided with adequate means of support preferably of the concealed type. Alternatively minimum two fixing holes on each side of minimum diameter 6.5 mm shall be provided.

2.3 Squatting plate type urinal shall be of one piece construction having an integral longitudinal flushing pipe.

2.4 When installed there should be no liquid left over in the bottom of a pan of the urinal after flushing.

2.5 Partition plates shall be of one piece construction

and provided with fixing arrangement at the flat back top and bottom.

3. Finish — Inside and outside visible surfaces of urinals shall be glazed, uniform and smooth. The finish shall ensure efficient flush.

4. Cleansability Test — The bowl urinal and squatting plate urinal shall satisfy the prescribed test.

Note 1 — For method of test, refer to **8** of the standard.

Note 2 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS : 2556 (Part 6) : 1995 Specification for vitreous sanitary appliances (vitreous china) Part 6 specific requirements of urinals and partition plates (fourth revision).

SUMMARY OF

**IS : 2556 (PART 7) : 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA)**

**PART 7 SPECIFIC REQUIREMENTS OF ACCESSORIES FOR
SANITARY APPLIANCES**

(Third Revision)

1. Scope — Requirements for dimensions and tolerances, construction, finish, tests and marking of following accessories, made of vitreous china :

Half round channel,
Foot rest,
Traps for squatting pans,
Floor traps, and
Shower rose.

2. Construction — The accessories shall be of one piece construction.

Note — In case of floor trap (see Fig. 4), the grating (jali) is a separate piece.

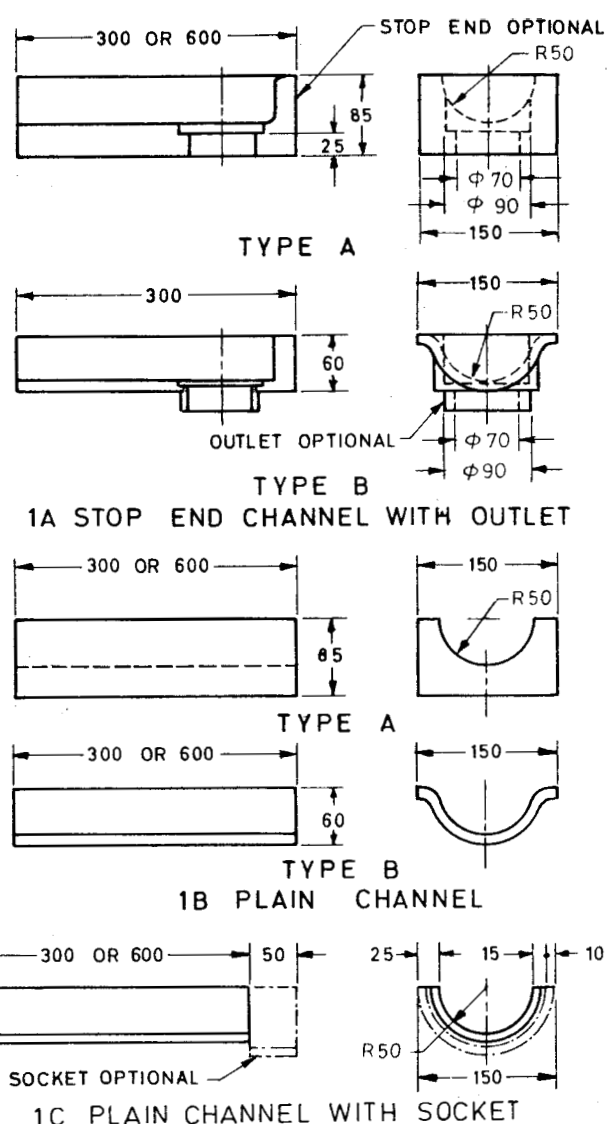
3. Finish — All the functional surfaces of the accessories, that is, those coming in contact with water shall be glazed uniform and smooth, in order to ensure an efficient function and use

4. Tests

4.1. Performance Test — Applicable only for shower rose (see Fig. 5). The shower rose when fitted at a height of 2100 mm from the floor under a minimum of 3 m head shall wet a circular area having 450 mm as its minimum diameter on the floor.

4.2. Flushing Test — Applicable only for traps for squatting pans (see Fig. 3). the flushing test shall be performed in accordance to the provisions stipulated in IS : 2556 (Part 3) : 1994⁺.

⁺ Specific requirements of squatting pans



Note — Ovality is permissible within the variation allowed for the dimension.

All dimensions in millimetres.

FIG.1 HALFRound CHANNEL

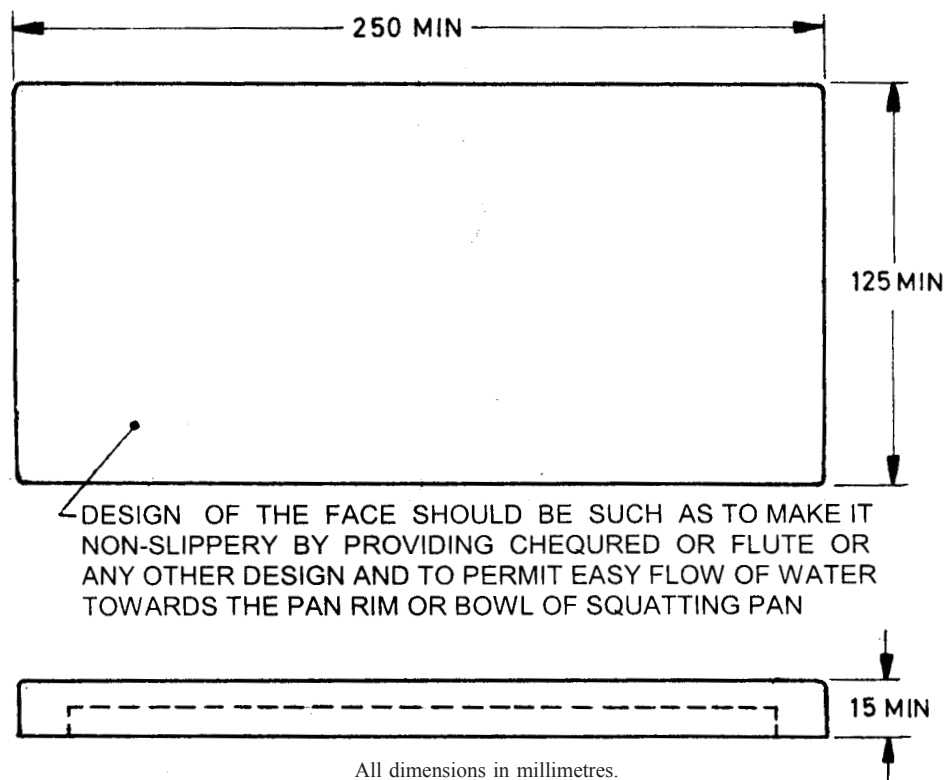
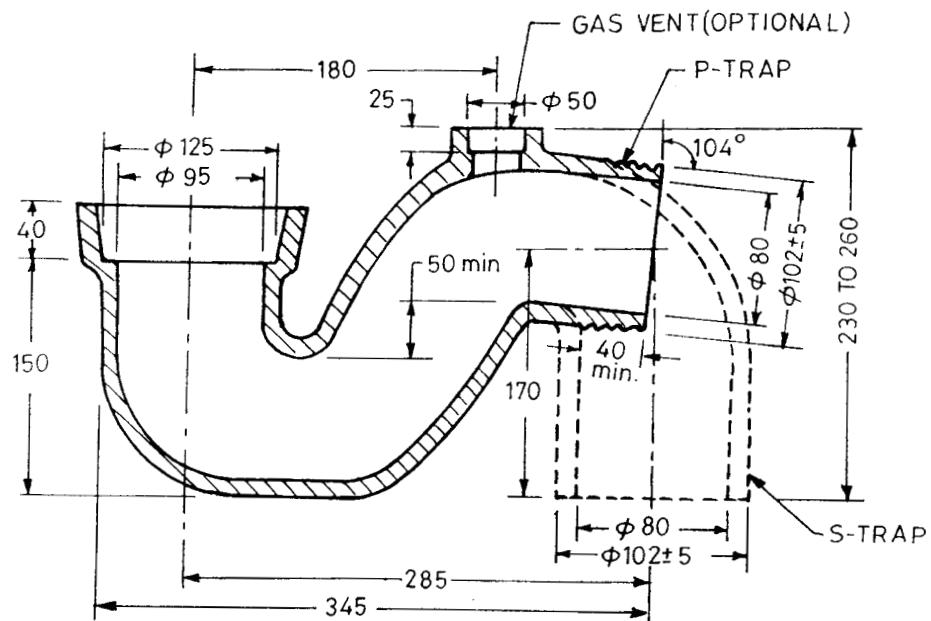


FIG. 2 FOOT REST

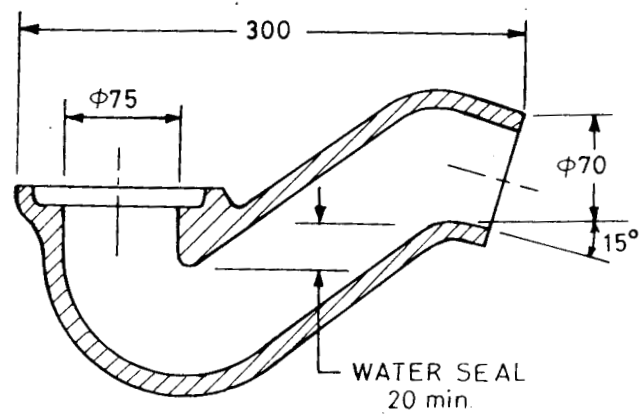


Note — Ovality is permissible within the variation allowed for the dimension

All dimensions in millimetres.

3A Traps for Long Pattern and Orissa Pattern Pans

FIG. 3 TRAPS FOR SQUATTING PANS — *CONTD*

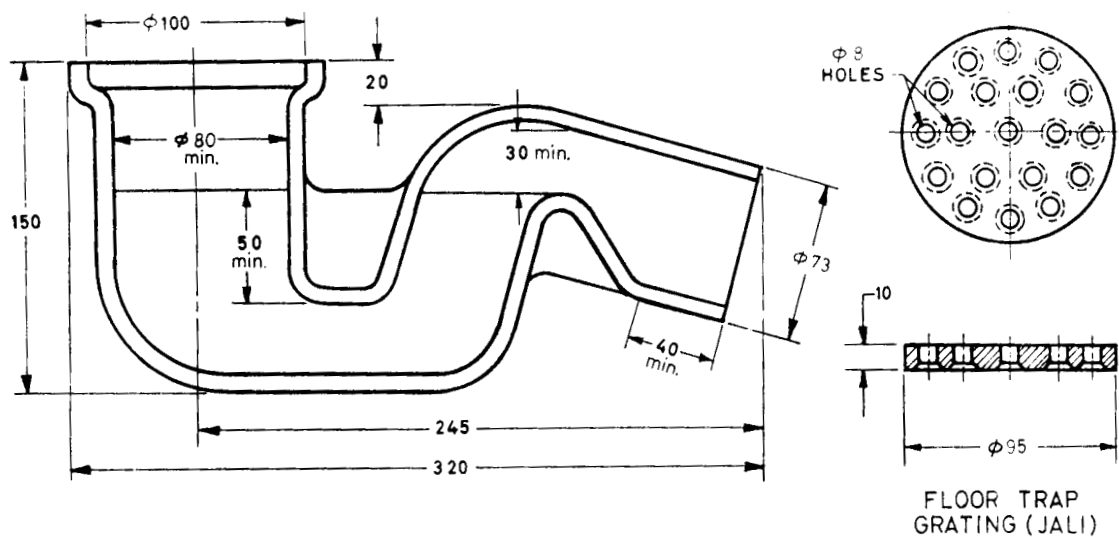


Note — Ovality is permissible within the variation allowed for the dimension.

All dimensions in millimetres.

3B Traps for Rural Pattern Orissa Pattern Pans

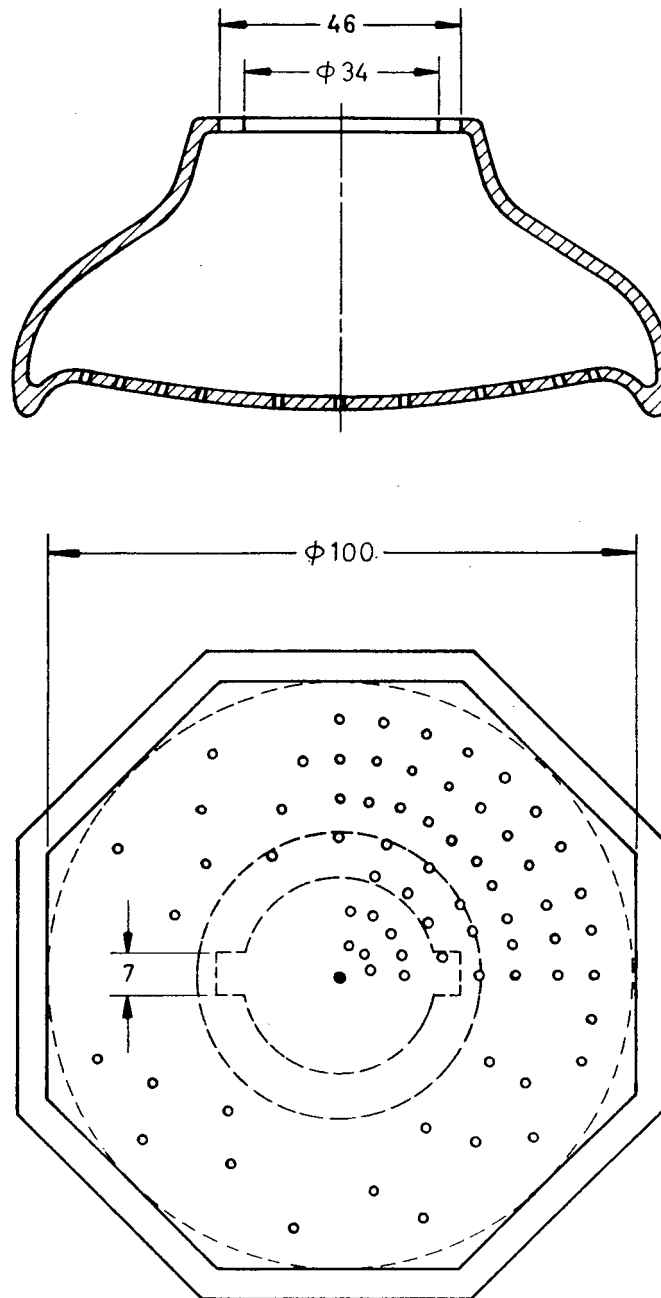
FIG. 3 TRAPS FOR SQUATTING PANS



Note — Ovality is permissible within the variation allowed for the dimension for inlet and outlet diameters.

All dimensions in millimetrs.

FIG. 4 FLOOR TRAPS



All dimensions in millimeters.

FIG. 5 TYPICAL ILLUSTRATION OF VITREOUS SHOWER ROSE

Note1 — For dimensions and tolerances, refer to 5, of the standard.

Note 2 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS : 2556 (Part 7) : 1995 vitreous sanitary appliances (vitreous china): Part 7-specific requirements of accessories for sanitary appliances. (third revision)

SUMMARY OF
**IS : 2556 (PART 8) : 1994 VITREOUS SANITARY APPLIANCES
 (VITREOUS CHINA)**
**PART 8 SPECIFIC REQUIREMENTS OF PEDESTAL CLOSE
 COUPLED WASHDOWN AND SYPHONIC WATER CLOSETS**
(Fourth Revision)

1. Scope — Requirements for patterns, construction, dimensions and tolerances, finish, inspection and marking of pedestal water closets with close-coupled cisterns both syphonic and washdown type including water saving types made of vitreous china.

2. Requirements

2.1 Patterns

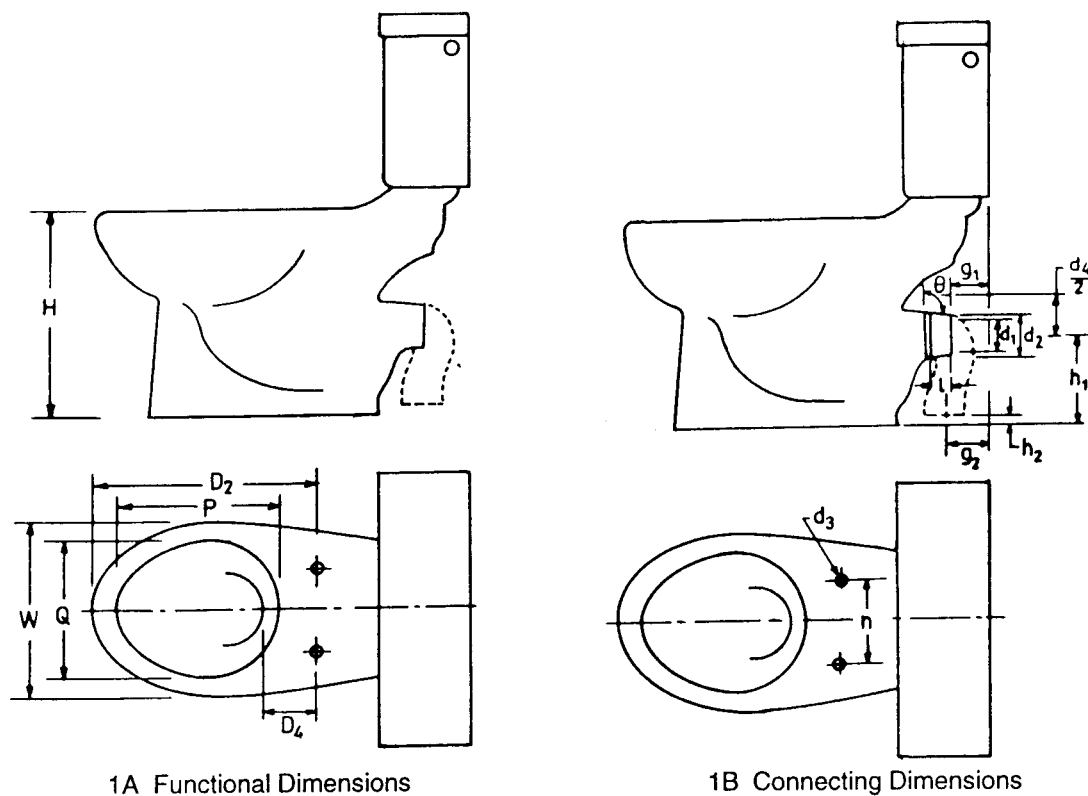
i) *Pattern 1* — Double trap syphonic pattern with 'S' trap or 'P' trap (See Fig. 1).

ii) *Pattern 2* — Single trap syphonic pattern with 'S' trap or 'P' trap (See Fig. 1).

iii) *Pattern 3* — Washdown pattern with 'P' trap or 'S' trap (Fig. 2 or concealed 'S' trap see (Fig. 3).

iv) *Pattern 4* — Washdown pattern with horizontal outlet see (Fig. 4).

Note1 — For dimensions and tolerances, refer to 6, of the standard.



All dimensions in millimetres.

FIG. 1 SYPHONIC WATER CLOSET – SINGLE OR DOUBLE TRAP PATTERN

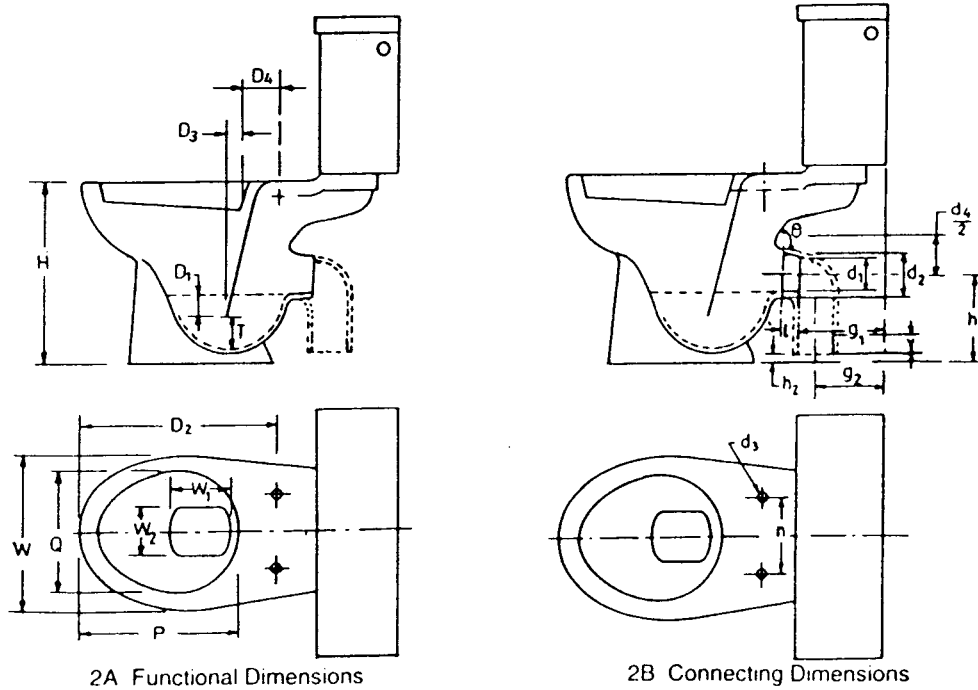


FIG. 2 WASHDOWN WATER CLOSET FOR CLOSE COUPLED SUITE, P OR S TRAP

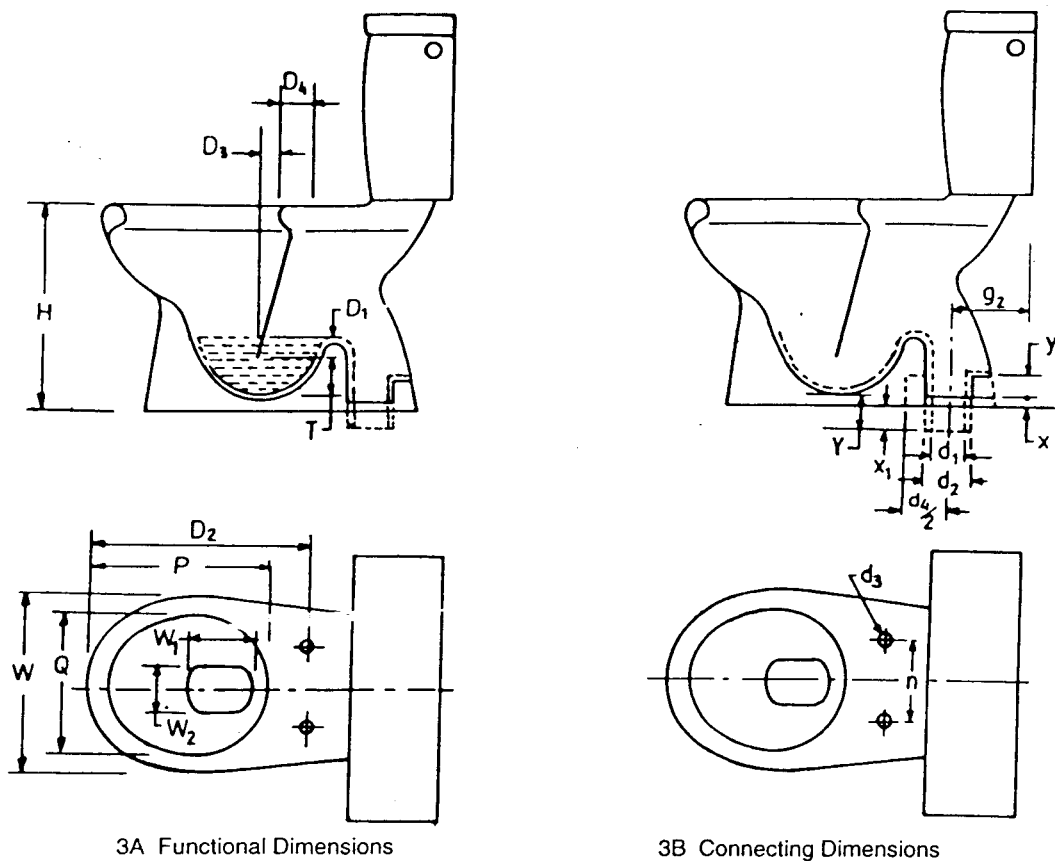
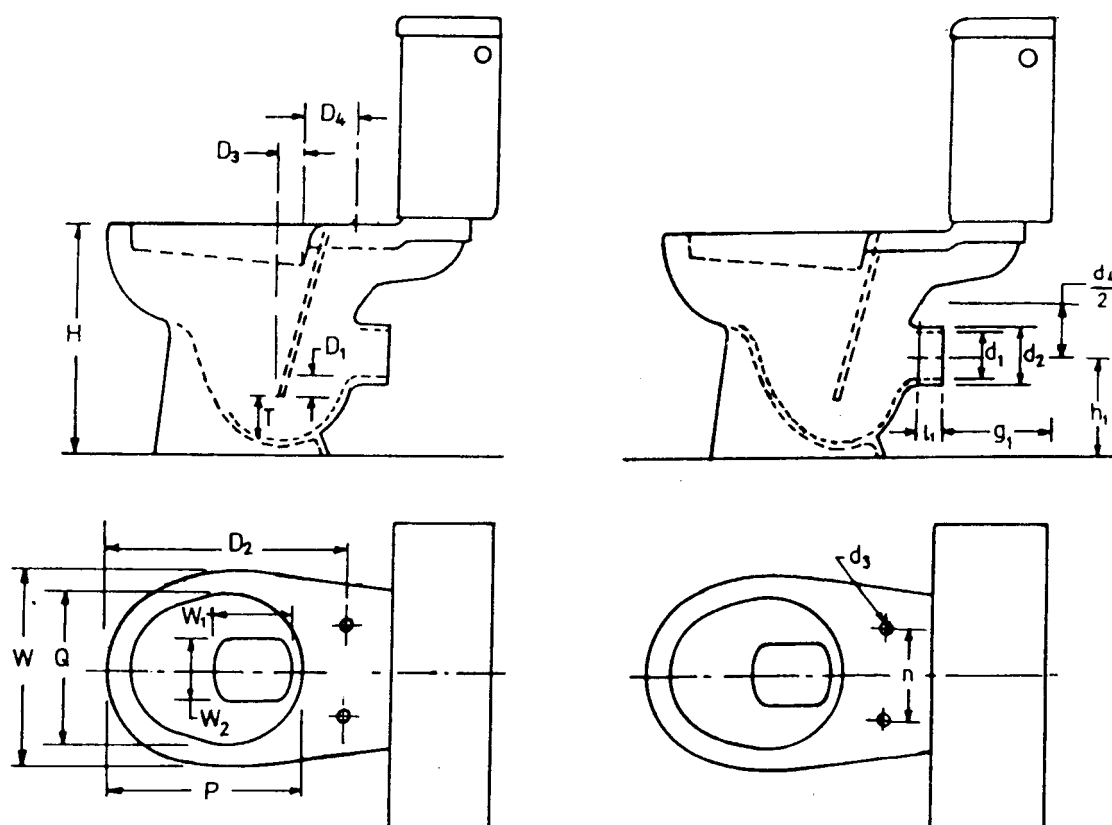


FIG. 3 WASHDOWN WATER CLOSET FOR CLOSE COUPLED SUITE -CONCEALED S TRAP



4A Functional Dimensions

4B Connecting Dimensions

All dimensions in millimetres.

Fig. 4 HORIZONTAL OUTLET WC FOR CLOSED COUPLED SUITE**TABLE 1 FUNCTIONAL DIMENSIONS**

Sl. No.	DESCRIPTION	REF TO FIGURES	SYPHONIC P OR S OUTLET (FIG. 1A)	WASHDOWN OUTLET (FIG. 2A AND 3A)	WASHDOWN HORIZONTAL OUTLET (FIG. 4A)
(1)	(2)	(3)	(4)	(5)	(6)
i)	Pattern No.	—	1 and 2	3	4
ii)	Height H	390 ± 10	390 ± 10	390 ± 10	
iii)	Width W	390 ± 10	390 ± 10	390 ± 10	
iv)	Depth of water seal	D_1	50 Min	50 Min	50 Min
	a) Back to front	W_1	—	150 Min	150 Min
	b) Side to Side	W_2	—	110 Min	110 Min
vi)	Distance from centre line of seal bolts noles to front of WC	D_2	415 to 445	415 to 445	415 to 445
vii)	Length of opening	P	290 Min	290 Min	290 Min
viii)	Width of opening	Q	240 Min	240 Min	240 Min
ix)	Distance between a vertical line from tip of back plate to inside face of flush rim at back	D_3	—	70 Max	70 Max
x)	Distance from centre of seat bolt hole to inside face to flush rim at back	D_4	80 Max	80 Max	80 Max
xi)	Trap inlet depth	T	—	75 Min	75 Min

2.2 Shall be of one piece construction with not less than two floor fixing holes having a minimum diameter of 6.5 mm

2.3 Flushing rim and inlet shall be of self draining type.

2.4 Low level coupled type flushing cistern with discharge capacity not less than 10 litres.

3. Finish — Inside surface of water closet and trap shall be glazed uniform and smooth in order to ensure an efficient flush.

4. Flushing Test

4.1 Toilet Paper Test — When repeated four times the pan shall discharge the full charge of paper at least thrice.

4.2 Smudge Test — Immediately after flushing there shall be no smudge left on the bowl.

4.3 Holding Capacity Test — Shall be capable of holding not less than highest possible water level of the closet.

4.4 Ball Tests

4.4.1 Single ball test — The ball shall be discharge in normal manner.

4.4.2 Fifty ball Test — A minimum of 85 percent of all balls should be flushed out.

Note 1 — For method of test, refer to 9 of the standard.

Note 2 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS 2556 (Part 8) : 1995 Specification for vitreous sanitary appliances (vitreous china): Part 8 Specific requirements of pedestal close coupled washdown and syphonic water closets (fourth revision).

SUMMARY OF
IS 2556 (PART 9) : 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA)
PART 9 SPECIFIC REQUIREMENTS OF PEDASTAL TYPE BIDETS
(Fourth Revision)

1. Scope—Requirements for patterns, construction, dimensions and tolerances, finish, inspection and marking of pedestal type bidets made of vitreous china.

2. Patterns

i) Pattern 1 — Pedestal bidets with flushing rim and spray hole (See Fig. 1A & 1B).

ii) Pattern 2 — Pedestal bidets without flushing rim and over rim supply (See Fig. 2A & 2B).

3. Construction — Shall be of one piece construction.

4. Finish — The inside surface of the bidet and waste outlet shall be glazed uniform, smooth for efficient drawing.

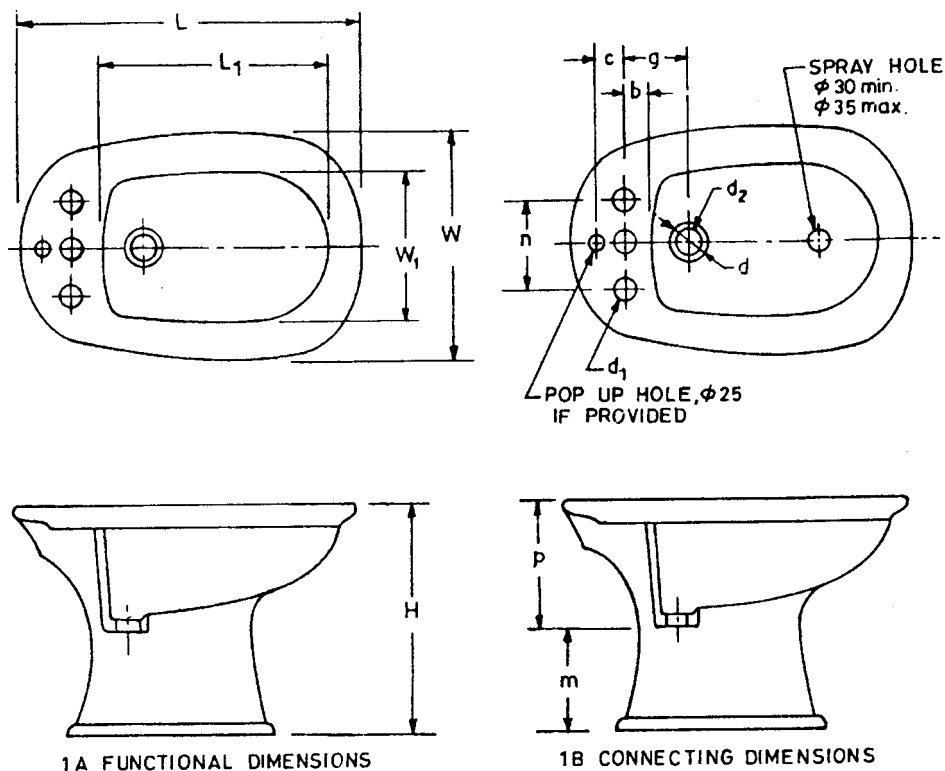


FIG. 1 TYPICAL ILLUSTRATION OF BIDET (WITH FLUSHING RIM)

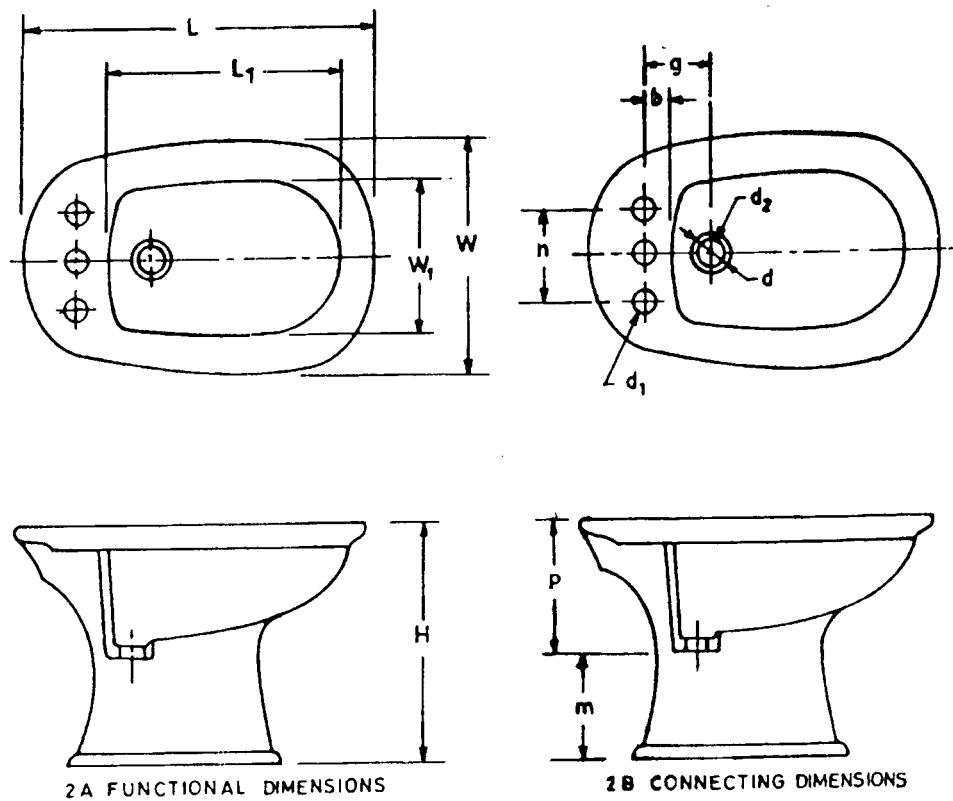


FIG. 2 TYPICAL ILLUSTRATION OF BIDET WITHOUT FLUSHING RIM

Note1 — For detailed dimensions and tolerances, refer to 6 of the standard.

Note 2 — For general requirements refer to Part 1 general requirements of the standard.

For detailed information, Refer to IS : 2556 (Part 9) : 1995 Specification for vitreous sanitary appliances (vitreous china) Part 9 Specific requirements of pedestal type bidets (Fourth Revision).

SUMMARY OF
IS 2556 (PART 14) : 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA)
PART 14 SPECIFIC REQUIREMENTS OF INTEGRATED
SQATTING PANS
(First Revision)

1. Scope — Requirements for patterns, dimensions and tolerances, construction, finish, tests, inspection and marking for integrated vitreous squatting pans.

2. Requirements

2.1 Pattern — Long pattern 500. Other sizes and patterns may be made, however, except functional dimensions, all other requirements shall be complied with.

2.2 Shall be provided with either box or open rim.

2.3 Anti - syphonage vent horn shall be provided where required by the sanitation authority.

2.4 Depth of water seal shall in no case be less than no case be less than 50 mm.

3. Finish — Inside surface of the integrated pan shall be glazed uniform and smooth in order to ensure efficient flush.

4. Flushing Test

4.1 Toilet Paper Test — When repeated four times, the pan shall discharge the full charge of the paper atleast thrice.

4.2 Smudge Test — Immediately after the flush there shall be no smudge left in the pan.

4.3 Holding capacity Test — Shall be capable of holding not less than 10 litres of water between the normal water level and the highest possible water level of the pan.

4.4 Ball Test — The ball shall be discharged in the normal manner.

Note1 — For method of test, refer to 8 of the standard.

Note 2 — For general requirements refer to Part 1 general requirements of the standard.

For detailed information, refer to IS : 2556 (Part 14) : 1995 Specification for Vitreous Sanitary Appliances (Vitreous China): Part 14 Specific Requirements of Integrated Squatting Pans (First Revision)

SUMMARY OF
IS : 2556 (PART 15) : 1994 VITREOUS SANITARY APPLIANCES
(VITREOUS CHINA)
PART 15 SPECIFIC REQUIREMENTS OF UNIVERSAL
WATER CLOSETS
(First Revision)

1. Scope — Requirements for patterns, dimensions and tolerances, construction, finish, tests, inspection and marking for universal water closets made of vitreous china.

2. Requirements

2.1 Sizes

Size 1 – 560 × 460 mm, 'P' or 'S' trap

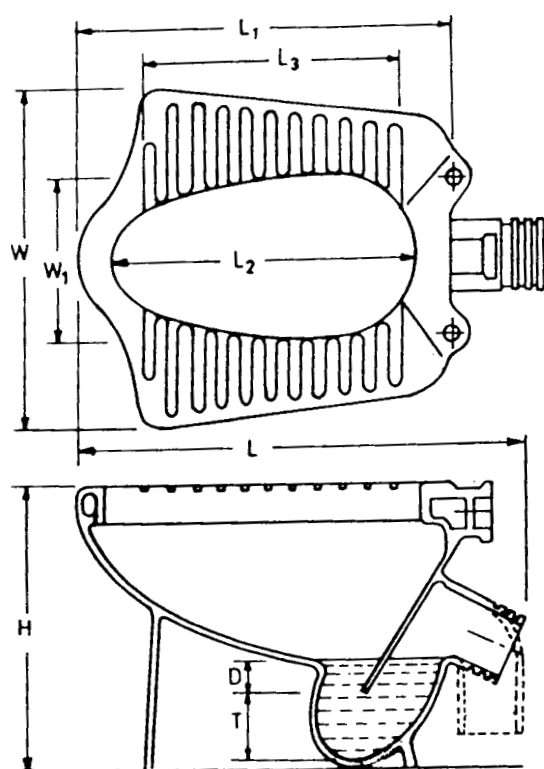
Size 2 – 640 × 460 mm, 'P' or 'S' trap

Other sizes may also be made, except for functional dimensions other requirements shall be complied with.

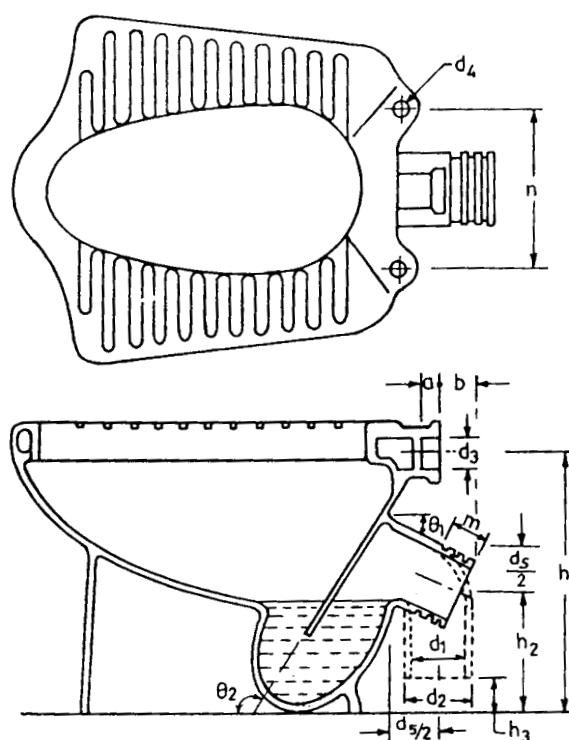
Note — For detailed dimensions and tolerances, refer to 5 of the standard

2.2 P trap closets shall be in one piece. S trap closets may be made in one or two pieces. Each closet shall be provided with not less than four fixing holes having a maximum diameter of 6.5 mm.

2.3 Flushing rim shall be of box type.



1A Functional Dimensions



1B Connecting Dimensions

FIG. 1 UNIVERSAL WATER CLOSET

2.4 Antisiphonage vent horn shall be provided where required by local authority.

2.5 Depth of water seal shall in no case be less than 50 mm.

3. Finish —The inside of water closets and traps shall be glazed uniform and smooth in order to ensure an efficient flush. The grooved part of the outlet of the closets and that of the bends where provided shall not be glazed.

4. Flushing Test

4.1 Toilet Paper Test – When repeated four times, the pan shall discharge the full charge of the paper atleast thrice.

4.2 Smudge Test – Immediately after the flush there shall be no smudge left in the pan.

4.3 Holding Capacity Test – Shall be capable of holding not less than 10 litres of water between the normal water level and the highest possible water level of the pan.

4.4 Ball Test – The ball shall be discharged in the normal manner.

Note 1 — For method of test, refer to **8** of the standard.

Note 2 — For general requirements refer to Part 1 General requirements of the standard.

For detailed information, refer to IS 2556 (Part 15) : 1995 Specification for vitreous sanitary appliances (vitreous china), Part 15: specific requirements of universal water closets (first revision).

SUMMARY OF IS 5455 : 1969 CAST IRON STEPS FOR MANHOLES

1. Scope – Requirements for cast iron steps for manholes.

2. Material – Suitable quality of grey cast iron as specified.

3. Requirements

3.1 Patterns

Pattern 1 — Minimum weight 4.5 kg (*see* 1A)

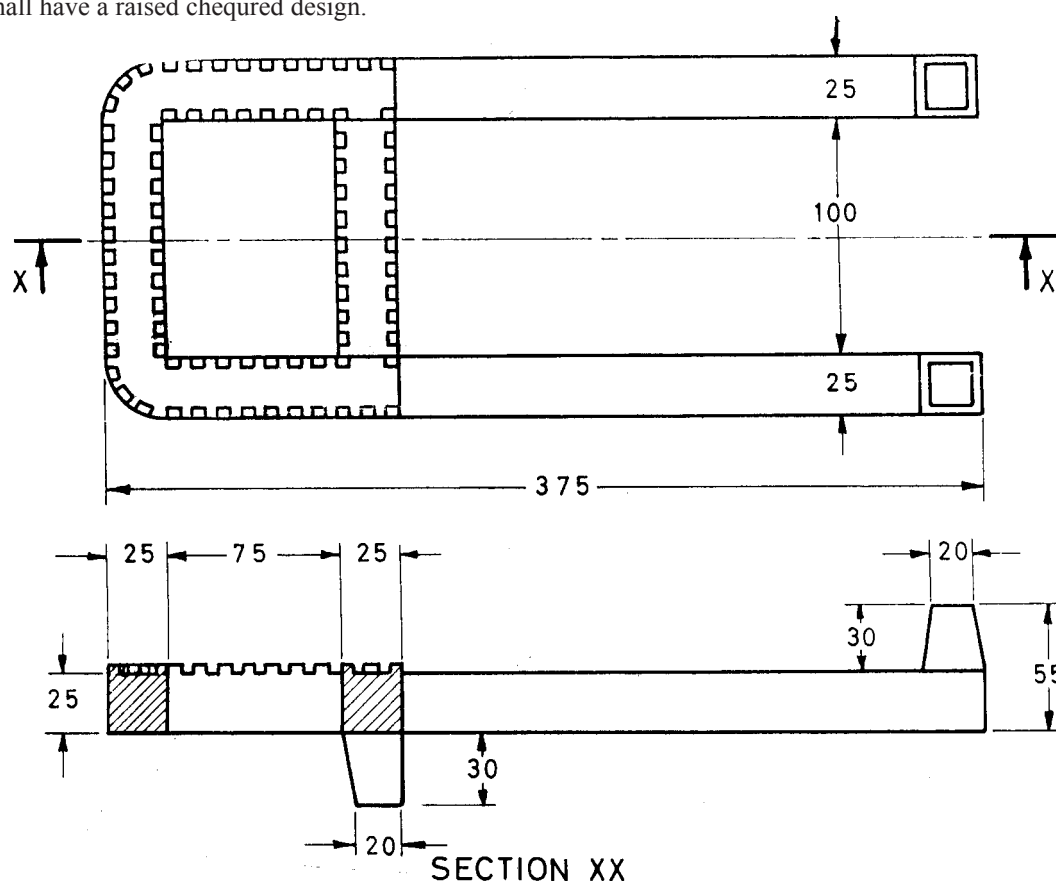
Pattern 2 — Minimum weight 5.3 kg (*see* 1B)

3.2 Portion of step projecting from the wall of the man hole shall have a raised chequered design.

4. Tolerance – ± 2 mm on all dimensions

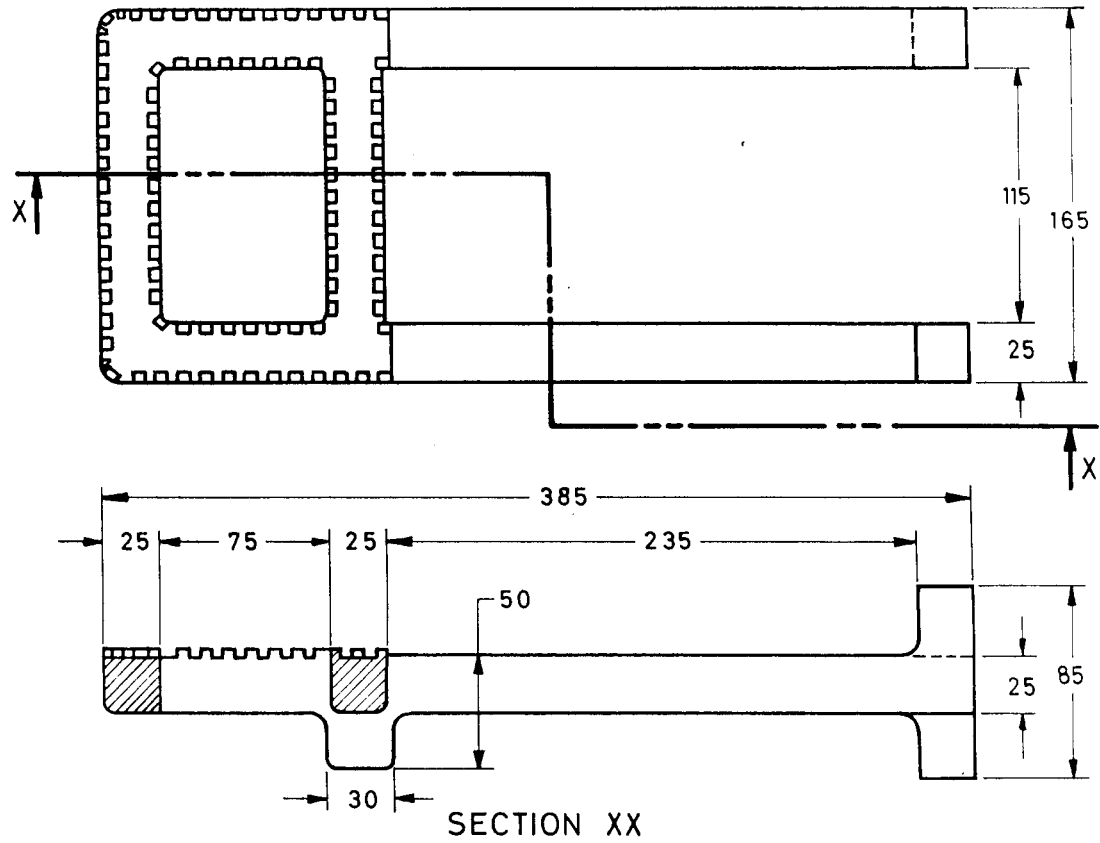
5. Coating – Shall be coated with a material having tar base or with a black bituminous composition or cashew-nut shell liquid. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of temperature of 63°C and shall not brittle as to chip of at a temperature of 0°C .

6. Test – shall with stand a load of 225 kg at a point at the centre of the front tread for 1 minute



All dimensions in millimetres.

FIG. 1A CAST IRON STEPS FOR MANHOLE (PATTERN 1)



All dimensions in millimetres.

FIG. 1B CAST IRON STEPS FOR MANHOLE (PATTERN 2)

Note — For method of test, refer to Appendix A of the standard.

For detailed information, refer to IS 5455: 1969. Specification for cast iron steps for manholes.

SUMMARY OF
IS 5961 : 1970 CAST IRON GRATING FOR DRAINAGE PURPOSES

1. Scope – Requirements for cast iron gratings for use in drainage works.

2. Materials – Frame and cover shall be of grey cast iron. Hinge pin shall be of mild steel wire.

3. Manufacture and Workmanship — Frame and cover shall be free from air and sand holes, cold shuts and warping.

4. Dimensions and Tolerances

Size of frame = 600×560 mm

(Outside dimensions)

Height of frame = 100 mm

4.1 Tolerance — On internal dimensions of the top of

the frame ± 2 mm.

Note — For detailed dimensions see Fig. 1 of the standard.

5. Weight – 75 kg minimum.

6. Coating – Shall be with a material having tar base with a black bituminous composition. Coating shall be smooth and tenacious which will not flow at a temperature of 63°C , and which is not so brittle as to chip off at 0°C .

7. Test – Gratings shall withstand without fracture a load of 35 tonnes for a minimum period of 30 seconds when subjected to loading test described in IS 1726 : 1991⁺.

⁺ Cast iron manhole covers and frames (*third revision*)

For detailed information, refer to IS 5961 : 1970 Specification for cast iron gratings or drainage purposes.

SUMMARY OF
IS 7231 : 1994 PLASTIC FLUSHING CISTERNS FOR WATER
CLOSETS AND URINALS
(Second Revision)

1. Scope — Requirements for manually operated high-level and low-level plastic flushing cisterns of capacities 5 litres and 10 litres, both single flush and dual-flush types, for water-closets, squatting pans and urinals.

2. Materials

- a) *Cistern and Cover* — High density polyethylene (HDPE) or Polystyrene high impact or Polypropylene T or Acrylonitrile butadiene - styrene or glass fibre reinforced plastic (GRP) conforming to prescribed standards
- b) *Flush Pipe* — Steeltube, seamless or welded, medium or light completely protected inside and outside by hot dip galvanizing electroplating or vitreous enamelling or lead pipe or copper alloy tube, HDPE pipes or VPVC plumbing pipe conforming to prescribed standard.
- c) *Overflow pipe* — HDPE or VPVC or any other corrosion resistant material conforming to prescribed

3. Construction

3.1 Cistern — It shall be mosquito-proof. The thickness of the body including cover at any point shall not be less than 2 mm for GRP, and not less than 3 mm for other plastic materials.

3.2 Cover — Removable cover which shall fit closely and shall be secured against displacement.

3.3 Flush Pipe — The flush pipe (except plastic flush pipe) shall have an internal diameter of 32 ± 1 mm for high-level cistern and 38 ± 1 mm for low-level cistern. The steel flush pipe shall be not less than 1 mm thick whereas the lead flush pipe shall have a minimum thickness of 3.5 mm. For high density polyethylene pipes, the outside diameter of the pipes shall be 40 mm. For unplasticized PVC plumbing pipes the outside

diameter of the pipe shall be 40 mm for high-level cisterns, and 50 mm for low-level cistern.

3.3.1 Flush Pipe Connection to Cistern — The flush pipe shall be securely connected to the cistern outlet and made airtight by means of a coupling nut. The nominal internal diameter of the cistern outlet shall be not less than 32 mm and 38 mm for high-level and low-level cisterns respectively.

3.4 Inlet and Outlet Holes — The cistern shall be provided with inlet and overflow holes, situated one at each end, which shall be capable of accommodating overflow pipe of not less than 20 mm nominal bore and a 15 mm size float valve.

3.5 Operating Lever — The operating mechanism/lever shall not project beyond the side of the cistern for a distance greater than 350 mm measured from the centre of the cistern to the end of the lever arm.

3.6 String (Chain) — The string (chain) shall be of such a strength as to sustain a dead load of 500 N without any apparent or permanent deformation.

3.7 Overflow Pipe — The overflow pipe shall be of not less than 20 mm nominal bore and shall incorporate a non-corrodible mosquito-proof device.

3.8 Float Valve — Shall be 15 mm nominal size

4. Operational and Performance Requirements

4.1 Flushing Arrangement — The cistern under working conditions and with the float valve in closed position shall operate on a single operation of the operating mechanism/lever without calling for a sudden jerk in pulling. If a valve is used instead of siphon for flushing purposes, the valve shall be completely leakproof.

4.2 Working Water Level — The working water level shall be a minimum of 6.5 cm below the effective top edge of the cistern and shall be legibly and permanently marked on the inside of the cistern.

[†] Talc as filler if used shall not exceed 20%

Note— For materials of other components See Table 1 of the standard.

4.3 Freedom from Self Siphonage — The siphonic system shall be capable of being rapidly brought into action when the water is at the working water level, but shall not self-siphon or leak into the flush pipe when the water is up to 1 cm above the invert of the overflow pipe.

4.4 Reduced Water Level — The discharge shall operate satisfactorily when the cistern is filled to a level up to 1 cm below the working water level.

4.5 Discharge Capacity — Cistern of 5 litres and 10 litres capacities, when required to give a full flush, shall respectively discharge 5 litres and 10 litres with variation of ± 0.5 litres. Dual-flush cistern of 10 litres capacity shall discharge alternatively a short flush of 5 ± 0.5 litres. Dual flush western 6/3 litre capacity shall discharge 6 ± 0.5 litres and alternatively a half flush of 3 ± 0.5 litre

4.6 Discharge Rate — The discharge rate shall be 10 ± 0.5 litres within 6 seconds and 5 ± 0.5 litres and 6 ± 0.5 litre within 6 s and 3 ± 0.5 litres within 35 for liters of

capacity 6/3 litre. 3 seconds for cistern of capacities 10 litres and 5 litres respectively.

5. Tests

5.1 Distortion Resistance Test — The cistern shall not buldge more than 6 mm and the cover shall not be dislodged.

5.2 Dead Load Test — When tested by the application of a dead load of 230 N applied 6 mm from the end of the operating lever arm for 30 seconds, shall not distort to such an extent that any part becomes detached.

5.3 Front Thrust Test — Only to cisterns intended for low level use shall not distort to such an extent as to be inoperable or unsightly when the load is removed.

5.4 Impact Test — The cistern, complete with its fittings, shall show no defect after one impact.

5.5 Endurance Test — The cistern and its component parts shall not show any damage or defects and all the parts shall be satisfactory, after 3000 operations.

Note — For method of test, refer to 9 and Appendices B to D of the standard.

For detailed information, refer to IS 7231 : 1994 Specification for plastic flushing cisterns for water closets and urinals (second revision).

SUMMARY OF
IS 11246 : 1992 GLASS FIBRE REINFORCED POLYESTER
RESIN (GRP) SQUATTING PANS
(First Revision)

1. Scope — Requirements for material, construction, workmanship, finish, performance and testing for glass fibre reinforced polyester resin (GRP) pourflush type squatting pans conact moulded as well as compression moulded.

2. Material

2.1 Glass Fibre — As per IS 11320: 1997* and IS 11551: 1996+

Low alkali glass with glass content of the laminate minimum 30 percent by weight.

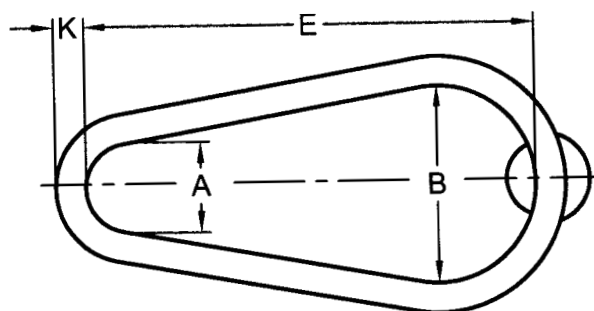


FIG. 1 SQUATTING PAN

TABLE 1 FUNCTIONAL DIMENSIONS

DESCRIPTION (1)	REF IN FIG. 1 (2)	DIMENSIONS (mm) (3)
Width of front profile (semi-circle)	A	125
Width at rear profile (semi-circle)	B	200
Vertical drop in front wall of pan	C	70
Rear of back wall of the pan inclination to horizontal off set to trap opening	D	6-8°
Length of top opening	E	425
Slope of bottom of pan	F	25-28°
Overall depth of pan (see Note)	G	320
Length of entry of squatting pan into the P-trap	H	40 Min
Dia at entry from sqattig pan to P-trap	J	77, ID
Projected bend of rim all-round	K	20-25

Notes —

1 Dimension C, G and H are for general guidance.

2 Tolerance + 4% for all dimensions of 50 mm and above.

* Glass fibre rovings for reinforcement of polyester and epoxide resin systems (*first revision*)

+ Glass fibre chopped strand mat for the reinforcement of epoxy, phenolic and polyester resin systems (*first revision*)

2.2. Polyester Resin — Unsaturated polyester resin shall be isophthalic type

2.3. Sheet Moulding Compound (SMC) — Shall be of low profile grade and shall consist of glass fibre reinforcements pre-impregnated with filled unsaturated polyester resin system in sheet form.

2.4 Surface Coat

- a) Gel coat.
- b) Polyurethane resin coat

3. Thickness and Mass

3.1 Thickness

- i) With gel coat — 2.0 mm, *Min*
- ii) With PU coat — 1.8 mm, *Min*

At the point of additional reinforcement, that is rim and bottom outlet, the minimum thickness shall be 2.8 mm with gel coat and 2.6 mm with PU coat.

3.2 Mass — The minimum mass of hand laid pans shall be 750 gm and for sheet moulding compound (SMC) shall be 900 gms.

4. Performance requirements

4.1 Warpage — Feeler gauge of 4mm shall not slide under it without application of force.

4.2 Thickness — See 3.1

4.3 Impact Resistance — Shall not show any cracks in the surface coat.

4.4 Crazeing — Shall not show cracks or crazeing after oven test.

4.5 Water Absorption — Shall not absorb water in excess of 0.5 percent.

4.6 Gel Coat — Shall not be less than 0.20mm thick and not more than 0.40mm thick.

4.7 Resistance of hydrochloric acid/uric acid: there shall be no discoloration and exposure of glass fibre.

4.8 Hardness — Minimum 30 points for gel coated 20 points for PU coats or Barcol impressor.

4.9 Scratch Resistance — Shall withstand 40,000 cycles in scrub test.

4.10 Ink Test - Ink stains and defects mentioned under 5.3 of the standard shall not be permitted.

For detailed information, refer to IS 11246 : 1992 Specification for glass fibre reinforced polyester resin (FRP) squatting pans (first revision).

SUMMARY OF
IS 778 : 1984 COPPER ALLOY GATE, GLOBE AND CHECK VALVES
FOR WATER WORKS PURPOSES
(Fourth Revision)

1. Scope — Requirements of copper alloy gate, globe and check valves of nominal sizes 8 to 100 mm suitable for working temperatures up to 45° C and non shock working pressure up to 16 MPa, for water works purposes.

This standard may be used for other fluids, but the physical and chemical testing shall be done for the same fluid.

2. Nominal Sizes

2.1 Screwed End Valves

8(1/4), 10(3/8), 15(1/2), 20(3/4), 25(1), 32(1.1/4), 40(1 1/2), 50(2), 65(2 1/2), 80(3) and 100 mm(4)

The nominal sizes shown in parantheses refer to the size of screw threads.

2.2 Flanged Valves Shall be as follows

15, 20, 25, 32, 40, 65, 80, and 100mm.

The nominal sizes of valves shall be designated by the nominal bore of the pipe of which the valve is normally fitted. The actual bore shall not be less than the nominal size.

3. Classification

Class 1 Valves — Valves of this class are suitable for non-shock cold working pressure up to 1.0 MPa (cold service means a temperature not exceeding 45°C).

Class 2 Valves — Valves of this class are suitable for non-shock cold working pressure up to 1.6MPa.

4. Types

4.1 Gate Valves

- a) Solid wedge type
- b) Split wedge type and
- c) Double disc type.

TABLE 1 MATERIALS FOR COMPONENT PARTS OF GATE, GLOBE AND CHECK VALVES

<i>SL. No.</i> (1)	<i>COMPONENT</i> (2)	<i>MATERIAL</i> (3)
i)	Body	a) Brass b) Leaded tin bronze
ii)	Bonnet or cover	a) leaded tin bronze b) Forged brass c) Brass
iii)	Stuffing box, disc hinge, check nut, stem nut, disc retaining nut, gland, gland nut, glandflange, body seat rings and disc or wedge facing rings(where renewable)	a) leaded tin broze b) Extruded brass rod c) Forged brass d) Brass
iv)	Stem, hinge pin and plug	a) Extruded brass rod b) High-tensile brass
v)	Ball (for ball type check valves)	c) Forged brass Chromium steel
vi)	Bolts, nuts	Mild steel
vii)	Handwheel	Cast iron*
viii)	Gasket	Compressed asbestos fibre
ix)	Gland packing	a) hemp and jute b) Asbestos
x)	Spring	Phosphor bronge wire
xi)	Seating ring	Synthetic rubber

* Steel, aluminium alloy, zink and non metallic material may be permitted if required.

- 4.2 *Globe Valve* – a) Straight type and
b) Right angle type.
- 4.3 *Check Valve* – a) Swing type and
b) Lift type with disc or ball check

5. **Materials** – See Table 1

6. **Design and Manufacture** — See 7 of the standard.

6.1 Body end port shall be circular end of a diameter not less than the nominal size of the ports of the valve

6.2 Area of water way through and between the ports of the valve shall be not less than area of a circle of diameter equal to the nominal size of the valve except to globe and check valves where area may be reduced through the valve seats to 85 percent of the fullwater way area.

6.3 Bonnets shall be screwed in bonnet, screwed on bonnet or bolted bonnet.

6.4 Gland shall be of one piece or two piece design consisting of a sleeve sliding in the stuffing box and secured by a gland nut or bolted flange.

6.5 Stem shall be in one piece and designed to prevent the wedge or disc from leaving the stem.

Note — For details of design see 7 of the standard.

7. **Dimension**

MINIMUM WALL THICKNESS OF BODY AND BONNET

All dimensions in millimetres

Class of Valve	Nominal Size of Valves											
	8	10	15	20	25	32	40	50	65	80	100	
1	1.7	1.7	1.8	1.9	2.0	2.2	2.3	2.5	2.7	3.0	3.5	
2	2.0	2.0	2.2	2.3	2.5	2.7	2.9	3.2	3.6	3.9	4.5	

Note — for dimensional details see 8 of the standard.

8. **Tests**

8.1 *Material Test* — shall conform to the prescribed standards.

8.2 *Body Test (Hydrostatic)* — Shall not show any leakage when prescribed pressure is applied to the inlet end, outlet and is blanked and valve is fully open.

8.3 *Back Seat Test* — There shall be no leakage through the stuffing box.

8.4 *Seat-Test-(Hydrostatic)* — Shall not show any leakage under the prescribed test.

Note — For method of test refer to the standard.

For details information, refer to IS 778 : 1984. Specification for Copper alloy gate, globe and check valves for water works purposes (Fourth revision).

SUMMARY OF

**IS 781 : 1984 CAST COPPER ALLOY SCREW DOWN BIB TAPS
AND STOP VALVES FOR WATER SERVICES**

(Third Revision)

1. Scope — Requirements for copper alloy screw down bib taps and stop valves suitable for cold non-shock working pressure up to 1.0 MPa. Bib taps shall have screwed male inlet. Stop valves shall have screwed female end or male ends or mixed ends (mixed ends means one end screwed male and the other end screwed female).

Note — Cold service means a temperature not exceeding 45°C.

2. Nominal sizes

- a) Bib taps shall be 8, 10, 15, 20 and 25 mm.
- b) Stop valves shall be 8, 10, 15, 20, 25, 32, 40 and 50 mm. Nominal size of the bib tap and stop valves shall be designated by the nominal bore of the socket or pipe outlet to which the tap or valve is normally fitted.

3. Materials

<i>Sl No.</i>	<i>Component</i>	<i>Material</i>
i)	Body and bonnet	a) Cast brass b) Lead tin bronze
ii)	Spindle nuts	Brass (extruded rolled or forged)
iii)	Gland Crutch (handle) cast washer, plate etc.	Brass (extruded, rolled, cast, die)
iv)	Washer	Lead tin bronze

For details information, refer to IS 781 : 1984 Specification for Cast copper alloy screw down bib taps and stop valves for water services (third revision).

4. Dimensions — The overall length of stop valves shall be as given below with a tolerance of +3mm

<i>Nominal Size</i>	<i>mm</i>		
	<i>Internally Threaded</i>	<i>Externally Threaded</i>	<i>Mixed Ends</i>
8	45	65	55
10	50	75	62
15	60	85	70
20	70	100	85
25	85	125	105
32	100	135	115
40	110	145	125
50	135	175	155
Tolerance ±3mm			

Note — For detailed dimensions, refer to the standard.

5. Finish — The bib taps shall be always polished bright. The stop valves may be polished bright or they may have an unpolished as 'cast' finish. The bib taps or stop valves may also nickel-chromium plated. The plating shall be capable of taking high polish and shall not easily tarnish.

8. Testing — When tested in closed position under hydraulic pressure of 1.5 MPa minimum maintained at that pressure for a period of at least 2 minutes during which it shall neither leak nor sweat.

SUMMARY OF

IS 1701 : 1960 MIXING VALVES FOR ABLUTIONARY AND DOMESTIC PURPOSE

1. Scope — Requirements regarding sizes, material, manufacture, workmanship and testing of mixing valves for ablutionary and domestic purposes.

2. Sizes — Shall be of three sizes, namely 15 mm (or ½ in.), 20 mm (or ¾ in.) and 25 mm (or 1 in.). The size of a mixing valve shall be denoted by the nominal size of the bore of the inlets which shall always be of equal diameters.

3. Materials — Brass, Leaded Tin Bronze, Stainless steel or equally suitable corrosion resisting alloy and manganese bronze in case of hot pressing.

4. Operation — The sequence of operation of the valve shall be as follows :

Off or Shut
Cold
Warm or Tepid
Hot

Closing of the valve shall be performed by rotation of control in an anticlockwise direction.

5. Workmanship

All gravity — and die-castings shall be in all respects, free from laps, blow holes and pitting. Both external and internal surfaces shall be clean, smooth and free from sand. They shall be neatly dressed and no castings shall be burned, plugged, stopped or patched.

All hot-pressed components shall be sound and solid

without lamination and shall be finished smooth.

6. Tests — Shall withstand without leaking or sweating a hydraulic pressure of 20 kg/cm² applied for a period of two minutes with the control in the mid-open position.

When the control is in the 'shut' position, the valve shall remain closed and show no leakage against a pressure of 15 kg/cm² applied for a period of two minutes.

The head loss through the mixing valve at different rates of flow shall not exceed those given in Table 1.

TABLE 1 LOSS OF HEAD

SIZE OF MAXIMUM VALVE	RATE OF FLOW L/MIN PERMISSIBLE	HEAD LOSS IN FITTING
		m
15	$\left\{ \begin{array}{l} 5 \\ 10 \\ 15 \end{array} \right.$	$\left\{ \begin{array}{l} 1.0 \\ 1.5 \\ 2.5 \end{array} \right.$
20	$\left\{ \begin{array}{l} 20 \\ 25 \\ 30 \end{array} \right.$	$\left\{ \begin{array}{l} 1.5 \\ 2.0 \\ 3.0 \end{array} \right.$
25	$\left\{ \begin{array}{l} 40 \\ 45 \end{array} \right.$	$\left\{ \begin{array}{l} 2.5 \\ 3.0 \end{array} \right.$

For detailed information, refer to IS 1701: 1960 Specification for mixing valves for ablutionary and domestic purposes.

SUMMARY OF

IS 1703 : 2000 WATER FITTINGS COPPER ALLOY FLOAT VALVES (HORIZONTAL PLUNGER TYPE)

(Fourth Revision)

1. Scope – Requirements regarding sizes, materials, manufacture and workmanship, and testing of float valves (horizontal plunger type) for water supply purposes.

2. Classification –

a) High Pressure — High Pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.

b) Low Pressure — Low Pressure float valves are indicated by the abbreviation 'LP', and are designed for use on mains having a pressure less than 0.175 MPa.

3. Nominal Sizes – 5, 20, 25, 32, 40 and 50 mm.

Note — For detailed dimensions, refer to the standard

4. Materials

TABLE 1 MATERIALS FOR BODY AND COMPONENT PARTS OF FLOAT VALVES

SL. No (1)	COMPONENT (2)	MATERIAL (3)
i)	Body and parts of fittings (except lever rod and back nut)	a) Cast Brass b) Leaded tin bronze
ii)	Lever rod	Brass rod
iii)	Back nut and nuts for inlet pipe	a) Brass rod b) Leaded tin bronze
iv)	Washer	Synthetic rubber
v)	Inlet pipe	Brass

5. Construction

5.1 The inlet shank shall be horizontal in case of 15 mm size it may be either horizontal or vertical.

5.2 The lever may be made in one piece or the short arm and rod may be separately constructed.

5.3 Floats shall conform to IS 9762 : 1994⁺

6. Testing

6.1 Hydraulic Test — Every float valve while in closed position shall withstand an internally applied hydraulic pressure of 1.5 MPa for a minimum period of 2 minutes without leakage or sweating.

6.2 Shutting Off Test — Every 'HP' float valve when assembled in working condition with the float immersed to not more than half its volume shall remain closed against test pressure of 1.05 MPa and a 'LP' float valve against a test pressure of 0.35 MPa.

6.3 Test for Mechanical Strength of lever — Shall be capable of supporting the prescribed test loads.

⁺polyethylene floats (spherical) for float valves.

For detailed information, refer to IS 1703: 1999 Specification for water fittings copper alloy float Valves (horizontal plunger type) (fourth revision)

SUMMARY OF
**IS 1711 : 1984 SELF-CLOSING TAPS FOR
 WATER SUPPLY PURPOSES**
(Second Revision)

1. Scope – Requirements for self-closing taps with or without stuffing box.

2. Nominal size – 15 mm and 20 mm. Nominal size shall refer to the nominal bore of the inlet connection.

3. Materials – See Table 1

4. Design – The opening of the tap shall be performed by hand pressing of the handle up or down or turning sideways or by pressing in of the pushbutton, and the tap shall close when the handle or pushbutton is released. The force required for operating the self-closing tap for its full opening shall not exceed 70 N. For self-closing tap which operate against heads exceeding 2 m, a non-concussive function is essential and provision to this effect shall be made in the design.

5. Finish – All machining shall be so carried out that the parts are true to shape and are in correct adjustment when assembled. All machined surfaces shall be smoothly finished. If the body is of lead tin bronze, the outside surface shall be polished bright.

6. Tests

6.1 Shall withstand an internally applied hydraulic pressure of 2MPa for a minimum period of 2 minutes without leakage or sweating.

6.2 Endurance Test — Shall not show any leakage or failure of the spring or other working parts after 50,000 operations

**TABLE 1 MATERIALS FOR COMPONENTS
FOR SELF-CLOSING TAPS**

<i>Sl. No</i> (1)	<i>COMPONENT</i> (2)	<i>MATERIAL</i> (3)
i)	Body, cover and lever or lever or push-button	a) Grey cast iron b) Malleable iron castings c) Cast brass d) Lead tin bronze
ii)	Spindle	a) Mild steel b) Lead tin bronze
iii)	Spindle spring	a) Phosphor bronze wire b) Spring steel wire c) Any corrosion resisting alloy having a tensile strength of phosphor bronze wire.
iv)	Cage and valve	Lead tin bronze
v)	Brass washer	Brass
vi)	Seat washer and in other washers	As specified
vii)	Gasket	a) Vulcanized fibre b) Any other equally suitable material

For details information, refer to IS 1711 : 1984 Specification for self-closing taps for water supply purposes (second revision)

SUMMARY OF

IS 1795 : 1982 PILLAR TAPS FOR WATER SUPPLY PURPOSES

(Second Revision)

1. Scope — Requirements regarding material, manufacture and workmanship, construction, finish and testing of pillar taps.

2. Nominal Sizes — 15 mm and 20 mm. The nominal size of the pillar taps shall be designated by the nominal bore of the pipe outlet to which the tap is to be fitted.

3. Materials — See Table 1

4. Construction

4.1 For detailed dimensions of body, backnut, bannet and gland, capstan head, spindle and washerplate and screw threads refer to the standard.

4.2 Anti-splash device shall be fitted, if required

5. Finished Mass — Minimum finished mass of 15 mm and 20 mm size pillar taps shall be 650 g and 1175 g respectively.

6. Finish — Shall be nickel-chromium plated. Shall be capable of taking high polish.

7. Testing — Shall withstand internally applied hydraulic pressure of 2 MPa (20 Kg/cm²) for 2 minutes without leakage or sweating.

**TABLE 1 MATERIALS FOR COMPONENTS
PART OF PILLAR TAPS**

<i>SL. No.</i>	<i>COMPONENT</i>	<i>MATERIAL</i>
i)	Body, body components, capstan head and washer plate	a) Cast brass b) Leaded tin bronze
ii)	Spindle, gland, washer plate and nut	a) Brass rod (extruded or rolled) b) Brass

For detailed information, refer to IS 1795 : 1982 Specification for Pillar taps for water supply purposes (second revision)

SUMMARY OF
IS 2692 : 1989 FERRULES FOR WATER SERVICES
(Second Revision)

1. Scope – Lays down nominal sizes and requirements regarding material, manufacture and workmanship, construction, sampling and testing of copper alloy screw-down ferrules for use on water supply mains.

2. Nominal Size
 8, 10, 15, 20, 25, 32, 40 and 50 mm.

3. Materials – See Table 1.

4. Testing – Every ferrule, complete with its component parts, shall withstand hydraulic pressure of at least 1.5 MPa, applied for two minutes, and during this period it shall neither leak nor sweat.

TABLE 1 MATERIALS FOR DIFFERENT PARTS OF FERRULES

<i>Sl.</i> (1)	<i>COMPONENT</i> (2)	<i>MATERIAL</i> (3)
i)	Body, plug and cap	Leaded tin bronze
ii)	Washer plate and nut	Brass (extruded rolled, cast, diecast) Leaded brass
iii)	Resilient washer	Leather Vulcanized fibre, rubber
iv)	Copper washer	Copper

Note — For detailed dimensions refer to the standard.

For detailed information, refer to IS 2692 : 1989 Specification for ferrules for water services (second revision)

SUMMARY OF
IS 3004 : 1979 PLUG COCKS FOR WATER SUPPLY PURPOSES
(First Revision)

1. Scope— Requirements of plug cocks of 15 mm, 20 mm and 25 mm nominal size with a key head for use underground for water supply purposes up to 1 MPa working pressure.

2. Requirements

2.1 Types of End — Plug cocks shall have each body end suitable for one of the following types of joints:

- a) Plain ends for lead (wiped) joint,
- b) Socket end for capillary solder joint,
- c) Union and tail piece for lead (wiped) joint,
- d) Union and tail pipe for capillary solder joint, and
- e) Union for copper tube compression joint.

2.1.1 Ends for (b), (d) and (e) by mutual agreement.

2.2 Nominal Size — 15, 20 and 25 mm.

Note — For detailed dimensions refer to the standard.

2.3 Materials — Cast brass and leaded tin bronze for bodies and components. Brass rod for washers, plug

nuts, union nuts and tail pipes.

2.4 Taper of the side of plug and body shall be 1 in 15 (1 in 7/5 included angle).

2.5 The larger end of the plug taper shall project 6 ± 1.5 mm from the body.

2.6 Finish of Body Ends — Body ends intended for direct plumbing to lead pipe shall be finished by machining and grinding.

Note — For details of nut and tail pipe, when the outlet has union for lead, refer to the standard.

2.7 Hydraulic Test — Shall be tested for body and seat tests under internal hydraulic pressure of at least 2 MPa and 1 MPa respectively.

For detailed information, refer to IS 3004 : 1979 Specification for plug cocks for water supply purpose (first revision)

SUMMARY OF

**IS 3311 : 1979 WASTE PLUG AND ITS ACCESSORIES FOR SINKS
AND WASH-BASINS.**

(First Revision)

1. Scope—Requirements for materials, manufacture, construction, testing and finish of waste plug, chain and stay suitable for use in wash-basins and sinks complying IS 771 (Part 2) 1985*, IS 2556 (Part 4): 1994+*IS 2556 (Part 5) : 1994‡. Dimensions of the waste plug have been specified so as to suit waste fittings covered in IS 2963: 1979.

2. Requirements

2.1. Materials, Manufacture and Construction—

- a) Waste plug — Rubber of hard and durable quality or any other equally suitable material.
- b) Chain—Phosphor bronze or brass wire of minimum diameter 1.8 mm with brazed oval links

approximately 13 mm long (any other equally suitable corrosion resistant material allowable). Overall length of chain not less than 300 mm.

c) Stay— Chain stay shall be bolt type or screw type, made of brass or other corrosion resistant material.

Note — For details refer to Fig. 1 of the standard.

2.2 Load Test — Shall withstand 20 kgf without deformation.

2.3 Finish — Chain and stay shall be chromium plated.

* Glazed fireclay sanitary appliances, Part 2 Specific requirements for kitchen and laboratory sinks (*second revision*)

† Vitreous sanitary appliances (Vitreous China) Part 4 specific requirements of wash basins (*third revision*)

‡ Vitreous sanitary appliances (Vitreous China) Part 5 specific requirements of laboratory sinks (*third revision*)

§ Copper alloy waste fitting for wash basins and sinks (*first revision*)

For detailed information, refer to IS 3311 : 1979 Specification for waste plug and its accessories for sinks and wash-basins (first revision).

SUMMARY OF
IS 4346 : 1982 WASHERS FOR USE WITH FITTINGS FOR WATER SERVICES
(First Revision)

1. Scope – Requirements of washers for water services suitable for use in bib taps, stop valves, self-closing taps, flush valves, pillar taps and ferrules, covered under respective standards.

2. Effects on Potable Water and Metals

2.1 Effect on Potable Water – Material used for tap washer shall not impart any taste to water having a residual chloride content not exceeding 0.2 mg/l or have any toxic effects or foster growth of bacteria, it shall also not impart colour when exposed for a second time in normal potable water for 24 hours in a glass containing 250 ml of water at 10° and 45°C.

2.2 Effect on Metal – The material of the washer shall not corrode the metal seating or the washer plate sufficiently to impair the performance and life of a tap or valve.

3. Materials

- a) Synthetic or natural vulcanized rubber
- b) *Vegetable tanned hydraulic leather* – The moisture content shall be between 15 percent and 20 percent.
- c) Polyethylene high density
- d) *Vulcanized fibre* – The material shall comply with the following requirements :
 - a) Tensile strength, *Min* 55 MPa;
 - b) Density, *Min* 1.10g/cm³;
 - c) Shear strength, *Min* 55 MPa

4. Dimensions

TABLE 1 DIMENSIONS OF WASHERS

All dimensions in millimetres.

<i>Nominal Size of Tap/Valve</i>	<i>Thickness of Washer Min</i>	<i>diameter of washer</i>		
		<i>Internal*</i>		<i>External</i>
		<i>Min</i>		<i>Max</i>
(1)	(2)	(3)	(4)	(5)
8	2.5	3	14.3	14.5
10	4.0	4	15.9	16.1
15	4.0	5	19.0	19.3
20	4.0	6	25.4	25.6
25	5.0	6	33.0	33.6
32	5.0	7	40.1	40.6
40	6.5	8	47.7	48.3
50	6.5	10	63.5	64.2

* A tolerance of $\begin{matrix} +0.5 \\ -0.0 \end{matrix}$ mm shall be permitted.

The variation in thickness in the case of leather washers shall not exceed ± 5 percent.

For detailed information, refer to IS 4346: 1982 Specification for washers for use with fittings for water services (first revision)

SUMMARY OF

**IS 5312 (PART 1) : 2004 SWING CHECK TYPE REFLUX
(NON-RETURN) VALVES FOR WATER WORKS PURPOSES
PART 1 SINGLE - DOOR PATTERN**

(Second Revision)

1. Scope — Requirements for flanged reflux valves of single door, swing check type used for water works purposes of sizes 50 to 600 mm.

2. Nominal Pressure

<i>Sizes of Valves</i>	<i>Nominal Pressure (PN)</i>
mm	MPa
50 to 125	1.6
150 to 300	1.0
350 to 600	0.6

3. Nominal Sizes

50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500 and 600 mm.

The nominal size shall refer to the nominal bore of the water way. The actual bore at any point shall not be less than the nominal size.

4. Materials

TABLE 1 MATERIALS FOR DIFFERENT COMPONENT PARTS OF REFLUX VALVES

Sl. No. (1)	Component (2)	Material (3)
i)	Body, cover, door bearing holder and door face disc	Grey cast iron
ii)	Hinge pin, door pin and door suspension	Stainless steel
iii)	Body seat rings	Leaded in bronze
iv)	Door face ring	leaded tin bronze
v)	Bearing bushes/ Bearing block	Leaded tin bronze
vi)	Plugs for hinge pin/ Air release plug	Leaded tin bronze
vii)	Bolts	Carbon steel
viii)	Nuts	Carbon steel
xi)	Gaskets	Rubber
x)	Hinges	Grey cast iron

5. Manufacture

5.1 All the parts of the valves shall be desinged so as to withstand the specified test pressures.

5.2 The area for flow passage at any cross-section in the valve shall not be less than the area of the nominal bore of the valve.

5.3 The design of hinge, hinge pin, door and door suspension shall be such to ensure free swinging of the door.

5.4 The design of valves used in verticl pipe lines shall be such that in the working position the valves positively close when the flow in the pipe comes to a stop.

5.5 The thickness of metal in all castings shall be maintained as uniform as possible throughout any section to avoid strains set up by sudden changes of cross - section.

5.6 Each reflux valve shall carry in arrow, very prominently to indicate the direction of flow.

5.7 Unless otherwise specified in the contract or order, the flanges and their dimensions of drilling shall be in accordance with IS 1535.

5.8 The inside diameter of the body sing shall not be less than the nominal bore of the valve.

5.9 Doors and Hings - The design of the doors and hings shall be suitable so as the withstand satisfactaly the repuated impact likely to occur during service

5.10 Door faces - The minimum thickness of door shall be 5 mm.

Note— For alternative material See Table of the standard.

For detailed information, refer to IS 5312 (Part1) : 1984. Specification for Swing check type reflux (non-return) valves for water works purposes- Part 1- single door pattern (first revision).

Note — For detailed dimensions and tolerances refer to the standard.

6. Coating — Shall be smooth, glossy and tenacious, sufficiently hard so as not to flow when exposed to a temperature of 77°C and not so brittle at a temperature of 15°C as to chip off when scratched lightly with a point of a pen knife.

7. Testing

7.1 Hydrostatic Body Test — Shall not show any leakage or permanent distortion under the specified pressure .

7.2 Hydrostatic Seat Test — shall show no leakage when subjected to the prescribed pressure.

Note— For alternative material see Table of the standard.

For detailed information, refer to IS 5312 (Part1) : 2004. Specification for swing check type reflux (non-return) valves for water works purposes Part 1- Single door pattern (second revision).

SUMMARY OF

**IS 5312 (PART 2) : 1986 SWING CHECK TYPE REFLUX
(NON-RETURN) VALVES FOR WATER WORKS PURPOSES
PART 2 MULTI - DOOR PATTERN
(First Revision)**

1. Scope – Requirements for flanged reflux valves of multi-door, swing check type used for water works purpose of sizes from 400 to 1200 mm.

2. Class – PN 0.6 and PN 1.0 where PN is Nominal Pressure defined as the maximum permissible gauge working pressure in MPa.

3. Nominal Sizes-

400, 450, 500, 600, 700, 750, 800, 900, 1000, 1100 and 1 200 mm. The nominal size shall refer to the nominal bore of the water way.

4. Materials

Sl. No. (1)	Component (2)	Material (3)
i)	Body with hinge and diaphragm	Grey cast iron
ii)	Hinge pin	High tensile brass
iii)	Bolts	Carbon steel
iv)	Nuts, nuts for hinge pins	Carbon steel
v)	Bearing bushes	Leaded tin bronze
vi)	Face and seat	Leaded tin rings bronze
vii)	Flange jointing	Rubber material

Note— For alternative material see Table 1 of the standard.

5. Design and Manufacture

5.1 Body may be made in two parts-inlet shell (having duck foot support) and outlet shell.

5.2 Area of waterway through the multidoor in the diaphragm shall not be less than the bore area except that this area may be reduced by not more than 15 percent for any proprietary designs.

5.3 Minimum two number of doors shall be provided in the diaphragm plate.

5.4 By-pass shall be made for connection if required.

5.5 Minimum finished mass of valves shall be as prescribed.

6. Coating — Shall be smooth-glossy and tenacious sufficiently hard so as not to flow when scratched lightly with the point of a pen knife.

7. Testing:

7.2 Body Test – Shall not show leakage or permanent distortion of any component when subjected to the prescribed test.

For detailed information, refer to IS : 5312 (Part 2) : 1986 Specification for swing check type reflux (non-return) valves for waterworks purposes Part 2- Multi-door door pattern.

SUMMARY OF

IS 8931 : 1993 COPPER ALLOY FANCY SINGLE TAPS COMBINATION TAP ASSEMBLY AND STOP VALVES FOR WATER SERVICES

(First Revision)

1. Scope – Requirements regarding materials, manufacture, workmanship, constructions, dimensions, finish and testing of chromium plated copper alloy non-rising spindle type fancy single taps, combination tap assembly and valves, suitable for operation from 0.1 MPa to 0.5 MPa pressure at maximum temperature of 65°C.

2. Materials:

<i>Sl.No.</i>	<i>Component</i>	<i>Material</i>
1.	Body, body components, inlet tubes, nozzle, bonnet	a) Castbrass b) Die cast and back nuts brass c) Forged brass d) Leaded tin bronze e) Brass rods f) Brass tubes g) Copper tubes
2.	Flanges	a) Castrass b) Die cast brass c) Forged brass d) Leaded tin bronze e) Brass rods f) Brass sheet
3.	Spindle, glands, washer plate, nuts, screws and pin	a) Brass rods (Extruded or rolled) b) Forged brass
4.	Circlip, wire locks	a) Phosphor bronze sheet b) Phosphor bronze wire c) Stainless steel
5.	O ring	a) Synthetic rubber
6.	Gasket and seat washer	a) Acrylo Nitrillebutadiene rubber b) Neoprene rubber c) Synthetic butadiene rubber (S.B.R.)
7.	Knob, knob components, diverter & components	a) Cast brass b) Die cast brass c) Forged brass d) Leaded tin bronze e) Brassrods f) Zinc g) Plastics

3. Nominal Sizes –

Pillar tap	15 mm
Bib tap	15 mm
Combination tap assembly	15 mm
Stop valve	15 mm and 20 mm
Angle stop valve	15 mm and 20 mm

4. Construction

4.1 The inlet and outlet connection threads whether internal or external, shall be a pipe thread.

4.2 Area of waterway throughout the body of a tap or valve shall not be less than the area of a circle of diameter equal to the minimum bore of seating unless otherwise specified.

4.3 The internal diameter of a combined outlet shall not be less than 15 mm

4.4 Flow straightening and aerating device may be filled in taps if required.

5. Dimensions

5.1 Minimum Thickness – Minimum of 2.0 mm . See also 7. In the case of single tap and combination tap assemblies the open outlet nozzle portion may be reduced to 1.6 mm in case of castings and forging and to 0.6 mm when drawn tubes are used.

Note — For detailed dimensions, refer to the standard.

6. Finish – The significant surfaces of taps, combination tap assembly and stop valves shall be nickle-chromium plated. However, the body of concealed stop valve and side stop valve of pillar mounting combination tap assembly may be polished bright or may have an unpolished surface, as 'Cast' finish.

7. Performance Tests

7.1. Water Tightness Characteristic — Shall not show any leakage of water or escape of airbubbles through the walls of the body, bonnet and divertor assembly.

7.2. Pressure Resistance Characteristic — No permanent deformation in the part of the taps and valves situated upstream or down stream shall be produced

7.3 Hydraulic Characteristic (Flow Rate) – Shall not be less than

a) 12.l/min for 15 mm nominal size single and combination tap and valve.

b) 23.l/min for 20 mm nominal size.

7.4. Mechanical Strength Characteristic – No permanent deformation or loosening of any part of the tap and valve.

For detailed information, refer to IS 8931 : 1993. Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services (first revision)

SUMMARY OF

IS 9338 : 1984 CAST IRON SCREW-DOWN STOP VALVES AND
STOP AND CHECK VALVES FOR WATER WORKS PURPOSES

(First Revision)

1. Scope – Requirements for flanged cast iron screw-down stop valves from 15 to 300 mm nominal sizes of the following types used for water supply up to 45° C :

Globe stop valve; Angle stop valve; oblique stop valve; Globe stop and check valve and Angle stop and check valves.

2. Nominal Pressure – Valves shall be designated by nominal pressure (PN) defined as the maximum permissible gauge working pressure in MPa for the sizes indicated as follow:

Nominal Pressure (PN)	Nominal Sizes
MPa	mm
1.0	200 to 300
1.6	Up to and including 150

3. Nominal Sizes :

15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250 and 300 mm. The nominal size shall refer to the nominal bore of the water way.

Note – For dimensions, refer to Figs 1 to 5 and Table 2 to 5 of the Standard.

4. Material

Sl.No.	Component	Material
(1)	(2)	(3)
i)	Body, bonnet, handwheel, gland (one piece) and back seat intergal	Cast iron
ii)	a) Fasteners/bolting b) Nut	Carbon steel -do-
iii)	Stem	a) High tensile brass b) Stainless Steel
iv)	Body seat ring/disc facing ring	a) Leaded tin bronze b) Stainless Steel
v)	Solid disc with integralface	a) Leaded tin bronze b) Stainless Steel
vi)	Disc with separate facing rings	Cast iron

vii)	Glad packing	a) Jute and hemp b) Asbestos
viii)	Bonnet gasket	Compressed asbestos fibre
ix)	Disc stem nut, back seat bushing (where separate), gland (two piece design)	a) Leaded tin bronze b) Stainless Steel
x)	Yoke bush	a) Leaded tin bronze b) High tensile brass c) SG iron

5. Manufacture

5.1 Area of the body end parts shall not be less than the area of the circle of diameter equivalent to the nominal size of the valve except that this area may be reduced by not more than 15 percent though the seats to permit use of disc guides from below.

5.2 The stems shall have trapezoidal threads.

5.3 The overall heights of the valves shall not exceed the specified valves.

6. Coating – Shall be smooth glossy and sufficiently tenacious so as not to flow when exposed to temperature of 77°C and not become so brittle to a temperature of 15°C so as to chip off when scratched lightly with the point of a pen knife.

7. Testing – Each valve shall be subjected to hydrostatic test as per following Table 1 and the value shall show no sign of leakage.

TEST PRESSURE (GAUGE) AND TEST DURATION OF VALVES

PN Rating of Valve (1) MPa	Test (2)	Test Pressure (Gauge), Min (3) MPa	Test Duration, Min (4) min
1.6	Body test	2.4	5
	Seat test	1.6	2
	Back seat test	2.4	5
	(Where specified)		
1.0	Body test	1.5	5
	Seat test	1.0	2
	Back seat test	1.5	5
	(Where specified)		

Note — For method of test refer to Appendix B of the standard.

For detailed information, refer to IS 9338 : 1984 Specification for Cast Iron screw-down stop valves and stops and check valves for water works purposes (first revision)

SUMMARY OF

IS 9739 : 1981 PRESSURE REDUCING VALVES FOR DOMESTIC
WATER SUPPLY SYSTEM

(Third Revision)

1. Scope – Requirements regarding material, construction and workmanship, performance and marking of pressure reducing valves of different sizes for domestic water supply system suitable for maximum inlet pressure of 1.7225 MPa. The valves covered by this standard are self-contained, direct acting, single seat, diaphragm type. Valves with integral or separate strainers connected to the valve inlet are included.

2. Nominal sizes

15 mm (1/2), 20 mm (3/4), 25 mm (1), 32 mm (1.1/4), 40 mm (1.1/2) and 50 mm (2).

Note — The figures within the brackets refer to the sizes and designations of the threaded end

3. Materials

Sl.No.	Component	Material
i)	Body, Disc holder, Bottom cover, Drain plug, Diaphragm retaining disc, Spring discs and Check nuts	Leaded-tin bronze
ii)	Diaphragm cover and spring chamber	Cast iron
iii)	Body seat ring (when replaceable), adjusting screw and valve stem	Chromium steel
iv)	Tommy bar	Mild steel
v)	Diaphragm and valve disc	Synthetic rubber
vi)	Gaskets	Compressed asbestos fibre
vii)	Fasteners	Steel
viii)	Springs	Carbon steel
ix)	Strainer screen	Stainless steel

4. Construction

4.1 Body and components shall be so designed as to provide ample resistance to distortion under maximum working pressure.

4.2 Valves shall have screwed female ends threaded for connection to pipe line.

Note — For methods of tests, refer 6 to the standard.

4.3 Screen of the strainer shall have a minimum unobstructed open flow area (total area of holes) equal to or greater than twice the nominal pipe flow area. The maximum hole dimension of the screen shall not exceed 1/12 of the valve orifice escape diameter.

5. Performance Requirements

5.1 Hydrostatic Test – When subjected to hydrostatic pressure of 1.7225 MPa at its inlet and an equal back pressure on the reduced pressure side, there shall be no leakage or distortion of parts that will affect the performance of the valve.

5.2 Reduced Pressure Deviation – The reduced pressure delivered by the reducing valve shall not deviate by more than 0.007 MPa for every 0.07 MPa change in the inlet pressure.

5.3 Minimum Reduced Pressure – When water flows through a pressure reducing valve at the rate given in Table 2, with the inlet pressure being maintained at 1.7225 MPa the valve shall be capable of adjustment to a reduced pressure as low as 0.17225 MPa.

TABLE 1 CAPACITIES OF PRESSURE REDUCING VALVES

Nominal size (mm)	15	20	25	32	40	50
Flow (l/s)	0.63	1.05	1.58	2.65	3.46	4.89

5.4 Reduced Pressure Adjustment Range — The reducing valve shall be provided with a reduced pressure adjustment range of not less than 0.17225 MPa.

5.5 Capacity — The reducing valve shall have minimum capacity as shown in Table 1 when maintaining a reduced pressure of 0.1171 MPa less than its no-flow set pressure and the inlet pressure maintained at 0.3445 MPa higher than the reduced point pressure.

For detailed information, refer to IS 9739 : 1981 specification for pressure reducing valves for domestic water supply system.

SUMMARY OF

IS 9758 : 1981 FLUSH VALVES AND FITTINGS FOR WATER CLOSETS AND URINAL

1. Scope— Requirements for flush valves, flush pipes and stop valves for water closet and urinals.

2. Materials— See Table 1.

Sl.No.	Component	Material
(1)	(2)	(3)
i)	Body of flush valve	a) Cast brass b) Die casting brass
ii)	Flush pipe	a) Steel tubes seamless or welded completely protected, inside and outside, either by vitreous enamelling (see IS 3972-1968) or hot dip galvanishing (see IS2629-1985) b) PVC c) High density polyethylene d) Lead
iii)	Washers	Rubber
iv)	Springs	a) Phosphor bronze b) Stainless steel
v)	Stop valve	Cast brass
vi)	Spindle to stop valve lever or flush valve	Extruded brass

3. Nominal Size— 15, 25 and 32 mm. Nominal size shall be the nominal bore of the supply pipe to which the valve is connected.

4. Manufacture and Construction

4.1 Flush valve of nominal sizes 15, 25 and 32mm shall have an outlet of 20, 32 and 40mm outside diameter respectively.

4.2 Flush valve shall be self closing and non-concussive in action.

5. Performance & Construction—

$$\left. \begin{array}{l} 5 \text{ litres} \\ 10 \text{ litres} \end{array} \right\} \pm 0.5 \text{ litre}$$

5.1 Discharge Rate— Flush valves shall discharge at an average rate of 5 litres with a tolerance of plus 0.5 litre in 3 seconds and there shall be no appreciable change in the force of the flush during the period of discharge.

5.2 Working Pressure— It shall be capable of working under pressure of 0.15 to 0.5 MPa and shall be capable of discharging the full capacity in a single operation.

6. Finish— The outside of the body shall be polished bright and chromium plated. The plating shall be capable of taking high polish which shall not easily tarnish or scaled off. For concealed work concealed parts need not be plated.

For detailed information, refer to IS 9758:1981 Specification for flush valves and fittings for water closets and urinals.

SUMMARY OF

IS 9762 : 1994 POLYETHYLENE FLOATS (SPHERICAL) FOR FLOAT VALVES

(First Revision)

1. Scope – Requirements for polyethylene spherical floats suitable for float valves of nominal sizes of 15, 20, 25, 32, 40 and 50 mm.

Note— Nominal size of the float is related with the nominal size of the float valve with which it is to be used

2. Material – High density polyethylene (HDPE) used for the manufacture of floats shall conform to Designation PEBW A50 T 090 or PEBN A50 T090 of IS 7328 : 1992⁺. The addition of not more than 10 percent of the manufacturer's own rework material resulting from the manufacture of floats conforming to this standard is permissible. No other reworked material shall be used.

3. Designation

HP 25 — For float of nominal size of 25 mm to be used for high pressure applications.

LP 40 — For float of nominal size of 40 mm to be used for low pressure applications.

4. Dimensions and Tolerances — See Table 1.

5. Testing

5.1 Leakage and Water Absorption Test – The increase in mass of the float shall not be more than 0.5 percent and shall show no leakage.

5.2 Deflection Test — The float shall not deflect by more than 7 mm.

5.3 Impact Test — Floats when dropped from a height of 1500 mm on to a concrete floor at ambient temperature shall not develop any crack or damage.

5.4 Boss Test — The boss and/or float shall not be visibly distorted or damaged.

TABLE 1 DIMENSIONS OF FLOAT, BOSS AND INSERT

		All dimensions in millimetres.					
Sl. No.		Dimensions of Floats for Nominal Size					
		15	20	25	32	40	50
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Dia of float HP	127	152	203	229	254	305
	LP 114	127	178	203	203	254	
ii)	Wall thickness, (Min)	1.5	2.0	2.5	2.5	2.5	2.5
iii)	Tapping of boss	M 8 × 1.25	M 8 × 1.25	M 1 2 × 1.75	M 14 × 2	M 14 × 2	M 16 × 2
iv)	Insert wall thickness (below threads)	1.50	1.50	1.75	2.0	2.0	2.0
v)	Insert base thickness	2.00	2.00	2.25	2.50	2.50	2.50
vi)	Axial length of thread	8.0	8.0	13.0	16.0	16.0	19.0
Note – Tolerance on diameter ± 2.5 mm							

⁺ High density polyethylene materials for moulding and extrusion.
(First Revision)

Note — For method of test, refer to Appendices A to C of the standard.

For detailed information, refer to IS 9762 : 1994 Specification for polyethylene floats (spherical) for float valves (first revision)

SUMMARY OF
IS 9763 : 2000 PLASTIC BIB TAPS, PILLAR TAPS, ANGLE VALVES
FOR HOT AND COLD WATER SERVICES
(Second Revision)

1. Scope — Requirements regarding material, dimensions, construction finish, and testing of plastic bib taps, pillar taps, stop valve & angle valves for hot and cold water services.

2. Materials — See Table 1.

<i>Component</i>	<i>Recommended Material</i>
Body of Tap/valve	PP copolymer, Nylon 66, PBT, Nylon 66 GF, Polyacetal, ABS, ABS-PC Alloy, PVC Bonnet of tap/valve PP Copolymer, Nylon 66, PBT, Nylon 66 GF, Polyacetal, ABS, ABS-PC Alloy Spindle of tap/valve PP Copolymer, Nylon 66, PBT, Nylon 66 GF, Polyacetal, ABS, ABS-PC Alloy
Handle of Tap/valve	PP Copolymer, PBT, Polyacetal, ABS, ABS-PC Alloy
Seal of Tap/Valve	Rubber, Nitrile PVC, Thermo plastic polyster based elastomer.

2.1 Chemical and Hygiene Requirements — All plastic materials coming into contact with water indented for human consumption shall not present any health risk upto a temperature of 90° C. They shall not cause any change to the drinking water in terms of quality, appearance, smell or taste. Materials shall be resistant to corrosion. Within the recommended limit for current

operation given in Table 2, the material shall not under go any change that would impair the performance of the taps. Parts subjected to the pressure shall withstand the maximum operating pressures given in Table 2

3. Nominal Sizes — Plastic taps and stop valves shall be of the nominal sizes: 15 mm (1/2") and 20 mm (3/4").

Note — The figures within brackets refer to the size and designation of the threaded end The nominal bore of the socket or pipe outlet to which the tap or valve is normally fitted shall designate nominal size of taps or valves.

4. Dimensions — The thickness in any portion of the body and bonnet shall not be less than 2.5 mm for all sizes.

Note — For dimensions, refer to 6 of the standard

5. Identification — The control devices for taps shall be indentified by:

- The colour blue, preferably, or the letter C for cold water
- The colour red, preferably, or the letter H for hot water. The cold water control device shall be on the right and hot water control device on the left, when viewed from the front

6. Finish — Only Plastic materials impervious to plating solutions shall be allowed to come in to contact with solution during plating.

TABLE 2 RECOMMENDED LIMIT FOR CURRENT OPERATION – CONDITIONS OF USE OF TAPWARE

Parameter	Maximum Limit of Use	Recommended limits for Correct Operation
Pressure	Static : 1 MPa (10 bar)	Flow : not less than 0.01 MPa (0.1bar)
Temperature	90° C	<i>Maximum</i> : 65° C Lower limit: as for installations.

7. Test

7.1 Resistance to Residual Chlorine in Water — Plastic taps and valves shall remain unaffected after being immersed in a 10 percent solution of hydrochloric acid for 24 hours.

7.2 Drip Proofness Test — This test shall be carried out by applying a hydraulic pressure of 0.1 MPa maintained for 15 minutes. There shall be no leakage of water during the test. Alternatively, the test can be performed using 0.04 MPa of pneumatic pressure.

7.3 Thermal Shock Test — This test shall be carried out by dipping the tap, valve in water maintained at a temperature not more than $65 \pm 2^\circ \text{C}$ for one hour and then suddenly quenching in water with temperature not more than 15°C and repeating the operation for 10 times. There shall be no defect in the tap or valve at the end of the test.

7.4 Hydraulic Pressure Test — Every Bib tap, Pillar tap, Angle valve, Stop valve complete with component parts shall be tested under an internal pressure of 1.6 MPa for a minimum period of 60 sec. During this period there shall not be any leak, sweat, bulge or pressure drop. Alternatively, the components may also be tested at 0.6 MPa of air pressure for a minimum period of 20 sec.

7.5 Mechanical Strength Characteristics — The Bib tap, Pillar tap, Angle valve, Stop valve shall be held in vertical position. A torque of not less than 6 Nm shall be applied to the operating mechanism using a torque wrench in closing direction for a period of 5 min. Throughout the duration of the test and the end of the test, there shall be no deformation or loosening of any part of the tap or valve.

Note — For dimensions, refer to 6 of the standard

For detailed information, refer to IS 9763 : 2000 Specification for plastic bib taps, pillar taps angle valves and stop valves for hot and cold water services (second revision).

SUMMARY OF

IS 12234 : 1988 PLASTIC EQUILIBRIUM FLOAT VALVES FOR COLD WATER SERVICES

1. Scope – Requirements regarding size, materials manufacture and workmanship, performance test and appropriate dimensions of equilibrium float valves for water service up to 45°C such as coolers, flush tanks and over head tanks.

2. Classification

- a) Horizontal inlet shank type, and
- b) Vertical inlet shank type.

Note — Foot valves may be fitted with two pressure reducing attachments, if required

3. Size – 15 mm nominal

4. Materials – See Table 1.

**TABLE 1 MATERIALS FOR BODY AND
COMPONENT PARTS OF FLOAT VALVES**

<i>Sl.No.</i>	<i>Component</i>	<i>Material</i>
1.	Valve body, inlet shank, valve seat, back nut, cap and float arm	Polyacetal
2.	Float, flow restrictors and discharge horn	Polyacetal or polypropylene or polypropathene
3.	Diaphragm	Synthetic rubber
4.	Diaphragm pin	Synthetic rubber Stainless steel or any other non-corrosive material or polyacetal.

5. Construction

5.1 Body, inlet shank (vertical or horizontal) and seat should be made one single unit to constitute the body of the valve.

5.2 The inlet shank shall have external parallel fastening thread of the same size the nominal size of the float valve.

5.3 Valve shall be provided with a discharge with antisiphonage provision.

6. Performance Tests

6.1. Hydraulic and Shut-off Test — The float valve shall be capable of with standing 2.0 MPa water pressure for 60 seconds without leak or sweating when held in the closed position. The diaphragm valve when assembled in working condition but without flow restrictors and with the float immersed to half its volume shall remain closed against a test pressure of 1.05 MPa.

6.2. Anti-siphonage Test — The float valve shall have no back siphonage as indicated by the presence of water in the catch pot. This shall be type test.

6.3. Flow Test — The float valve shall be capable of delivering at least 9 litres of water in 3 min into its container

6.4. Endurance Test – The float valve shall be capable of completing 200,000 cycles and shall then be capable of satisfying hydraulic and shut-off test. This shall be type test.

Note — For method of test refer to Appendices A to C of the standard.

For detailed information, refer to IS 12234 : 1988 Specification for plastic equilibrium float valve for cold water services.

SUMMARY OF

IS 13049 : 1991 DIAPHRAGM TYPE (PLASTIC BODY) FLOAT OPERATED VALVES FOR COLD WATER SERVICES

1. Scope — Specifies materials, workmanship, performance and sampling requirements besides where appropriate, dimensions and tolerances, of diaphragm type float operated valves for water services up to 45°C for use in flush tanks, overhead water tanks, etc.

2. Materials

Sl. No	Components/Parts	Material
(1)	(2)	(3)
1.	Valve body, inlet shank valve seat and back nut	Polyacetal
2.	Discharge horn (if provided)	Polyacetal or Polypropylene or polyethylene or Acrylonitrile Butadiene Styrene (ABS) or Ethylene Vinyl Acetate (EVA) or any other suitable material
3.	Diaphragm	Synthetic rubber

3. Nominal Size — 15 mm

4. Construction

4.1 Inlet shank shall be not less than 48 mm in length.

4.2 Valves shall be supplied with a high pressure (HP) or a low pressure (LP) seal.

4.3 Diaphragms made of synthetic rubber shall have the form and dimension as required for the operation of the valve.

4.4 Float arm and assembly shall have not more than 25mm, Inlet deflection after the test additional deflection after loading for 28 days shall not be more than 12mm.

5. Performance Tests

Note— For method of test refer to Appendices A to C of the standard.

For detailed information, refer to IS 13049 : 1991 Specification for diaphragm type (plastic body) float operated valves for cold water services.

5.1 Hydraulic Test — Shall be capable of withstanding whilst held in the closed position, an internally applied

hydraulic pressure of $2^{+0.025}_{-0}$ MPa for a period of

60^{+5}_{-0} seconds, without leaking.

5.2 Shut-off Test — When assembled in working condition but without flow restrictions and fitted with the relevant seat and the float immersed to half its volume, shall remain closed against the following minimum test pressures as appropriate:

HP seat — 1.05 MPa

LP seat — 0.35 MPa

5.3 Anti-siphonage Test — Shall have no back siphonage as indicated by the presence of water in the catchpot.

5.4 Flow Test — Shall be capable of delivering at least 9 litres of water in 140 seconds into the container.

5.5 Endurance Test — Shall be capable of completing 200000 cycles and shall then immediately satisfy the hydraulic and shut-off tests.

5.6 Hydraulic Pressure on Discharge Arrangements — The valve together with its discharge arrangements shall withstand a constantly applied hydraulic pressure of 1 MPa for 7 without causing any permanent deformation or separation of any component part.

SUMMARY OF

IS 13114 : 1991 FORGED BRASS GATE, GLOBE AND CHECK VALVES FOR WATER WORKS PURPOSES

1. Scope : Requirements for forged brass gate, globe and check valves suitable for working temperatures up to 45°C and non-shock maximum hydraulic working pressure of 2 MPa for water works purposes.

2. Nominal Sizes : 8(1/4), 10(3/8), 15(1/2), 20(3/4), 25(1), 32(1.1/4), 40(1.1/2) and 50(2) mm.

Note : The nominal sizes shown in parantheses refer to the size of screw threads.

3. Materials: See Table 1.

TABLE 1 MATERIALS

Component	Material
Body, bonnet, cover stuffing box, disc, wedge and hinge	Forged brass
Gland, gland nut, ball, stem, stem nut, hinge pin	Forged brass or free cutting brass Cast iron (see Note) a) Hemp and jute b) Asbestos c) Any other equally efficient packing material suitable for cold water Phosphor bronze wire
Handwheel	
Gland packing	
Spring (in case check valve is spring loaded)	

Note : Handwheels may also be made either in steel, aluminium alloy, zinc alloy or of non-metallic materials.

4. Types

- a) Gate valves
- b) Globe valves

c) Check valves: Swing type and Lift type

5. Dimensions and Tolerances – See Tables 2 & 3

6. Design and Manufacture

6.1 Flow way area at any point shall be not less than that of a circle having an equivalent diameter as specified. However, globe and check valves with plug types discs and discs guided from below shall have a flow way area of not less than 85 percent of that specified for above.

6.2 For globe valves and check valves the direction of flow shall be with the upstream pressure under the disc.

6.3 Handwheel shall close the valve by turning in clockwise direction, when facing the wheel.

7. Testing

7.1 Hydrostatic Test

7.1.1 Test Pressures : Shall show no visible leakage during the test under conditions as below:

- | | |
|-----------------------------|--|
| a) Shell Test | : 1.5 × maximum working pressure of 2 MPa. |
| b) Seat and Backseat Test : | 1.1 × maximum working pressure of 2MPa. |

7.1.2. Test Duration : Minimum test duration shall be as follows

- | | |
|-----------------------------|-----------|
| a) Shell Test | : 15 ses. |
| b) Seat and Backseat Test : | 15 ses. |

There shall be no visible leakage during the tests.

TABLE 2 WALL THICKNESS AND OTHER DIMENSIONS

<i>Nominal Size</i>	<i>Minimum Wall Thickness</i>	<i>Stem</i>	<i>Minimum Across Flat or Diameter</i>	<i>Mini mum OD of Sealing Face at Ends</i>	<i>Mini mum Threads at Ends</i>	<i>Length of</i>
(1)	(2)		(3)	(4)		(5)
mm	mm		mm	mm		mm
8	1.6		5.5	18		7.0
10	1.7		6.0	22		7.5
15	1.8		6.5	26		9.5
20	2.0		7.5	32		10.5
25	2.1		8.5	39		12.0
32	2.4		9.5	49		13.5
40	2.5		10.5	55		13.5
50	2.8		12.0	68		17.0

TABLE 3 END-TO-END DIMENSIONS

<i>NOMINAL SIZE</i>	<i>GATE VALVES</i>	<i>GLOBE VALVES</i>	<i>HORIZONTAL LIFT CHECK VALVES</i>	<i>VERTICAL LIFT CHECK VALVES</i>	<i>SWING CHECK CHECK VALVES</i>
(1)	(2)	(3)	(4)	(5)	(6)
mm	mm	mm	mm	mm	mm
8	43	47	47	47	—
10	43	50	50	50	—
15	52	60	60	52	58
20	56	70	70	60	72
25	65	80	80	63	83
32	73	95	95	76	—
40	76	110	110	86	—
50	90	125	125	97	—

Note: Whenever dimensions are not given, those sizes are not generally manufactured in those designs.

For detailed information, refer to IS 13114: 1991 Forged brass gate, globe and check valves for water works purposes.

SUMMARY OF
IS 13349 : 1992 SINGLE FACED CAST IRON THIMBLE
MOUNTED SLUICE GATES

1. Scope – Covers single faced vertically sliding type cast iron sluice gates of nominal sizes from 300 to 2500 mm, suitable for mounting on the flange of cast iron wall thimble. These sluice gates are meant for use for water supply and waste water application.

These sluice gates are designed for either seating head or unseating head or unseating head, or both.

Sluice gates as per this standard in addition to manual may be adapted to electric, hydraulic or pneumatic power operation. Requirements for actuating gear except in case of manual operation is left to the mutual agreement between the purchaser and the manufacturer.

Sluice gates as per this standard may be of the conventional-closure or of flush-bottom closure type.

2. Classification

- a) Class 1 : Suitable for maximum
Sluice gates unbalanced head upto and including 5 metres of water.
- b) Class 2 : Suitable for maximum
Sluice gates unbalanced head above 5 metres and upto and including 10metres of water, and
- c) Class 3 : Suitable for maximum
Sluice gates unbalanced head above 10 metres and upto and including 15metres of water.

3. Shapes and Types

- a) The opening of the sluice gates and the wall thimble may be either circular, square or rectangular.
- b) Sluice gates may be manufactured either with rising stem or non-rising stem.
- c) Sluice gates may be either of conventional bottom closure or flush bottom closure.
- d) Sluice gates maybe for either upward opening or downward opening.
- e) Sluice gates may have operating head stock either mounted on platform or directly mounted on yoke.

4. Nominal Sizes : See Tables 1 and 2.

TABLE 1 NOMINAL SIZE OF SQUARE (OR ROUND) SLUICE GATES, IN MM

300	750	1 200	1 800
400	900	1 400	2 000
500	1 000	1 500	2 250
600	1 100	1 600	2 500

TABLE 2 NOMINAL SIZE OF RECTANGULAR SLUICE GATES, IN MM

<i>Width × Height</i>	<i>Width × Height</i>	<i>Width × Height</i>
300 × 400	1 000 × 750	1 500 × 1 800
400 × 300	1 000 × 1 200	1 500 × 2 000
500 × 400	1 000 × 1 500	1 600 × 1 200
500 × 750	1 100 × 900	1 600 × 2 000
600 × 400	1 100 × 1 500	1 800 × 1 200
600 × 750	1 200 × 900	1 800 × 1 500
750 × 500	1 200 × 1 500	1 800 × 2 500
750 × 600	1 200 × 1 800	2 000 × 1 500
750 × 900	1 400 × 1 000	2 000 × 2 500

5. Materials – see Table 3

TABLE 3 MATERIALS

<i>Sl. No.</i>	<i>Item</i>	<i>Material</i>
(1)	(2)	(3)
1.	Thimble, frame, guide, extension guide, slide (shutter), gear box, pedestal, stem guide, bracket, wedging devices, flush bottom seal support bar	Cast iron
2.	Yoke (Bridge)	Cast Iron structural steel
3. a)	Wedges	Cast iron Naval brass Phosphor bronze Leaded tin bronze Stainless steel
	b) Wedge facings	Naval brass Phosphorbronze Leaded tin bronze Stainless

Note : For materials of other components, refer to Table 3 of the standard

6. Surface Preparation and Painting—After cleaning, the surfaces shall be primed by application of either one shop coat of zinc chromate or coaltar coating suitable for use in potable water and applied. After painted surfaces are dry, the machined or bearing surfaces and the holes, both plain and threaded, shall be coated with grease to offer temporary protection to the surfaces until the time of installation.

Surfaces of thimble and stem guides which would be in contact with the concrete shall not be coated.

7. Manual Lifting Devices : Shall be ungeared or geared operatable by handwheel or a cracle handle. Geared mechanism may be either single or dual speed as necessary.

Note : For details *see* 9 of the standard.

8. Shop Testing

- a) Seat Clearance Check
- b) Smooth Movement Test
- c) Shop Leakage Test

8.1. Hydrostatic Test : Water pressure of 1.5 times the unbalanced specified maximum operating head shall be applied to the sluice gates in closed position for a period of 5 minutes. Under this test there shall be no leakage through the metal nor shall any part be permanently deformed.

Note 1 : For Design and Construction requirements refer to 7 of the standard.

Note 2 : For method of test refer to the Standard.

For detailed information, refer to IS 13349 : 1992 Specification for single faced cast iron thimble mounted sluice gates.

SUMMARY OF

IS 14845 : 2000 RESILIENT SEATED CAST IRON AIR RELIEF VALVES FOR WATER WORKS PURPOSES

1. Scope – Requirements of single air valve (small and large orifice) double air valves (small and large orifice with or without integral isolating valve) and kinetic air valves with or without separate isolating sluice valve for use on water mains.

2. Types

- a) Single Air valve : Small orifice type (S 1)
: Large orifice type (S 2)
- b) Double Air valve : Standard type with in-built isolating valve (DS1) or without isolating valves (DS2)
- c) Kinetic Air valve : Kinetic air valve (DK)

3. Nominal Pressures – Maximum permissible gauge working pressures of PN 1.0 and PN 1.6 MPa.

4. Nominal Sizes

- a) Single air valve S 1 : (Small orifice type) 15,25,40 mm
- b) Single air valve S 2 : (Large orifice type) 25,40,50 mm
- c) Double air valve : (All types)
(DS 1,2) 40,50, 80,100,150 and 200 mm
- d) Kinetic air valve : 40,50,80,100,
(DK) 150 and 200 mm

5. Temperature Rating - All air valves shall be suitable for continuous use at their PN rating within the temperature of 45° C.

6. Service Application

6.1 Single Air Valve (Small Orifice)–For automatically releasing air which may accumulate under pressure in a section of pipe line during normal working condition.

6.2 Single Air Valve (Large Orifice)– For automatically releasing/admitting air that may accumulate under

pressure in a section of pipe line at the time of initial charging or draining of mass.

6.3 Double Air Valves–These valves are simply a combination of small and large orifice air valves with common connection to the main, small orifice function being similar to that of a single air valve. Large orifice serves for automatically exhausting air when a pipe is being filled with water, or automatically ventilating a pipe when it is being emptied of water.

6.4 Kinetic Air Valves–These valves are essentially the same as the conventional double air valves but with certain refinements and are suitable for high head pipe lines where high rates of air discharge and ventilation is required.

7. End Connection–End connection of single air valves (Small and large orifice) shall be either flanged or screwed. Double air valves shall have flange ends machined and drilled.

For kinetic air valves, all flanges including that of the isolating sluice valve shall be machined and drilled

8. Materials

TABLE 1 MATERIALS

Sl.no.	Component / Body	Material
i)	Body, Cover, Valve, Stuffing box, Valve guide, Cowl, gland, cap, Joint supporting	Grey cast iron
ii)	Stem	High tensile brass
iii)	Low Pressure Seating & Face ring	Natural rubber
v)	High Pressure Orifice	Leaded tin bronze
vi)	Stem nut	Leaded tin bronze
vii)	Body seat ring	Leaded tin bronze
viii)	Bolts	Carbon steel

ix)	Nuts	Carbon steel
x)	Gasket	Rubber
xi)	Gland packing	Jute/hemp
xii)	Float (Low pressure orifice)	Timber core with vulcanite coating
xiii)	Float (High pressure orifice)	Timber core with vulcanite coating
xiv)	Float Guide	Leaded tin bronze

Note : For alternative materials refer to Table 1 of the standard.

9. Design and Manufacture

9.1 Minimum body thickness shall be as indicated in Table 2.

TABLE 2 BODY THICKNESS

Valve Size	Single Air Valve				Kinetic Air Valve			
	Small Orifice	Large Orifice	Double Air Valve					
	PN 1.0	PN 1.6	PN 1.0	PN 1.6	PN 1.0	PN 1.6	PN 1.0	PN 1.6
15	6	8	-	-	-	-	-	-
25	6	8	6	8	-	-	-	-
40	8	10	8	10	8	10	8	10
50	-	-	9	10	9	10	9	10
80	-	-	-	-	12	10	12	
100	-	-	-	-	10	12	10	12
150	-	-	-	-	13	16	13	16
200	-	-	-	-	14.5	18	14.5	18

9.2 The orifice size in case of high pressure orifice shall not be less than 2.5 mm and tapering to 10mm suitable to release accumulated air within the pipe.

For detailed information, refer to IS 14845:2000 Resilient sealed cast Iron air relief valves for water works purposes

9.3 Minimum float diameter shall be as indicated Table 3.

TABLE 3 MINIMUM FLOAT DIAMETER

(All dimensions in mm)						
Single Air Valve	Double Air Valve	Kinetic Air Valve				
Valve Small Orifice	Large Orifice	Small Orifice	Large Orifice	Small Orifice	Large Orifice	
15	75	40	--	--	--	--
25	100	75	--	--	--	--
40	100	75	100	75	90	55
50	100	75	100	75	100	75
80	--	--	100	100	115	100
100	--	--	125	125	125	125
150	--	--	125	200	150	200
200	--	--	140	250	150	250

Note : For design and manufacture refer to Fig 1 to 4 and clause 10 of the Standard.

For details see 10 of the standard.

10. Finish : The finish of the castings shall be smooth and free from blow-hole, crack, flaw, burr and other defects.

11. Testing and performance

11.1 When tested as specified the air passage and function of float valves in a valve shall be satisfactory.

11.2 Hydrostatic test of valve body shall reveal no leakage through pressure sustaining components and joints.

11.3 When tested as specified the valve seat body shall show no leakage.

SUMMARY OF

IS 14846 : 2000 SLUICE VALVES FOR WATER WORKS PURPOSES (50 TO 1200 mm SIZE)

1. Scope — Requirements for non-rising stem type sluice valves from 50 to 1 200 mm sizes used for water supply up to 45° C and having double flanged ends for connections.

2. Nominal Pressures—(Maximum permissible gauge working pressur)

<i>Nominal Pressure (PN)</i>	<i>Nominal Sized</i>
MPa	mm
PN 1.0	50 to 1200
PN 1.6	50 to 600

3. Nominal Sizes – 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1000, 1100 and 1 200 mm. The nominal size shall refer to the nominal bore of the waterway. The actual bore at any point shall not be less than the nominal size.

4. Materials

<i>Sl.No.</i>	<i>Component</i>	<i>Material</i>
i)	Body, Bonnet, Dome, Stool cover, Wedge, Stuffing box, gland, thrust Plate and Cap	Grey cast iron
ii)	Hand wheel	Grey Cast iron
iii)	Stem	Stainless Steel
iv)	Wedge nut, Shoe, Channel	Leaded tin Bronze
v)	Body seat ring, Wedge facing ring and Bushes	Leaded tin Bronze
vi)	Bolts	Carbon Steel
vii)	Nuts	Carbon Steel
viii)	Gasket	Rubber
ix)	Gland Packing	Jute and hemp
x)	Gear	Spheroidal graphite iron
xi)	Gear Housing	Grey cast iron
xii)	Pinion & Pinion Shaft	Wrought Carbon Steel

5. Manufacture

5.1 The portion of bonnet (gland and stuffin box) which come in contact with spindle shall be provided cohenever required with bushings of minimum 3 mm thickness and specified material.

5.2 Valves shall be filled withdouble faced cast iron wedge made in one piece and having twomachired facing rings.

5.3 Stems shall have machine cut single start the wedge can be raised to a position so as to ensure full flow passage through the valve.

Note : For detailed dimeension and typical sketches refer to the standard.

6. Coating — All coatings shall be carried out after satisfactory testing of the valves prior to despatch. All unmachined ferrous surfaces of the valve (both inside and outside) shall be thoroughly clean, dry and shall be free from rust and grease before painting All exposed machined ferrous surfaces shall be painted with one coat of aluminium red oxide primer.

7. Testing

7.1 Hydrostatic Test

TEST PRESSURE FOR SLUICE VALVES		
PN Rating	Test for	Test Pressure
	Body/Seat	MPa (Gauge)
PN 1.0	Body	1.5
	Seat	1.0
PN 1.6	Body	2.4
	Seat	1.6

TEST DURATION FOR SLUICE VALVES		
Valve Size (mm)	Test for	Test Duration (Minutes)
50 to 1200	Body	5
	Seat	2

7.2. Liquid Penetrant Test – After forming of a collar no stem shall show any sign of flaw when subjected to liquid penetrant flaw detection test in accordance with IS : 3658.

Note; For details of materials , see Table I of the standard.

Note: For methods of tests, refer to Annex. B of the standard and IS 3658 : 1999 code of practice for liquid penetrant how detection (second revision)

For detailed information, refer to IS 14846: 2000. Sluice valves for water works purposes (50 to 1200 mm) size.

SUMMARY OF

IS 779 : 1994 WATER METERS (DOMESTIC TYPE)*(Sixth Revision)*

1. Scope – Covers terminology, construction, technical characteristics, metrological characteristics and other requirements of water meters with threaded end connections of size up to and including 50 mm, having nominal flow rates in the range of 1.5 to 15 kl/h, suitable for measuring the flow of cold potable water at a nominal pressure of 1 MPa (*Max*) and ambient temperature.

This standard is applicable both for semipositive (piston type) and inferential (turbine type) including magnetic type water meters having dry or wet dial.

2. Nominal Sizes – 5, 20, 25, 40 and 50 mm.

3. Classes – A and B depending on maximum verification scale interval and metrological characteristics.

4. Materials -

Body / Component	Materials
Body	a) Bronze b) Brass
Registration box	a) Bronze b) Brass c) Plastic
Strainers	a) Plastics b) Brass c) Stainless steel
Impellers, pistons and chambers	a) Ebonite (for piston only) b) Vulcanite (for piston only) c) Plastics
Measuring chamber	a) Brass b) Bronze c) Plastics
(Semi positive meters only)	
Gears, gearshaft and pinions	
a) For use under water	i) StainlessSteel ii) Nickel alloy iii) Plastics
b) For use above water	i) Brass rod ii) Brass sheet (for gears only) iii) Stainless iv) Plastics
c) Dia	Copper duly Enamelled or powder coated

Note: For material details, see Annex. B of the standard.

5. Indicating Device : Indicating device shall be able to record 9999 kl (min) for meter size of 15, 20 and 25 mm and 99999 kl (min) for size 40 and 50 mm and shall thereafter indicate zero.

For digital indicators the visible displacement of all digits shall be upward in value. Indicators with pointer shall rotate in a clockwise direction.

Each scale shall be either :

- graduated in values expressed in litres, or
- accompanied by a multiplying factor ($\times .001$, $\times .01$, $\times .1$, $\times 10$, $\times 100$, $\times 1\ 000$, etc.)

The fastest-moving visible graduated element, the control element, the scale interval of which is known as the "verification scale interval", shall move continuously. The length of verification scale interval shall be not less than 1 mm and not more than 5 mm.

Table 1 Verification Scale Interval

METER SIZE	MAXIMUM VALUE OF VERIFICATION SCALE INTERVAL, LITRES	
	Class A	class B
15	0.2	0.2
20	0.5	0.2
25	1.0	0.5
40	2.0	1.0
50	2.0	2.0

6. Meter Size and Over all Dimensions: See Table 2.

7. Technical Characteristics

7.1 Pressure Tightness – Meter shall be able to withstand constantly without defects, leakage, seepage, the continuous water pressure of

- 1.6 Mpa for 15 minutes, and
- 2 Mpa for 1 minute

7.2 Loss of Pressure – Shall not exceed 0.025 Mpa at the maximum flow rate, Q_{\max} .

7.3 Temperature suitability – as prescribed

8. Metrological Characteristics

8.1 Metering accuracy – The maximum permissible error in the metering accuracy, shall be as under :

- In the lower region of flow, $\pm 5\%$
 Q_{\min} (inclusive) to Q_t (exclusive)
- In the upper region of flow, $\pm 2\%$
 Q_t (inclusive) to Q_{\max} (inclusive)

Table 2 Meter Size, Threads, Nominal Flow Rates and Dimensions




METER SIZE	THREADS	NOMINAL FLOW RATE, Q_N IN KL/H	All dimensions in millimetres							
			MINIMUM LENGTH OF THREADS ON EITHER END OF BODY (SEE FIG. 2 OF THE STANDARD)			OVERALL DIMENSIONS (SEE FIG. 1 OF THE STANDARD)				
						Length		Width W (Max)	Height	
						With nipples	Without nipples		H_1	H_2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
15	G ¾ B	1.5	10	12	250	165	110	100	50	180
20	G 1 B	2.5	12	14	290	190	165	130	60	240
25	G 1¼B	3.5	12	16	380	260	-	170	65	260
40	G 2 B	10	13	20	430	300	-	210	75	300
50	G 2½B	15	15	25	470	330	-	270	115	300

Tolerance : On the overall length shall be ± 5 mm for meter with nipples and $\pm 0, -2$ mm for meters without nipple.

Note : Meters shall be supplied with nuts and nipples unless specified otherwise by the purchaser.

8.2 Minimum Starting Flow Rate as Table 3.

Table 3 Minimum Starting Flow Rate, Transitional Flow Rate and Maximum Flow Rate Values

METER	MINIMUM STARTING FLOW RATE Q_{MIN} L/H FOR		TRANSITIONAL FLOW RATE Q_T L/H FOR		MAXIMUM FLOW RATE Q_{MAX} KL/H
					
	Class A	Class B	Class A	Class B	
(1)	(2)	(3)	(4)	(5)	(6)
15	60	30	150	120	3
20	100	50	250	200	5
25	140	70	350	280	7
40	400	200	1 000	800	20
50	600	300	1 500	1 200	30

Note: For methods of tests, refer to IS 6784 :1996 Method of performance testing of water meters(domestic type) (second revision)

For detailed information, refer to IS 779:1994 Water meters (domestic type) (sixth revision)

SUMMARY OF
IS 2104 : 1981. WATER METER BOXES (DOMESTIC TYPE)
(First Revision)

1. Scope – Requirements for materials, dimensions and construction of boxes for water meters of nominal size conforming to IS 779 – 1994*.

2. Sizes and Shape

2.1. Shall be of two sizes and suitable for the water meters of following sizes :

Size 1 – for 15, 20 and 25 mm water meters,
and

Size 2 – for 40 and 50 mm water meters.

2.2. Shape : Oval or rectangular.

3. Dimensions –

Minimum inside clear dimensions :

<i>Size</i>	<i>Length</i> mm	<i>Width</i> mm	<i>Height</i> mm
1	600	600	500
2	900	600	600

4. Manufacture

4.1 Construction –

- a) *Cast iron boxes* – Minimum thickness of box shall be 8 mm for Size 1 and 10 mm for Size 2.
- b) *Mild steel boxes* – Minimum thickness shall be 3 mm.
- c) *Precast reinforced concrete boxes* – Thickness of wall shall not be less than 40 mm.
- d) *Slot for pipe* – Height of slot shall be half the clear inside height of box and width shall be 40 mm for Size 1 and 75 mm for Size 2 with a tolerance of +3 mm.

Note : For typical illustration water meter boxes of different materials, refer to Fig. 1 to 5 of the standard.

4.2. Fabrication and Fittings – Locking arrangement may be provided either with a dog-and-clamp arrangement or alternatively, by means of a padlock. Suitable anchorage for fixing box to concrete or masonry bed plate shall be provided.

* Water meters (domestic type) (*sixth revision*)

For detailed information, refer to IS 2104 : 1981 Specification for water meter boxes (domestic type) (first revision)

SUMMARY OF
IS 2373 : 1981 WATER METERS (BULK TYPE)
(Third Revision)

1. Scope – Covers bulk type water meters of the following types :

- a) Vane-wheel (impeller) type water meters from 50 to 300 mm ; and
- b) Helical type water meters from 50 to 500 mm

2. Nominal size : (Bore of inlet) 50, 80, 100, 150, 200, 250, 300, 350, 400 and 500 mm.

3. Ranges of Registration :

Nominal Size	Ranges of Registration of Water Meters in Litres	
	Minimum Registration in Dial Division Not to be More Than	Maximum Registration Not to be Less than
50	10	100 000 000
80	10	100 000 000
100	100	100 000 000
150	100	100 000 000
200	100	100 000 000
250	100	1000 000 000
300	100	1000 000 000
350	100	1000 000 000
400	1 000	10 000 000 000
450	1 000	10 000 000 000

4. Performance Requirements

4.1. Temperature : Up to 45°C.

4.2. Hydrostatic Test : Shall satisfactorily withstand a pressure of 1.6 MPa (16 kgf/cm²).

4.3. Capacity Ratings :

Nominal Size	Nomininal Capacity Ratings of Water Meters in Litres per hour	
	Vane-Wheel Type	Helical Type
mm		
50	30 000	50 000
80	50 000	125 000
100	70 000	200 000
150	150 000	500 000
200	250 000	800 000
250	400 000	1 100 000
300	500 000	1 500 000
350	-	2 000 000
400	-	3 000 000
500	-	5 000 000

Note: For materials and manufacturing details, refer to *the standard*.

For detailed information, refer to IS 2373 : 1981. Specification for water meters (bulk type)

4.4 Capacity Ratings for Intermediate flows

Nominal Size	Capacity Ratings of watermeters in Litres per hour	
	Vane-Wheel Type	Helical Type
mm		
50	17 000	20 000
80	27 000	62 000
100	40 000	100 000
150	80 000	250 000
200	150 000	400 000
250	220 000	550 000
300	300 000	750 000
350	-	1 000 000
400	-	1 500 000
500	-	2 500 000

4.5. Minimum Starting flow :

Nominal Size	Capacity Ratings of Water Meters in Litres per hour	
	Vane-Wheel Type	Helical Type
mm		
50	250	500
80	500	1 000
100	700	1 500
150	1 000	3 500
200	2 400	5 500
250	3 200	9 000
300	6 400	14 000
350	-	20 000
400	-	25 000
500	-	35 000

4.6 Metering Accuracy : ± 2 percent.

5. Frost Protection : Meters liable to be damaged by frost shall be protected with suitable frost protection devices.

SECTION 11
BUILDERS HARDWARE

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SUMMARY OF
IS 204 (PART 1) : 1991 TOWER BOLTS
PART 1 FERROUS METALS
(Fifth Revision)

1. Scope – Requirements for tower bolts made of ferrous metals.

2. Types

<i>Type</i>	<i>Description</i>
<i>a) Barrel Tower Bolts</i>	
1A	Mild steel barrel tower bolts with mild steel barrel and mild steel bolt.
1B	Mild steel barrel tower bolts with mild steel barrel and cast iron bolt.
<i>b) Semi-Barrel Tower Bolts</i>	
2A	Mild steel semi-barrel tower bolts, full cover with mild steel sheet pressed barrel and mild steel bolt.
2B	Mild steel semi-barrel tower bolts, full cover with mild steel sheet pressed barrel and cast iron bolt.
3A	Mild steel semi-barrel tower bolts, open cover with mild steel sheet pressed barrel and mild steel bolt.
3B	Mild steel semi-barrel tower bolts, open cover with mild steel sheet pressed barrel and cast iron bolt.
<i>c) Riveted or Spot Welded Tower Bolts</i>	
4A	Mild steel tower bolts riveted type with back plate and mild steel bolt and open staple.
4B	Mild steel tower bolts riveted type with back plate and cast iron bolt and open staple.

Note— If specifically ordered, this type of tower bolt may also be supplied with alternative staple of riveted or welded type with back plate.

d) *Skeleton Tower Bolts*

5. Mild steel skeleton towerbolts with steel sheet pressed plate and staples and mild steel bolt.

3. Materials

- i) Mild steel sheets
- ii) Mild steel bars
- iii) Cast iron

Note— For details of materials see 4 and Table 5 of the standard.

4. Dimensions

4.1 Barrel Tower Bolts — 75, 100, 125, 150, 175, 200, 225, 250 and 300 mm sizes

4.2 Semi-Barrel Tower Bolts — 75, 100, 125, 150, 175, 200, 225, 250, 300, 375 and 450 mm sizes.

4.3 Riveted or Spot Welded Tower Bolts — 100, 125, 150, 175, 200, 225, 250, 300, 375, 450, 600, 750 and 900 mm sizes.

4.4 Skeleton Tower Bolts — 375, 450, 600, 750 and 900 mm sizes.

Note — For detailed dimensions and tolerances on them, refer to Tables 1 to 4 of the standard.

5 Finish – Unless otherwise ordered for the bolts shall be bright finished or bright, satin finished. Other parts of the tower bolts shall be finished as above or may also be stove enamelled black. (See 7 of the standard).

For detailed information, refer to IS 204 (Part 1) : 1991 Specification for tower bolts: Part 1 Ferrous metal (fifth revision).

SUMMARY OF

IS 204 (PART 2) : 1992 TOWER BOLTS

PART 2 NON FERROUS METALS

(Fifth Revision)

1. Scope Requirements for tower bolts made of non-ferrous metals.

2. Types

<i>Type</i>	<i>Description</i>
a)	<i>Barrel Tower Bolts</i>
1	Brass barrel tower bolts with cast brass barrel and rolled or cast brass bolts.
2	Brass barrel tower bolts with barrel of extruded sections of brass and rolled or drawn brass.
3	Brass barrel tower bolts with brass sheet barrel and rolled or drawn brass bolt.
4	Aluminium barrel tower bolts with barrel and bolt of extruded sections of aluminium alloys.
5	zinc barrel tower bolts with barrel and bolt of die-cast zinc alloy.
b)	<i>Skeleton Tower Bolts</i>
6	Brass skeleton tower bolts with cast brass plate and staples and rolled or drawn brass bolt.
7	Brass skeleton tower bolts with staples and plate of extruded sections of brass and rolled or drawn brass bolt.
8	Aluminium skeleton tower bolts with plate, staples and bolt of extruded sections of aluminium alloy.
9	Zinc skeleton tower bolts with plate, staples and bolts of die-cast zinc alloy.

3. Materials

i) Aluminium alloy tubes

ii) Aluminium alloy extruded rods

iii) Brass sheets

iv) Cast brass

v) Extruded brass

vi) Zinc base alloy die casting.

Note— For details of materials see 4 and Table 3 of the standard.

4. Dimensions

4.1 Barrel Tower Bolts — 75, 100, 125, 150, 175, 200, 225, 250 and 300 mm sizes

4.2 Skeleton Tower Bolts— 375, 450, 600, 750, and 900 mm sizes.

Note — For detailed dimensions and tolerances on them, refer to Tables 1 and 2 of the standard.

5. Finisha) *Barrel Tower Bolts*1) *Brass tower bolts (Types 1 to 3)* — Bolt and barrel polished or plated as specified by the purchaser.2) *Aluminium alloy tower bolts (Type 4)* — Bolts and barrel anodized. The anodic film may be either transparent or dyed as specified by the purchaser.3) *Zinc alloy tower bolts (Type 5)* — Bolt and barrel oxidized, bronzed or plated as specified by the purchaser.b) *Skeleton Tower Bolts*1) *Brass skeleton bolts (Types 6 and 7)* — Bolt, plate and staples bright finished.2) *Aluminium alloy skeleton tower bolts (Type 8)* — Bolt, plate and staples anodized. The anodic film may be either transparent or dyed as specified by the purchaser.3) *Zinc alloy tower bolts (Type 9)* — Bolt and barrel oxidized, bronzed or plated as specified by the purchaser.

For detailed information, refer to IS 204 (Part 2) : 1992 Specification for tower bolts Part 2 : Non ferrous metals (fifth revision).

SUMMARY OF
IS 205 : 1992 NON FERROUS METAL BUTT HINGES
(Fourth Revision)

1. Scope – Requirements for butt hinges made from non-ferrous metals.

2. Types

- a) Extruded aluminium alloy butt hinges,
- b) Extruded brass butt hinges,
- c) Cast brass butt hinges, and
- d) Sheet brass butt hinges.

3. Materials

- | | |
|-------------|---|
| <i>Flap</i> | <ul style="list-style-type: none"> i) Extruded aluminium alloy ii) Extruded brass iii) Cast brass iv) Brass sheet i) Aluminium alloy |
| <i>Pin</i> | <ul style="list-style-type: none"> ii) Phosphor bronze wire or rod iii) Mild steel wire or rod iv) Brass wire v) Stainless steel |

4. Dimensions— Dimensions of different types of hinges shall be normally as given in Tables 2 to 5 of the standard. For tolerances see table 6 of the standard.

5. Requirements

5.1 Number of knuckles in each hinge shall not be less than five except in case of cast brass hinges of sizes less than 40 mm and in case of sheet brass hinges where it shall not be less than three.

5.2 Screw Holes— Shall be counter sunk.

6. Workmanship and Finish— Hinges shall be free from all defects. All sharp edges shall be rounded.

6.1 Brass hinges shall have bright or satin finish and shall be suitably protected against discoloration. Aluminium alloy hinges shall be anodized.

Note— For details see 4 and Table 1 of the standard.

For detailed information, refer to IS 205 :1992 Specification for non-ferrous metal but things (fifth revision).

SUMMARY OF
IS 206 : 1992 TEE AND STRAP HINGES
(Fourth Revision)

1. Scope—Requirements for mild steel Tee and strap hinges that are commonly used in general building construction.

2. Types

2.1 Tee hinges shall be of the following types—

<i>Type</i>	<i>Designation</i>
1	Light weight
2	Medium weight
3	Heavy weight

2.2 Strap hinges shall be of the following types —

<i>Type</i>	<i>Designation</i>
1	Light weight strap
2	Medium weight
3	Heavy weight

3. Materials

i) Mild steel sheet

ii) Mild steel wire

4. Dimensions

4.1 *Light Weight Tee Hinges* — 75, 100, 125, 150, 200, 250, 300, 350, and 400 mm sizes.

4.2 *Medium Weight Tee Hinges* — 75, 100, 125, 150, 200, 250, 300, 350, 400, 450 and 500 mm sizes.

4.3 *Heavy Weight Tee Hinges* — 150, 200, 250, 300, 350, 400, 450, 500 and 600 mm sizes.

4.4 *Light Weight Strap Hinges* — 75, 100, 125, 150, 200, 250, 300, 350 and 400 mm sizes.

4.5 *Medium Weight Strap Hinges* — 75, 100, 125, 150, 200, 250, 300, 350, 450 and 500 mm

4.6 *Heavy Weight Strap Hinges* — 150, 200, 250, 300, 350, 400, 450, 500 and 600 mm sizes.

Note— For detailed dimensions and tolerances, refer to Tables 2 to 7 of the standard.

5. Finish — Tee and strap hinges shall be either bright finished or stove enamelled black, as specified by the purchaser.

Note — For details of materials, see 4 and Table 1 of the standard.

For detailed information, refer to IS 206 : 1992 Specification for tee and strap hinges (fourth revision).

SUMMARY OF
IS 208 : 1996 DOOR HANDLES
(Fifth Revision)

1. Scope – Requirements for materials, manufacture, dimensions and finish of door handles of the type that are commonly fixed to doors.

2. Types

<i>Type 1</i>	Cast
<i>Type 2</i>	Pressed oval
<i>Type 3</i>	Pressed half oval
<i>Type 4</i>	Fabricated

3. Materials

<i>Type 1</i>	Cast iron, malleable cast iron, cast brass, cast aluminium or zinc and 3 alloy die casting,
<i>Type 2 and 3</i>	Mild steel, and
<i>Type 4</i>	Brass or aluminium alloy.

4. Dimensions and Tolerances — Shall conform to Tables 2A and 2B, read with Figures 1 to 4 of the standard.

<i>Dimensions</i>	<i>Tolerance</i>
mm	mm
Up to 100	± 1
101 to 200	± 1.5
201 and above	± 2

5. Finish

<i>Type 1</i> –	Bright satin finish, nickel chromium plated or copper oxidised or bronze finish for cast brass and zinc die cast handles. Stove enamelled black or copper oxidized for cast iron and malleable cast iron handles. Aluminium anodized to a bright natural, mat or stain finish or dyed.
<i>Type 2</i> –	Stove enamelled black.
<i>Type 3</i> –	Stove enamelled black.
<i>Type 4</i> –	Bright satin finish, nickel plated or copper-oxidized, bronze finish for brass handles. Aluminium anodized to a bright, natural, mat or satin finish or dyed.

Note– The material used shall comply with the requirements given in Table 1 of the standard.

For detailed information, refer to IS 208 : 1996 Specification for door handles (fifth revision).

SUMMARY OF
IS 281 : 1991 MILD STEEL SLIDING DOOR BOLTS
FOR USE WITH PADLOCKS
(Third Revision)

1. Scope – Requirements regarding materials, dimensions, manufacture and finish of mild steel sliding door bolts commonly used in general building construction for locking doors, gates, etc, with padlocks.

2. Types

- i) Plate Type, and
- ii) Clip or bolt type.

3. Sizes

- (a) *Plate type sliding bolts*— 150, 200, 250, 300, 375 and 450 mm; and
- (b) *Clip or bolt type sliding bolts*— 200, 250, 300, 375 and 450 mm

4. Materials

Mild Steel

Mild Steel Wire

Mild Steel Rod

Note— For details of material see 5 of the standard.

5. Sizes

- a) *Plate type sliding bolts* — 150, 200, 250, 300, 375 and 450 mm.
- b) *Clip or bolt type sliding bolts* — 200, 250, 300, 375 and 450 mm

5.1 Tolerances—Length of bolt -

Sizes up to and including 300 mm \pm 2 mm

Sizes 375 mm and 450 mm \pm 3 mm

Note— Size represents length of the bolt. For detailed dimensions and tolerances see 6 of the standard.

6. Finish—

- i) *Sliding Bolts, Plate Type* – Back plate straps and staple plate shall be stove enamelled black before assembling. Hasp and bolt shall be finished bright or copper-oxidized or shall be plated with nickel or chromium.
- ii) *Sliding Bolts, Clip or Bolt Type* — Hasp, bolt, staple and clips or fixing bolts shall be copper oxidized or shall be plated with nickel or chromium.

Note—When the sliding bolts is to be finished bright, a thin coating of rust preventive shall be given.

For detailed information, refer to IS 281 : 1991 Specification for mild steel sliding door bolt for use with padlocks (third revision).

SUMMARY OF
IS 362 : 1991 PARLIAMENT HINGES
(Fifth Revision)

1. Scope – Requirements regarding materials, manufacture, finish, marking and packing of parliament hinges.

2. Types

Type 1 Cast (Cast brass)

Type 2 Pressed (Mildsteel, Aluminium alloy)

Type 3 Fabricated (Extruded Aluminium alloy)

Note— Materials for different types are given above within brackets. For requirements of materials, *see* Table 1 of the standard.

3. Dimensions

3.1 Aluminium Alloy Parliament Hinges — 50, 65, 75, 100, 125, 150, 175, and 200 mm.

For tolerances *see* Table 2 of the standard.

3.2 Cast Brass Parliament Hinges — 50, 65, 75, 100, 125, 150, 175 and 200 mm.

For tolerances *see* Table 3 of the standard.

3.3 Mild Steel Parliament Hinges — 50, 65, 75, 100, 125, 150, 175 and 200 mm.

For tolerances *see* Table 4 of the standard

4. Manufacture — Hinges shall be well made and be free from flaws and defects of all kinds. Washer shall be provided between knuckles for Type 1 and Type 3 hinges. Washer shall be made of nylon, plastic or any other suitable material. In locations susceptible to corrosion, use of brass or phosphor bronze hinge pins is recommended in case of brass hinges. All screw holes shall be clean and counter sunk.

5. Finish—Brass parliament hinges shall have either bright or satin finish and shall be suitably protected against discoloration.

5.1 Aluminium alloy hinges shall be anodized to a bright, natural, mat or satin finish or dyed.

5.2 Mild steel parliament hinges shall be finished bright or electro-galvanized as specified by the purchaser.

For detailed information, refer to IS 362 : 1991 Specification for parliament hinges (fourth revision).

SUMMARY OF

IS 363 : 1993 HASPS AND STAPLES

(Fourth Revision)

1. Scope – Requirements regarding materials, manufacture, dimensions, manufacture and finish of hasps and staples.

2. Types

Type	Description
1.	Mild steel, brass or aluminium alloy hasps and staples—safety type.
2.	Mild steel hasps and staples—wire type.

3. Sizes**3.1 Mild Steel Hasps and Staples**

Type 1—90, 115, 150 and 175 mm.

3.2 Brass or Aluminium Alloy Hasps and Staples

Type 1 – 90, 115, 150 and 175 mm.

3.3 Mild Steel Hasps and Staples

Type 2 — 65,75, 90, 100, 125,150 and 175 mm.

For tolerances *see* Tables 2, 3 and 4 of the standard.**4. Finish –**

a) Mild steel hasps — Stove enamelled, black and staples

b) Brass hasps – Oxidized or covered with staples clear lacquer after polishing as specified by the purchaser

c) Aluminium alloy – Anodized.

Note— For details regarding materials *see* 4 and Table 1 of the standard.

For detailed information, refer to IS 363 : 1993 Specification for hasps and staples (fourth revision).

SUMMARY OF
IS 364 : 1993 FAN LIGHT CATCH
(Third Revision)

1. Scope—Requirements regarding material, dimensions, manufacture and finish of fan light catches commonly used on ventilators in buildings.

2. Types

- a) Mild steel fan light catches,
- b) Aluminium alloy fan light catches, and
- c) Cast brass fan light catches.

3. Materials

- a) Mild steel sheet shall satisfy prescribed bend test.
- b) Mild steel wire shall have a tensile strength of 40 kg/mm², minimum and shall satisfy the prescribed wrapping test.

Note— For details regarding material, see 4 of the standard.

4. Dimensions and Tolerances

4.1 Dimensions — The leading dimensions shall conform to those specified in Fig. 1 of the standard.

4.2 Tolerances

<i>Dimension</i> mm	<i>Tolerance</i> mm
Up to and including 5	± 0.2
Above 5 and up to and including 25	± 0.5
Above 25	± 1

5. Finish — Aluminium alloy fan light catches shall be anodized after the initial fabrication work. A coating not less than 0.015 mm is recommended for normal use. The anodic film may be transparent or dyed as desired by the purchaser. For exterior use, where sunlight falls on the fittings, only light fast colours like light fast bronze or light fast gold or plain anodic finishes shall be employed and the thickness of the anodic film shall be not less than 0.025 mm.

5.1 Brass fan light catches shall have satin finish or other finish as specified by the purchaser.

5.2 Mild steel fan light catches may be stove enamelled to a colour and finish as specified by the purchaser.

For detailed information, refer to IS 364 : 1993 Specification for fan light catch (third revision).

SUMMARY OF
IS 452 : 1973 DOOR SPRING RAT- TAIL TYPE
(Second Revision)

1. Scope—Requirements for materials, dimensions, manufacture, finish and tests for door springs, rat-tail type commonly used in building construction.

2. Types (*According to material used*)

- a) Mild steel door springs, and
- b) Brass door springs.

3. Sizes – 300 and 375 mm

Note – Size denotes distance between centres of spindle and roller.

4. Requirements

- a) Tail rod – 10 mm dia.
- b) Roller plate – 16 mm thick.
- c) Base plate – 2.5 mm thick (size 80 × 40 mm centre to centre of screw holes).
- d) Roller – 2 mm dia and 3 mm thick.

5. Performance Tests

- a) The tail rod when pushed through to the maximum possible limit and released 100 times in quick succession the spring shall show no sign of damage or any permanent set.
- b) The torque required to push open the door through 90° shall not exceed 4 kgf/m.

6. Finish – Mild steel door springs, casing, tail rod, spindle cap and base plate shall be stove enamelled black or copper oxidized. In case of brass, there shall be bright finished or copper oxidized.

6.1 Spindle, roller plate and roller shall be bright finished and the spring if made of mild steel wire shall be copper oxidized or electro-galvanized.

Note 1 — For details regarding material of door spring rat-tail type see 3 of the standard.

Note 2 — For detailed dimension of door springs see Fig.1 of the standard.

For detailed information, refer to IS 452 : 1973 Specification for door spring rat- tail type (second revision).

SUMMARY OF
IS 453 : 1993 DOUBLE-ACTING SPRING HINGES
(Third Revision)

1. Scope – Requirements for material, dimensions manufacture, finish and tests of double-acting spring hinges and corresponding blank hinges used generally for swing doors.

2. Types

- a) Mild Steel double-acting spring hinges, and
- b) Brass double-acting spring hinges.

3. Sizes

<i>Size of Spring Hinge</i> mm	<i>Size of Blank Hinge</i> mm
100	70
125	75
150	75

4. Dimensions— See Fig 1 and 2 of the standard.

5. Performance Test

- a) Door when pushed through 90° and released 2 000 times on each side in quick succession, the hinge and its components shall show no sign of damage.
- b) Door shall require force of 2.0 ± 0.5 kg for 100 mm hinge and 3.0 ± 0.5 kg. For 125 mm and 150 mm hinges, at a distance of 45 cm from the hinge pin to move the door through 90°

6. Finish—

- a) *Mild Steel Hinges* — Stove-enamelled black or copper-oxidized.
- b) *Brass Hinges* — Satin, bright, nickel plated, or copper-oxidized.

Note— For details regarding materials see 4 of the standard

For detailed information, refer to IS 453 : 1993 Specification for double-acting spring hinges (third revision).

SUMMARY OF

IS 1019 : 1974 RIM LATCHES

(Second Revision)

1. Scope — Requirements regarding material, dimensions, manufacture and finish of rim latches for general use.

2. Handling of Rim Latches— Left hand latch if fitted on left hand door. Right hand latch if fitted on right hand door.

3. Types

Type 1 — Opens when handle is turned in one direction only.

Type 2 — Opens when handle is turned in any direction.

3.1 Type 1 rim latches shall either be 'left-hand' or 'right-hand'.

4. Sizes — 75, 100, 125 and 150 mm denoted by overall length of the body measured from the outside face of the fore end to the rear end.

5. Material — Shall be of the mild steel, brass, aluminium alloy or zinc base alloy.

6. Dimensions (in mm)

Size *Length* × *Breadth* × *Depth*

75 75 × 60 × 14

100 100 × 70 × 20

125 125 × 70 × 20

150 150 × 70 × 20

Tolerance + 1 mm

6. Finish

Brass latches Bright or satin finish

Aluminium latches Anodized finish

Steel latches Black japanned, stove enamelled black or copper oxidoized.

8. Performance Requirement — When knob of latch is turned, the catch bolt shall draw smoothly into the body and shall be flush with the face of the body.

Note— For requirements for material of rim latches see Table 1 of the standard.

For detailed information, refer to IS 1019 : 1974 Specification for rim latches (second revision)

SUMMARY OF
IS 1341 : 1992 STEEL BUTT HINGES
(Sixth Revision)

1. Scope—Requirements regarding material, dimensions, manufacture and finish of mild steel butt hinges.

2. Types

- a) Light weight hinges
- b) Medium weight hinges
- c) Broad type hinges
- d) Square type hinges
- e) Heavy type I and II hinges

3. Materials

- i) Flap — Mild steel
- ii) Pin — Mild steelwire

Note—For details on materials, see 4 and Table 1 of the standard.

4. Dimensions and Tolerances

4.1 Light Weight Mild Steel Butt Hinges— 15, 25, 40, 50, 65, 75 and 100 mm sizes.

4.2 Medium Weight Mild Steel Butt Hinges— 20, 25, 40, 50, 65, 75, 90, 100, 125 and 150 mm sizes.

4.3 Broad Type Mild Steel Butt Hinges— 50, 75, 100, 125 and 150 mm sizes.

4.4 Square Type Mild Steel Butt Hinges— 50, 65, 75, 90 and 100 mm sizes.

4.5 Heavy Weight Mild Steel Butt Hinges— 50, 65, 75, 90, 100, 125, 150, 175 and 200 mm sizes.

4.6 Tolerances—See Tables 2 to 7 of the standard.

5. Finish — Hinges shall be finished bright with smooth surfaces.

For detailed information, refer to IS 1341 : 1992 Specification for steel butt hinges (sixth revision).

SUMMARY OF
IS 1823 : 1980 FLOOR DOOR STOPPERS
(Third Revision)

1. Scope – Requirements for floor door stopper suitable for use with door shutters of 30, 35, 40, and 45 mm thickness.

2. Materials

- a) *For Body or Housing and Cover Plate*—Aluminium alloy (pressure die) castings or aluminium alloy sheets or brass sheet or cast brass or brass gravity die casting.
- b) *For Spring*—Phosphor bronze or hard drawn steel wire.
- c) *For Tongue*—Aluminium alloy pressure die casting or cast brass or nylon or plastic.

3. Requirements

- a) Four countersunk holes for fixing door stopper to floor.
- b) Body or housing shall be cast in one piece and fixed to cover plate by brass or mild steel screws.
- c) Rubber piece shall be attached to extreme end to absorb shocks.

4. Dimensions (in mm)

Thickness of door shutter	30	35	40	45
Overall length of cover plate	140	140	150	150
Width of cover plate.	40	40	40	40
Thickness of cover plate	4.5 for castings 3 for sheet metal			

4.1 Tolerances

- a) On overall length of cover plate ± 0.5 mm
- b) On thickness of cover plate $+ 0.3$ mm and -0 mm.

Note —For detailed dimensions and tolerances, refer to Table 2 to be with Fig. 1 of the standard.

5. Manufacture

5.1 The stoppers shall be well made and free from defects likely to prevent its correct fixing or affect adversely its reliability in use.

5.2 Body or housing shall be cast in one piece and fixed to cover plate by brass or mild steel screws.

5.3 There shall be four countersunk holes for fixing stoppers to the floor.

5.4 On the extreme end, a rubber piece shall be attached to absorb shocks due to pulling action of door. The rubber used shall comply with the following requirements:

- a) Relative density, *Max* 1.3
- b) Hardness 60 ± 5
- c) Ageing for 24 h at $100 \pm 1^\circ\text{C}$
 - i) Change in initial hardness $+5, -0$
 - ii) Shall not develop brittleness or tackiness

6. Workmanship and Finish — Stoppers shall be free from flaws and defects of all kinds. Aluminium door stoppers shall be anodized and brass stoppers be finished smooth. Stoppers may also be chromium or nickel plated, anodized or oxidized. The exterior of door stopper shall be flush with floor and be finished bright or satin.

For detailed information, refer to IS 1823 : 1980 Specification for floor door stoppers (third revision).

SUMMARY OF
IS 1837 : 1966 FAN LIGHT PIVOTS
(First Revision)

1. Scope — Requirements for fan light pivots (also known as ventilator hinges)

2. Types

Type 1 – Mild steel pivots

Type 2 – Aluminium pivots

Type 3 – Brass pivots

3. Dimensions (in mm)

3.1 Tolerances

Pivot length and breadth ± 0.5 mm

Pin Projection ± 0.2 mm

Pin dia ± 0.2 mm

Note — For detailed dimensions refer to the standard coverplate

4. Finish

Type 1 – Bright finished with smooth surface

Type 2 – Natural or anodized finish

Type 3 – Bright or satin finish

No.	Thickness of Ventilator Shutte	Pivot Length	Pivot Breadth	Pin Projection	Pin Dia	
					<i>Type 1</i>	<i>Type 2 and 3</i>
1	25	20	50	10	10	9.5
2	30	25	50	12.5	12.5	12.5
3	30	25	65	12.5	12	12.5
4	35	25	65	15	16	15
5	35	25	75	15	16	15

Note — For requirement for materials see 3.1 of the standard.

For detailed information, refer to IS 1837 : 1966 Specification for fan light pivots (first revision).

SUMMARY OF
IS 2209 : 1976 MORTICE LOCKS (VERTICAL TYPE)
(Third Revision)

1. Scope – Requirements for mortice locks (vertical type)

2. Sizes – 65, 75 and 100 mm. Size shall be denoted by the overall length of body measured from the outside face of the fore end to the rear end. Measured length shall not vary by more than 3 mm from the length specified for size.

Note 1—Mortice locks of other size may be made if mutually agreed.

Note 2 — For typical design of mortice lock see Fig. 1 of the standard

3. Material—Material for different component parts shall comply with the requirements given in Tables 2 and 3 of the standard.

4. Non-Interchangeability—Two lever locks shall be manufactured to have non-interchangeable keys in a batch consisting of a minimum of 24 locks. In case of locks with more than two levers, these shall have non-interchangeable keys in a batch of minimum 100 locks.

5. Manufacture

- a) *Body*—Clear depth 15 mm, *Max.*
- b) *Locking bolt*— Section not less than 8 × 25 mm.
- c) *Lever spring* — Lever spring fitted into the lever shall withstand the prescribed tests without showing signs of permanent set.
- d) Lock shall be capable of being opened with the key from both inside and outside.

6. Finish –

- a) *Brass body* – Finished smooth.
- b) *Steel body* – Protective coating such as painting.
- c) *Aluminium alloy body* – Anodized.
- d) *Face plate and striking plate*— Finished smooth and polished bright or satin (or may be chromium plated anodized or oxidized).

7. Tests — Shall withstand the performance and endurance tests as given in **9.1** and **9.2** of the standard.

For detailed information, refer to IS 2209 : 1976 Specification for mortice locks (vertical type) (third revision).

SUMMARY OF
IS 2681 : 1993 NON-FERROUS METAL SLIDING DOOR BOLTS
(ALDROPS) FOR USE WITH PADLOCKS
(Third Revision)

1. Scope— Requirement for non-ferrous metal sliding door bolts (aldrops) commonly used in general building construction for locking doors, gates etc. with padlocks.

2. Types

Type 1— Brass sliding door bolts with sand cast brass hasp, staple and fixing bolts or clips and rolled or drawn brass bolts.

Type 2— Brass sliding door bolts with die-cast brass hasp, staple and fixing bolts or clips and rolled or drawn brass bolts.

Type 3— Aluminium alloy sliding door bolts with hasp, staple and fixing clips of sheets, or extruded sections and fixing bolts and sliding bolts of extruded sections of aluminium alloy.

3. Materials — Shall comply with the requirements given in Table 1 of the standard.

4. Dimensions

<i>Type</i>	<i>Size, mm</i>
1 and 2	150, 200, 250, 300, 375 and 450
3	200, 250, 300, 350, 375 and 450

Note— For details of dimensions and tolerance see Tables 2 and 3 read with Fig. 1 of the standard.

5. Finish — Brass sliding door bolts shall have satin finish or shall be polished or plated.

Aluminium shall be anodized to a bright, natural, satin finish or dyed.

For detailed information, refer to IS 2681 : 1993 Specification for non-ferrous metal sliding door bolts (aldrops) for use with padlocks (third revision).

SUMMARY OF
IS 3564 : 1995 HYDRAULICALLY REGULATED DOOR CLOSER
(Fourth Revision)

1. Scope – Requirements for exposed type hydraulically regulated door closers for vertical hinge type doors opening to one side only and weighing more than 80 kg. This does not cover the requirements for concealed type hydraulic door closers and also the pneumatic or mechanical type of door closers.

4. Materials

- | | |
|------------------------------------|--|
| i) Non porous body and back plate | Cast iron /Aluminium alloy / Zinc alloy |
| ii) Piston or Pack-piston / pinion | Cast iron / Steel Aluminium alloy/Zinc alloy |

Note— For materials for other components *see* 7 and Table 2 of the standard.

5. Essential Requirements

5.1 The closer shall be manufactured in three sizes conforming to the requirements given in Table 1, in accordance with the direction of the opening of the door either clockwise or anti-clockwise.

5.2 The closing time shall be easily adjustable between 5 and 20 seconds by means of regulating screw.

5.3 Hydraulic oil filling shall work satisfactorily at all temperatures between 50 °C and –10 °C without requiring any change except adjustment of the regulating screw.

2. Types

- a) Bottle type (*Type A*)
b) Tubular type (*Type B*)

Note— *See* Fig. 1 to 4 of the standard.

3. Nominal Sizes — The nominal sizes of door closers in relation to the mass and the width of the door size, to which it is intended to be fitted, shall be as given in Table 1.

5.4 The closer shall be capable to regulate the speed by extending spring or adjustment in control valve screw, as the case may be.

6. Test

6.1 Performance Requirements — When opened through 90°, the door shall swing back to an angle of $20 \pm 5^\circ$ with normal speed, but thereafter the speed should get automatically retarded and should smoothly negotiate with the latch (where provided)

6.2 Endurance Test — After 50,000 operations against maximum load specified, the closer shall show no defects, failure or leakage of oil etc.

Note — For test details *see* Annex B of the standard.

7. Finish — Polished or painted and finished with lacquer. In case of aluminium body, it may be anodized.

Mild steel parts shall be pickled and given phosphate treatment.

TABLE 1 DESIGNATION OF DOOR CLOSERS

Sl. No.	Designation of Closer	Mass of the Door(kg)	Width of the Door (mm)	Remarks
(1)	(2)	(3)	(4)	(5)
i)	1.	Up to 35	Up to 700	For light doors, such as double leaved and toilet doors
ii)	2	36-60	701 to 850	Interior doors, such as of bedrooms, kitchen and store
iii)	3	61 to 80	851 to 1 000	Main doors in a building, such as entrance doors

Note—For methods of test, refer to Annex B of the standard.

For detailed information, refer to IS 3564 : 1995 Specification for hydraulically regulated door closers (fourth revision).

SUMMARY OF
IS 3818 : 1992 CONTINUOUS (PIANO) HINGES
(Third Revision)

1. Scope – Requirements for continuous (piano) hinges.

2. Material

<i>Name of Component</i>	<i>Material</i>
Flap	a) Mild Steel sheet b) Aluminium alloy sheet c) Cold rolled low carbon steel sheets
Pin	a) Mild steel wire b) Aluminium alloy sheet

3. Dimensions and Tolerances — Dimension of type I, II, III and IV and permissible tolerances shall conform to those specified in Fig. 1 to 3 of the standard.

4. Requirements

- a) Knuckles shall be straight and at right angle to the flap.
- b) Hinge pin shall be of mild steel in the case of mild steel hinges and shall be of mild steel (galvanized) or Aluminium alloy in case of aluminium alloy hinges. The aluminium alloy hinge pin shall be hard anodized to a minimum thickness of 0.025 mm and sealed with oil wax or lanolin.
- c) Screw holes shall be countersunk.

5. Finish — Mild steel hinges shall be protected with anticorrosive treatment, such as, bright polished, chromium plated or oxidized finish. Aluminium hinges shall be anodized.

For detailed information, refer to IS 3818 : 1992 Specification for continuous (piano) hinges (third revision).

SUMMARY OF
IS 3828 : 1966 VENTILATOR CHAINS
(Third Revision)

1. Scope – Requirements for ventilator chains.

2. Material

- | | |
|--------------|-------------------------------|
| a) Staple | Mild steel
Aluminium alloy |
| b) Eye | Mild steel
Aluminium alloy |
| c) Wire Mild | Mild Steel
Aluminium alloy |

- | | | |
|-----------|---|--|
| a) Eye | — | Formd by forging and folding plate of 2.5 minimum thickness. Width 25 mm. |
| b) Chain | — | Made from 1.8 mm minimum dia wire. Length 300 ± 5 mm. Each link 30 ± 2 mm. |
| c) Staple | — | Made of 2.5 mm minimum thick plate size 40×20 mm. Hook 5 mm dia and 5 mm internal radius of bend. |

3. Manufacture and Dimensions

4. Load Test – Assembly shall be strong enough to bear 20 kg load without deformation.

5. Finish – Shall be protected against corrosion.

For detailed information, refer to IS 3828 : 1966 Specification for ventilator chains (third revision).

SUMMARY OF
IS 3843 : 1995 STEEL BACK FLAP HINGES
(Second Revision)

1. Scope – Covers types and the requirements regarding materials, dimensions, manufacture and finish of steel back flap hinges.

2. Types—

- a) Light weight hinges, and
- b) Heavy weight hinges

3. Materials—

- a) Flap Steelcover plate
- b) Pin Mild Steel wire

4. Sizes

4.1 Light Weight Hinges— 20, 25, 30, 35, 40, 45, 50, 60, 65 and 75 mm

4.2 Heavy Weight Hinges— 25, 40, 50, 65 and 75 mm

Note—For details of dimensions and tolerances refer to Table 1 and 2 of the standard.

5. Requirements— All screw holes shall be clean and counter sunk.

6. Finish— The hinges shall be oxidized or finished bright with smooth and rust free surface.

For detailed information, refer to IS 3843 : 1995 Specification for steel back flap hinges (second revision).

SUMMARY OF
IS 3847 : 1992 MORTICE NIGHT LATCHES
(First Revision)

1. Scope— Requirements for mortice night latches for general use.

2. General— Nominal size shall be denoted by overall length of the body measured from the outside face of the fore end to the rear end. Termed 'Left hand' if fitted on 'Left hand door' and 'Right Hand' if fitted in 'Right Hand door'. Two lever latches and latches with more than two levers shall have non-interchangeable keys for a batch of minimum 12 and 60 latches respectively.

3. Materials—

For body, body covers,

i) Mild Steel (shall satisfy the prescribed bend test)

Case plate, face plate ii) Aluminium alloy sheet and striking plate

iii) Cast brass (copper content shall not be less than 60 percent

iv) Brass sheet

Note—For materials for the other components see 6 and Table 1 of the standard.

4. Finish— Steel body shall be given suitable protective coating, such as painting. Face plate and striking plate shall be finished smooth and polished bright or satin.

5. Test— Shall satisfy the prescribed tests.

Note— For methods of tests refer to 10 of the standard.

For detailed information, refer to IS 3847 : 1992 Specification for mortice night latches (first revision).

SUMMARY OF

IS 4621 : 1975 INDICATING BOLT FOR USE IN PUBLIC BATHS
AND LAVATORIES*(First Revision)*

1. Scope – Requirements for indicating bolts for use in public baths and lavatories.

c) Gears

Aluminium alloy casting,
Brass casting

2. General – Operation of bolt may be achieved either by gear work or by displacement. Normally made in two sizes, namely, size 1 and size 2. When the bolt is drawn, it shall show the word “ENGAGED” on red background, and when it is withdrawn it shall show the word “VACANT” on green background.

4. Dimensions and Tolerances

	<i>Size 1</i>	<i>Size 2</i>	<i>Tolerance</i>
	(mm)	(mm)	(mm)

Length of bolt 75 85 ± 1 Breadth of bolt 45 50 ± 1 Dia of disc 70 70 ± 1 **3. Material**

a) Body, knob and indicating spindle Aluminium alloy casting, Extruded aluminium alloy, Brass casting, Extruded brass, Zinc base alloy die casting.

b) Indicating disc Aluminium alloy sheet, Brass casting

Note— For detailed dimensions and tolerances, see 4 of the standard.

5. Finish – Assembled bolt shall be satin finished or bright polished. Aluminium bolts shall be anodized.

For detailed information, refer to IS 4621 : 1975 Specification for indicating bolts for use in public baths and lavatories (first revision).

SUMMARY OF
IS 4948 : 2002 WELDED STEEL WIRE FABRIC
FOR GENERAL USE
(Second Revision)

1. Scope — Requirements for welded wire fabric for general use, such as fencing, window grill and crates. Not intended to cover fabric for concrete reinforcement.

2. Materials

2.1. Mild steel wire used for the manufacture of welded fabric shall conform to IS 280.

2.2 Stainless steel wire used for the manufacture of welded fabric shall conform to grade X 04 Cr 17 Ni 12 Mo 2 or X 04 Cr 18 Ni 10 of IS 6528*.

2.3 Tolerance on Diameter

For size of wire 1.6 to 5.6 mm ± 0.050

For size of wire over 5.6 mm ± 0.060

* Stainless steel wire - Specification (*first revision*)

Note 1 — For quality of wire refer to **3** of the standard.

Note 2 — For method of test, refer to **6** of the standard.

For detailed information, refer to IS 4948 : 2002 Specification for welded steel wire fabric for general use (second revision).

3. Mesh Sizes Commonly available (in mm) — Refer to Annex A of the standard.

4. Tolerance

4.1 In any individual mesh, the maximum variation between two members when measured between centre to centre shall not vary more than 5 percent.

4.2 The length of flat sheets or rolls measured on any wire may vary by 25 mm or one percent whichever is greater.

5. Test for Welding — The minimum average strength value of the weld shall not be less than 21 kgf/mm² and the area of the wire to be taken into consideration for calculation is the longitudinal wire. Fabric having a diameter difference between transverse and longitudinal wire greater than 2 mm shall not be subjected to weld shear test.

SUMMARY OF
IS 4992 : 1975 DOOR HANDLES FOR MORTICE LOCKS
(VERTICAL TYPE)
(First Revision)

1. Scope—Requirements for door handles for operation of mortice locks (vertical type) covered in IS 2209 : 1976.*

2. Type— Handle type and knob type.

3. Material— Brass, mild steel, aluminium alloy, etc.

4. Dimension and Tolerances— Size of

Door handle knob housing = $(150 \pm 5) \times (40 \pm 2)$ mm

Length of handle = 90 ± 2 mm.

5. Performance Requirements— A sample picked out at random from a lot of 100, when fitted to a lock and operated 1 000 times shall not show any damage or ineffectiveness in working. When the handle is in its extreme position in the lock and pulled horizontally with a load of 100 kgf, it shall not develop cracks, lose shape or get damaged.

6. Workmanship— All sharp edges shall be removed.

7. Finish— Brass handles shall have natural finish or shall be bright chromium electroplated. Aluminium alloy handles shall be anodized. Zinc base alloy die cast handles and mild steel handles shall be bright chromium plated.

* Mortice lock (vertical type) (*third revision*)

For detailed information, refer to IS 4992 : 1975 Specification for door handles for mortice locks (vertical type) (first revision).

SUMMARY OF
IS 5187 : 1972 FLUSH BOLTS
(First Revision)

1. Scope — Requirements for flush bolts for use in cupboards and doors

2. Material

a) Body and plate — Cast brass, cast aluminium and extruded aluminium alloy

b) Bolt — Cast brass, extruded brass and extruded aluminium alloy.

c) Spring — Phosphor bronze and steel strip.

3. Manufacture — Rod shall be retained in its maximum bolting position by the spring.

4. Dimensions and Tolerances

<i>Type</i>	<i>Size</i>	<i>FacePlate Length</i>	<i>Throw of Bolt Min.</i>	<i>Bolt Dia</i>
	(mm)	(mm)	(mm)	(mm)
1	100	100	20	8 ± 1

<i>Type</i>	<i>Size</i>	<i>FacePlate Length</i>	<i>Throw of Bolt Min.</i>	<i>Bolt Dia</i>
	(mm)	(mm)	(mm)	(mm)
1	150	150	25	8 ± 1
1	200	200	30	8 ± 1
2	100	100	15	8 ± 1
2	150	150	15	8 ± 1
2	200	200	15	8 ± 1
2	250	250	15	8 ± 1
2	300	300	15	8 ± 1

Note— For detailed dimensions and tolerances, See 5 of the standard.

5. Workmanship and Finish — Shall have smooth and easy working when assembled. Brass bolts shall be satin or bright polished, or nickel or chromium plated or copper oxidized. Aluminium flush bolts shall be anodized.

For detailed information, refer to IS 5187 : 1972 Specification for flush bolt (first revision).

SUMMARY OF
IS 5899 : 1970 BATH ROOM LATCHES

1. Scope— Requirements for material, size and finish of bathroom latches.

2. Shape and Size

Overall size — 40×50 mm

Thickness — 10 mm

Note— For typical illustration *see* Fig. 1 of the standard.

3. Material

a) *Body* — Cast brass, cast iron, aluminium alloy, and aluminium extrusions.

b) *Bolts* — Brass cast, brass extruded, mild steel rod, cast iron, aluminium alloy and aluminium extrusions.

c) *Knob* — Cast brass, cast iron, aluminium alloy and aluminium extrusions.

4. Workmanship and Finish— Latch shall be smoothly finished. Aluminium alloy body may be anodized. Cast brass body shall be given a protective coating such as painting.

For detailed information, refer to IS 5899 : 1970 Specification for bathroom latches.

SUMMARY OF
IS 5930 : 1970 MORTICE LATCH
(VERTICAL TYPE)

1. Scope — Requirements for mortice latches for use on doors, such as bath room doors, W.C. doors and doors to private rooms.

2. Sizes — 65, 75 and 100 mm. Size shall be denoted by overall length of the body measured from the outside face of the fore end to the rear end. Measured length shall not vary by more than 3 mm from the length specified for size.

Note — For typical illustration of a mortice lock see fig.1 of the standard.

3. Material — Material for different component parts shall comply with the requirements given in Tables 1 and 2 of the standard.

4. Interchangeability — Component parts of latches of the same size and type shall be completely interchangeable.

5. Manufacture —

- | | |
|--------------------------|---------------------------------------|
| a) <i>Body</i> — | Depth of body shall not exceed 15 mm. |
| b) <i>Locking Bolt</i> — | Section not less than 18 × 25mm. |
| c) <i>Mechanism</i> — | Latch shall operate easily |

from both sides of the door. Bolt shall turn into locking position when the thumb turn knob is turned through 90°.

d) *Lever Spring* — Lever spring fitted into the lever shall withstand following tests without showing signs of permanent set.

i) Lever spring shall be pressed down so as to touch top edge of lever and released. Repeat six times.

ii) Lever spring shall also stand a transverse load of 15 kgf before failure of joint between lever and spring.

6. Workmanship and Finish — Brass body shall be finished smooth. Steel body shall be given a protective coating such as painting. Aluminium alloy body may be anodized. Face plate and striking plate shall be finished smooth and polished bright or satin, or chromium plated, anodized or oxidized.

7. Tests — The finally assembled latch shall withstand tests given in 9.1.1 to 9.1.3 of the standard.

For detailed information, refer to IS : 5930-1970 Specification for mortice latch (vertical type).

SUMMARY OF
IS 6315 : 1992 FLOOR SPRINGS (HYDRAULICALLY REGULATED)
FOR HEAVY DOORS
(Second Revision)

1. Scope – Requirements for concealed type floor springs (hydraulically regulated) for vertical doors weighing not more than 125 kg. In case of doors consisting of more than one leaf the weight of each leaf shall not exceed 125 kg.

2. Construction – Oil check shall work satisfactorily at all temperature between 49°C and –10°C without requiring any other change except by the adjustment of the capstan nut.

Note— For typical details of floor springs *see* fig. 1 of the standard.

3. Material—

For foundation box, main body and half cover	Cast brass, Brass sheet. Mild steel sheet, Cast iron, Aluminium alloy sheet, Zinc base alloy pressure die-casting.
--	--

Note — For details of material *see* 5 and Table 1 of the standard

4. Performance Requirements

4.1 Floor spring shall not show any change or deterioration in working after it has been subjected to 50 000 operations at a rate of not more than 6 to 8 operations per minute.

4.2 Closing time of floor spring shall be easily adjustable between 3 and 20 for which a suitable device to adjust the speed shall be provided.

4.3 Door leaf when opened through 90° plus and released, the door shall stand open till pushed back in the closing position. When opened to an angle less than 90°, the door shall swing back automatically.

4.4 Force not more than 20 N shall be required at a distance of one meter from the frame, to open the door leaf weighing 125 Kg through 90 degrees.

5. Finish

5.1 The hydraulic floor spring should be covered by one brass/aluminium sheet which only will flush on the floor. The cover sheet, shoe and top-centre will be polished or electroplated as agreed to between the purchaser and the manufacturer.

5.1.1 Mild steel parts may be given the treatment as follows:

- a. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign element.
- b. After pickling all the mild steel parts shall be given phosphating treatment followed by a coat of suitable primer, such as red oxide.

5.1.2 Two coats of enamel paint shall then be applied as follows:

- a) Undercoat, and
- b) Finish coat with synthetic stoving enamel, according to prescribed standard.

5.1.3 The components shall, thereafter, be baked at a specified temperature in an oven heated uniformly. The finish shall be smooth and uniform with a hard and tough film of enamel strongly adhering to the surface. The finish shall be free from all visible defects and shall not chip, when tapped lightly with a pointed instrument.

For detailed information, refer to IS 6315 : 1992 Specification for floor springs (hydraulically regulated) for heavy doors (second revision).

SUMMARY OF

IS 6318 : 1971 PLASTIC WINDOW STAYS AND FASTENERS

1. Scope — Lays down performance and functional requirements of window stays made of polypropylene and fasteners (handles) made of nylon.

2. Material

Requirements of polypropylene

- a) Density, 0.900 to 0.910 g/ml
- b) Tensile strength at yield, *Min* 315 kgf/cm²
- c) Impact strength, *Min* 3.7 kgf/cm (of notch)
- d) Water absorption, 3.7 *Max* 0.04 percent
- e) Deflection temperature, *Min* 54°C
- f) Weather resistance — Shall retain at least 50 percent of original elongation
- g) Deformation underload, *Max* 6.0 percent, 50°C and 70 kg/cm².

3. Size and Shape

Length of window stay = 300 mm

Length of window fastener = 110 mm

Note — For typical illustration see Fig 1 of the standard.

4. Tests

4.1 Test for Stays — Window stay shall be capable of restraining the shutter in three positions, at angles of 30°, 60° and 90° with the frame. Tolerance in position of restraint: ±5°.

4.2 Test for Fasteners — Fastener shall be able to hold a force of 40 kgf (applied in increments of 5 kgf at one minute intervals)

Note — For test procedures see 4 of the standard.

For detailed information, refer to IS 6318 : 1971 Specification for plastic window stay and fasteners.

SUMMARY OF
IS 6343 : 1982 DOOR CLOSERS (PNEUMATICALLY REGULATED)
FOR LIGHT DOORS WEIGHING UPTO 40 KG
(First Revision)

1. Scope—Requirements for door closers (pneumatically regulated) for use on light doors weighing up to 40 kg.

2. Material

- a) *Cylinder*— Brass tube mild steel tube/ aluminium tube,
- b) *Piston/Piston Rod*—Steel/cast iron/ aluminium alloy/zinc alloy.
- c) *Brackets and Fittings* — Mild steel/ cast iron/ aluminium alloy/zinc alloy/ cast brass,
- d) *Spring* — Steel, and
- e) *Regulating Screws*—Brass/bronze/aluminium alloy/ steel/zinc alloy.

3. Dimensions and Tolerances — Shall be as agreed upon between the purchaser and the manufacturer.

4. General Requirements

4.1 The surface of closer shall be clean, without sharp edges, free from cracks, dents, burrs or any other visible surface defects.

4.2 After fixing, the closer shall operate smoothly and quietly without any undue play during opening and closing operation.

4.3 The closer shall work satisfactorily at all temperatures between 40°C and 10°C without requiring any other change except by adjustment of regulating screw.

4.4 The speed of closing the door shall be adjusted by increase or decrease in the tension of helical spring.

4.5 The closer shall not show any sign of leakage in the air pressure.

4.6 Each closer shall be furnished with clear, detailed instructions for installation and regulation of the closer.

Note — For typical illustration of the door closer, see Fig.1 of the standard.

5. Performance Requirements

5.1 After being fitted in its position, when the door is opened through 90° and released, it shall swing back to an angle of 20±5° with normal speed, but thereafter the speed shall get automatically retarded till a smooth, final close is reached.

5.2 Endurance Test — The closer fitted to the door of maximum permissible weight shall be subjected to 50,000 operations at the rate of a maximum of 6 to 8 operations per minute. The number of operations to be carried out continuously at any time during the test shall not be less than 3 000. At the end of the test the closer shall show no defects, failure, or deterioration in its working.

6. Finish — The exposed surface shall be polished or pointed as agreed to mutually. In case of aluminium body, it may be anodized. All components of mild steel shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign element. The finish of mild steel surface shall be smooth, uniform and free from all visible defects with hard and tough film of enamel strongly adhering to the surface. All components shall be finished in colour as agreed to mutually.

Note — For requirements regarding manufacture and details of finishing, refer to the standard.

For detailed information, refer to IS 6343 : 1982 Specification for door closers (pneumatically regulated) for light doors weighing up to 40 kg (first revision).

SUMMARY OF

IS 6607 : 1972 REBATED MORTICE LOCKS (VERTICAL TYPE)

1. Scope – Requirements for rebated mortice locks suitable for use on double leaf doors with rebated meeting stiles.

2. Sizes – 65, 75 and 100 mm.

Sizes shall be denoted by length of the body measured from the outside face of the fore end to the rear end over the body in mm. The measured length shall not vary more than ± 3 mm from the length specified for size.

Note — For typical design of rebated mortice locks see Fig. 1 of the standard.

3. Non-interchangeability – Two-lever locks shall have non-interchangeable keys in a batch of minimum of 24 locks. Locks with more than two levers shall have non-interchangeable keys in a batch of a minimum of 100 locks.

4. Requirements

- a) *Body* – Depth of body shall not exceed 15 mm.
- b) *Locking bolt* – Section shall not be less than

12 × 16 mm for all sizes of locks.

- c) *Mechanism* — Locking mechanism shall be lever type with not less than two levers.
- d) *Lever Spring* — Shall withstand the prescribed test.
- e) *Keys* — Two for each lock usable from inside and outside.
- f) *Latch Bolt* — Section not less than 12 × 16 mm.

5. Workmanship and Finish — Brass body shall be finished smooth and polished. Aluminium alloy body may be anodized. Rebated face plate and striking plate may be polished, chromium plated or oxidized. Steel body shall be given protective coating. Steel parts shall be given specified protective treatment before painting.

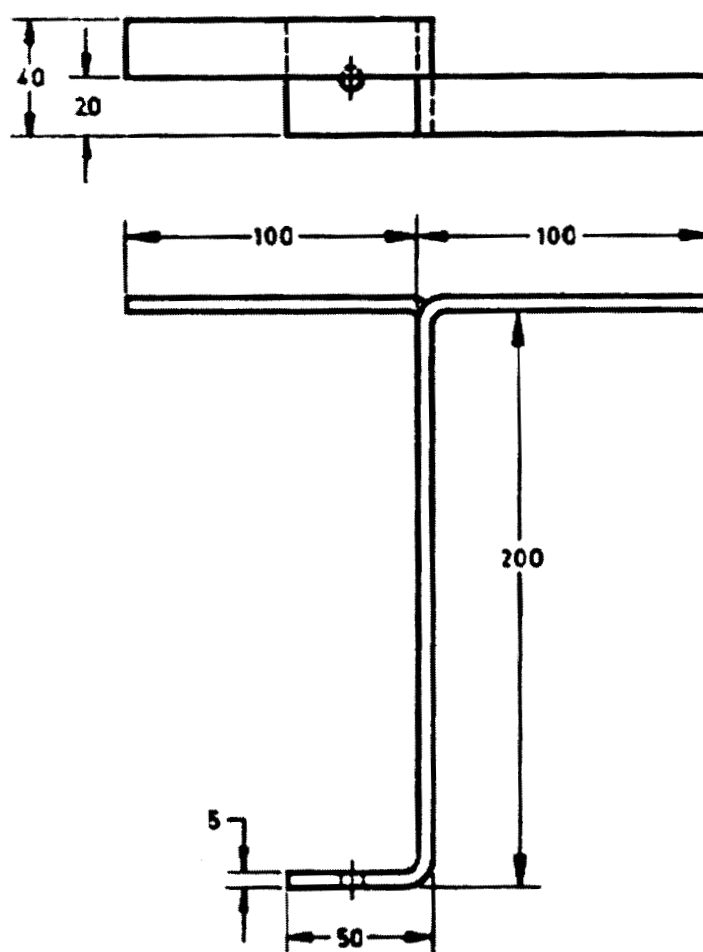
6. Tests — Shall withstand the tests specified in 9 of the standard.

Note — For requirements for materials for component parts of mortice locks see Table 1 of the standard.

For detailed information, refer to IS 6607 : 1972 Specification for rebated mortice locks (vertical type).

SUMMARY OF
IS 7196 : 1974 HOLD FAST

- | | |
|---|---|
| <p>1. Scope — Requirements for mild steel hold fasts for use with wooden doors and window frames.</p> <p>2. Size and Dimensions Shall be as given in Fig. 1</p> | <p>3. Manufacture — Shall be made from mild steel flats not less than 5 mm thick, and without any burrs or dents.</p> <p>4. Finish — Shall be given a coat of bitumen and sanded.</p> |
|---|---|



All dimensions in millimetres.

Fig. 1 Mild Steel Hold Fast

For detailed information, refer to IS 7196 : 1974 Specification for hold fast.

SUMMARY OF
IS 7197 : 1974 DOUBLE ACTION FLOOR SPRINGS
(WITHOUT OIL CHECK) FOR HEAVY DOORS

1. Scope — Requirements for concealed type floor springs (without oil check) for vertical doors weighing not more than 125 kg. For doors having more than one leaf, the weight of each leaf shall not exceed 125 kg.

2. Type and Size — For typical details of a floor spring see Fig.1 of the standard.

3. Material

- a) *Foundation box, main body and half cover*—
 Brass sheet 1.25 mm, minimum thick; Mild steel sheet 1.25 mm, minimum thick; Cast iron; aluminium alloy pressure die-castings 2 mm, minimum thick; aluminium alloy sheet 1.25 mm, minimum thick or zinc base alloy pressure die-castings 2 mm, minimum thick.

- b) *Spring Rod* — Mild steel

Note — For requirements for materials for other parts of floor spring see Table 1 of the standard.

4. Dimensions and Tolerances — As agreed to between the purchaser and the manufacturer.

5. Construction — Floor spring shall be covered by brass or aluminium sheet which only shall be flush with the floor. Provision shall be made in floor springs for adjusting door leaf to final closed position by turning the adjusting screw.

6. Performance Requirements — A sample mounted to a door leaf weighing 125 kg shall be subjected to 50,000 operations (that is, movement of door leaf through 180°) at the rate of not more than 6 to 8 operations per minute. Floor spring shall not show any damage or deterioration at the end of test.

A force of not more than 2 kgf shall be required at a distance of one metre from the door frame, to open the door leaf weighing 125 kg through 90°.

7. Finish — Cover sheet, shoe and top centre pivot shall be polished, electroplated or anodized. Mild steel and cast iron parts shall be given a synthetic stoving enamel finish according to prescribed specifications. The finish shall be smooth, uniform and shall not chip when tapped lightly with a pointed instrument. Aluminium parts shall be anodized.

For detailed information, refer to IS 7197:1974 Specification for double action floor springs (without oil check) for heavy doors.

SUMMARY OF
IS 7534 : 1985 SLIDING LOCKING BOLTS FOR USE WITH
PADLOCKS
(First Revision)

1. Scope – Requirements regarding materials, dimensions, manufacture and finish of sliding locking bolts commonly used for locking doors, gates, etc. with padlocks.

2. Types

Type I – with straight locking plate, and

Type II – with curved locking plate.

3. Sizes

110, 150, 200, 250 and 300 mm

4. Material

<i>Part</i>	<i>Material</i>
Bolt plate and receiving plate	Mild steel sheet Aluminium alloy sheet
Bolt	Mild steel rods Aluminium alloy extruded rod

5. Dimensions and Tolerances

<i>Type Bolt</i>	<i>Size</i>	<i>Length of Bolt Plate</i>	<i>Length of Bolt</i>	<i>Dia. of Bolt</i>
I	150	210 ± 1	150 ± 2	
	200	260 ± 1	200 ± 2	10 ± 0.5
	250	310 ± 1	250 ± 2	or
	300	360 ± 1	300 ± 2	12 ± 0.5
II	110	65 ± 1	110 ± 2	$10 \pm 0.$

Note — For detailed dimensions and tolerances see 6 and Table 2 of the standard.

6. Finish — Shall be copper oxidized, electrogalvanized or stove enamelled black. Aluminium alloy bolt shall be anodized to a bright, natural mat or satin finish or dyed

For detailed information, refer to IS 7534:1985 Specification for sliding locking bolts for use with pad locks (first revision).

SUMMARY OF IS 7540 : 1974 MORTICE DEAD LOCKS

1. Scope – Requirements for mortice dead locks.

Note – Mortice dead locks have a single bolt which is shot and withdrawn by means of key (from either side) providing reasonable degree of security. Being lock for occasional rather than frequent use it is well suited for use alone, or as an additional lock for the doors of store rooms, cellars, warehouses, etc.

2. Sizes – 45, 65 and 75 mm. Size is denoted by overall length of the body measured from the outside face of the face end to the rear end. Measured length shall not be more than ± 3 mm from the specified size

Note — For typical details of mortice dead locks *see* Fig. 1 of the standard.

3. Material

3.1. Body, Body Cover — Mild steel, cast brass, brass sheet, aluminium alloy castings and sheets and zinc base alloy casting.

Note — For requirements of materials for other component parts, see Table 1 of the standard.

4. Non-interchangeability — Two-lever locks shall have non-interchangeable keys in a batch of a minimum of 24 locks. Locks with more than two levers shall have non-interchangeable keys in a match of a minimum of 100 locks.

5. Manufacture

a) <i>Body</i>	Depth of body shall not exceed 15 mm
b) <i>Locking Bolt</i>	Section shall not be less than 10×30 mm.
c) <i>Levers</i>	Not less than two.
d) <i>Lever spring</i>	Shall withstand the prescribed tests with out showing any sign of permanent set.
e) <i>Keys</i>	Two for each.

6. Finish – Brass body shall be finished smooth and polished. Aluminium alloy body be anodized. Face plate and striking plate shall be polished, painted, plated or oxidized. Steel body shall be given suitable protective coating.

6. Tests — Shall withstand the tests specified in 9 of the standard.

For detailed information, refer to IS 7540 : 1974 Specification for mortice dead locks

SUMMARY OF
IS 8760 : 1978 MORTICE SLIDING DOOR LOCKS
WITH LEVER MECHANISM

1. Scope – Requirements for mortice sliding door locks having lever mechanism.

2. Sizes – 30 mm, 50 mm, 70 mm and 100 mm. Size shall be denoted by the overall length of the body in millimetres measured from the outside face of the fore-end to rear end. Measured length shall not vary by more than 3 mm from the length specified for size.

3. Shape and Design – Any shape but shall be capable of being opened with key from both sides.

Note — For typical illustration of mortice sliding door lock see Fig 1 of the standard.

4. Dimensions – As agreed to between the purchaser and the manufacturer.

5. Non-interchangeability – Two lever locks shall have non-interchangeable keys in a batch consisting of a minimum of 24 locks.

Locks with more than two levers shall have non interchangeable keys in a batch consisting of a minimum of 100 locks.

6. Finish

<i>Brass body</i>	Finished smooth
<i>Steel body</i>	Suitable protective coating such as painting.
<i>Aluminium alloy body</i>	Anodized
<i>Face plate and striking plate</i>	Finished smooth and polished bright or satin. May be chromium plated, anodized or oxidized where so desired by purchaser.

7. Test — Shall withstand the tests specified in **10** of the standard.

For detailed information, refer to IS : 8760 1978. Specification for mortice sliding door locks with lever mechanism (first revision).

SUMMARY OF IS 9106 : 1979 RISING BUTT HINGES

1. Scope — Requirements regarding materials, dimensions, manufacture and finish of rising butt hinges.

2. Types

<i>Type</i>	<i>Material</i>
1.	Cold rolled mild steel
2.	Cast iron
3.	Extruded brass

3. Materials

Flap	(i) Mild steel
	(ii) Cast iron
	(iii) Extruded brass
Pin —	Mild steel wire

4. Sizes —

Steel rising butt hinges	—	75 and 100 mm
Cast iron rising butt hinges	—	75 and 100 mm
Brass rising butt hinges	—	75, 100, and 125 mm.

Note — For detailed dimensions and tolerances *see* Table 5 of the standard.

5. Finish — Hinges shall be well made and shall be free from flaws and defects.

Hinges shall be finished bright with smooth surfaces. The brass hinges shall have bright or satin finish and shall be suitably protected against discolouration.

Note — For details on material *see* 3 and Table 1 of the standard.

For detailed information, refer to : IS 9106 : 1979 Specification for rising butt hinges.

SUMMARY OF
IS 9131 : 1979 RIM LOCKS

1. Scope – Requirements for materials, construction, dimensions and finish of rim locks of two types commonly fixed to single and double-leaf doors in buildings.

2. Types

Type 1 – Left hand or right-hand, and

Type 2 – Reversible

3. Size – 100 and 150 mm

The size of the rim lock shall be denoted by the length of face over the body in millimetres. The measured length shall not vary by more than 3 mm, from the length specified for the sizes.

4. Materials — Shall comply with the requirements given in Tables 1 and 2 of the standard.

5. Non-Interchangeability — The rim locks shall be manufactured to have non-interchangeable keys in a batch consisting of a minimum of 24 locks.

6. Construction

a) Body – Overall depth of the body shall be not more than 15 mm.

b) Locking bolt — Section not less than 8×22 mm

c) Mechanism — Shall be of ordinary lever type or any other type approved by the purchaser.

d) Latch Bolt — Section not less than 8×14 mm

7. Finish – Brass rim locks shall have bright or satin finish, and aluminium locks anodized finish. The steel locks shall be japanned, stove enamelled black or copper oxidized as specified by the purchaser.

8. Tests — The finally assembled lock shall withstand the tests given in **12.1.1** to **12.1.6** of the standard.

For detailed information, refer to IS 9131 : 1979 Specification for rim locks.

SUMMARY OF

IS 10019 : 1981 MILD STEEL STAYS AND FASTENERS

1. Scope – Requirements regarding materials, dimensions, manufacture and finish of stays and fasteners made of mild steel of the types that are commonly used in windows.

2. Types

- a) Type 1 – Mild steel stays and fasteners having tabular cross section, and
- b) Type 2 – Mild steel stays and fasteners made out of one piece sheet.

3. Materials

- i) Mild steel sheets
- ii) Mild steel bars

Note— For details of materials *see* 3 and Table 1 of the standard.

4. Shape and Dimension – Shall be as given in Fig 1 and 2 of the standard.

5. Test for Window Stays – The stay shall be capable of holding the window shutter in three different positions so as to make angles of 30°, 60° and 90° with the window frame. Tolerances in such positions shall not exceed + 5°.

6. Finish – Shall be either copper oxidized or a holding galvanised or electro-galvanised.

For detailed information, refer to IS 10019 : 1981 Specification for mild steel stays and fasteners.

**SUMMARY OF
IS 10090 : 1982 NUMERICALS**

1. Scope – Requirements regarding materials, dimensions, manufacture and finish of numerals.

2. Materials

- i) Cast brass
- ii) Cast bronze
- iii) Cast aluminium

Note— For details of materials see 2 and Table 1 of the standard.

3. Sizes — 25, 50, 75, 100, 150 and 300 mm. The thickness of the numerals shall not be less than 2 mm, and the width shall be as agreed upon between the purchaser and the manufacturer.

4. Manufacture

- a) Shall be manufactured in one piece and shall be free from all defects.
- b) Projecting lugs or pins at the back or countersunk screw holes shall be provided for fixing.

5. Finish – Brass and bronze numerals shall be finished smooth, and shall have bright or satin finish, or they shall be plated. They shall be suitably protected from discoloration. They shall be suitably protected from discoloration. Aluminium numerals shall be anodized.

For detailed information, refer to IS 10090 : 1982 Specification for numerals.

SUMMARY OF
IS 10342 : 1982 CURTAIN RAIL SYSTEM

1. Scope – Requirements regarding materials, manufacture, dimensions, testing and finish of rails, runners and hooks used in the curtain rail system.

Note — This standard, however does not cover the requirements for drop curtain rail system used in theaters, auditoriums, etc.

2. Types and Materials

Type 1 – Cast, (brass, aluminium)

Type 2 – Pressed, (mild steel or brass or aluminium alloy sheet).

Type 3 – Fabricated, (extruded brass or aluminium alloy)

Note— For details of materials see 4 and Table 1 of the standard.

3. Shape and Dimensions

3.1 The curtain ring shall be either ‘I’ or ‘C’ section

3.2 Dimension for ‘C’ rails : 900, 1 200, 1 800, and 2 400 mm length with a tolerance of ± 3 mm.

3.3 Dimensions for ‘I’ rails : 1 800, 1 200 and 2 400 mm length with a tolerance of ± 3 mm.

4. Finish – All components of curtain rail system shall be finished smooth. Aluminium components shall be anodized to a bright, natural, mat or satin finish or shall be dyed. Brass components shall have bright or satin finish and may be lacquered, nickel plated, or copper oxidized or bronze finished. Mild steel components shall be stove enamelled or electrogalvanized.

For detailed information, refer to IS 10342 : 1982 Specification for curtain rail system.

SUMMARY OF
IS 12817 : 1997 STAINLESS STEEL BUTT HINGES
(First Revision)

1. Scope – Types and requirements regarding materials, dimensions, manufacture and finish of stainless steel butt hinges.

2. Types

- a) Light weight (narrow) hinges
- b) Medium weight hinges
- c) Heavy weight hinges
- d) Unequal flap hinges

3. Sizes

3.1 Light Weight (Narrow) Hinges — 60 and 75 mm

3.2 Medium Weight Hinges — 50, 65, 75, 100, 125 and 150 mm

3.3 Heavy Weight Hinges — 75, 100, 125 and 150 mm

3.4 Unequal Flat Hinges

60 × 10 × 16 mm

60 × 12 × 19 mm

75 × 10 × 16 mm

75 × 12 × 19 mm

Note 1— The size shall be denoted by the length of the hinge.

Note 2 – For details on dimensions and tolerances, refer to 6 and Tables 1 to 4 of the standard.

4. Materials — Shall conform to the prescribed grades of the standard.

5. Finish — Unless otherwise specified, hinges, shall be naturally finished bright with smooth surface without chemical coatings.

For detailed information, refer to IS 12817:1997 Specification for stainless steel butt hinges (first revision)

SUMMARY OF
IS 12867 : 1989 PVC HAND RAIL COVERS

1. Scope – Covers the dimensions and requirements for PVC handrail covers for use on metal strip handrails.

2. Material – Handrails covers are manufactured by extrusion using plasticized PVC compound of desired formulation and colour.

3. Sizes – PVC handrail covers are normally made available in widths to match the desired width of metal

strip, suitably welded as part of the handrail, with a view to providing comfortable grip. The common sizes shall suit metallic flats of width 25 mm, 40 mm, 50 mm and 65 mm. For general use handrail covers should be supplied in 25 m lengths.

4. Requirements – See Table 1

TABLE 1 - REQUIREMENTS OF PVTC HANDRAIL COVERS

Sl. No.	Characteristics	Requirements
i)	Heat ageing and exudation	No exudation of plasticizer shall be apparent nor shall there be any change in appearance.
ii)	Tensile strength test	Tensile strength shall not be less than 10 N/mm ²
iii)	Elongation	Minimum elongation shall be 115 percent
iv)	Hardness	Minimum value of Rockwell hardness number shall be L65
v)	Resistance to combustion	The specimen shall not burn to the 25 mm mark and shall not show any flame or after glow after 5 s after the burner has been removed.

Note 1 — For methods of tests, refer to Appendices A to C of the standard and IS 8543 (Part 4/ Sec 1): 1984 Method of testing plastics: Part 4 short term mechanical properties, Section 1 Determination of tensile properties.

Note 2 — Method of installation is given in Annex D of the standard.

For detailed information, refer to IS 12867 : 1989 Specification for PVC handrail covers.

SUMMARY OF
IS 14912 : 2001 DOOR CLOSERS - CONCEALED TYPE
(HYDRAULICALLY REGULATED)

1. Scope – Requirement for concealed type hydraulically operated door closers, fixed in concealed position within the thickness of the panel on vertical, hinge type doors opening to one side only and not weighing more than 80 kg.

This standard does not cover overhead type door closers covered in IS 3564 : 1995* or pneumatic type door closers or closers working on only mechanical device.

2. Nominal Sizes

<i>Designation</i>	<i>Mass of Door</i>	<i>Width of Door</i>
No. 1	Up to 60 kg	Up to 850 mm
No. 2	60 to 80kg	851 to 1 000 mm

3. Materials

Non porous body	–	Aluminium alloy
Piston	–	Steel / Cast iron

Note— For materials of other components see Table 2 of the standard.

*Hydraulically regulated door closers.

4. Requirements

- a) Closing time shall be easily adjustable between 5 to 20 seconds by means of regulating screws.
- b) Hydraulic oil, filling shall work satisfactorily at all temperature between 50°C and -10°C without requiring any change except adjustment of the regulating screw.
- c) The closure shall be capable to regulate the speed by extending spring or adjustment in control valve screw, as the case may be.

5. Test

- a) *Performance requirement* – When opened through 90°, the door shall swing back to $20^{\circ} \pm 5^{\circ}$ with normal speed but thereafter speed should automatically get retarded and should smoothly negotiate, with the latch (where provided)
- b) *Endurance test* – After 50,000 operations against maximum load specified, the closure shall show no defects, failure or leakage of oil etc.

For detailed information, refer to IS 14912 : 2001. Specification for door closers—concealed type (hydraulically regulated)

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SECTION 12
WOOD PRODUCTS

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SUMMARY OF

IS 12049 : 1987 DIMENSIONS AND TOLERANCES RELATING TO WOOD BASED PANEL MATERIALS

1. Scope – Covers the dimensions, such as length, measurement for wood based panel materials.

The wood based panels considered are plywood, blockboard, hardboard, fibre insulation board, particle board, veneered particle board, particle board for insulation and high density particle board.

2. Dimensions

2.1 Plywood

2.1.1 Size– Plywood panels shall be of the sizes specified below

<i>Length</i>		<i>Width</i>
mm		mm
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1200
1800	×	900

2.1.2 Thickness–The thickness shall be as given in the specification.

2.2 Hardboard

2.2.1 Size– Hardboards shall be of the sizes specified below:

<i>Length</i>		<i>Width</i>
mm		mm
4800	×	1200
3600	×	1200
3000	×	1200
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1200
1800	×	900
1200	×	1200

2.2.2 Thickness –The thicknesses shall be as given in the specification.

2.3 Blockboard

2.3.1 Sizes – Blockboards shall be of the sizes specified below :

<i>Length</i>		<i>Width</i>
mm		mm
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1200
1800	×	900

2.3.2 Thickness – The thickness shall be as given in the specification.

2.4 Fibre Insulation Board

2.4.1 Size – Fibre insulation boards shall be of the sizes specified below :

<i>Length</i>		<i>Width</i>
mm		mm
3600	×	1200
3000	×	1200
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1200
1800	×	900

2.4.2 Thickness – The thickness shall be as given in the specification.

2.5 Wood Particle Board (Medium Density) – and prelamination particle board.

2.5.1 Size — Shall be as sizes specified below:

<i>Length</i>		<i>Width</i>
mm		mm
4800	×	1800
3600	×	1200
3000	×	1800
3000	×	1200
2400	×	1800
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1800
1800	×	1200
1800	×	900

2.5.2 Thickness — The thickness shall be as given in the specification.

2.6 Veneered Particle Board

2.6.1 Size— Veneered particle boards shall be of the sizes specified below:

<i>Length</i>		<i>Width</i>
mm		mm
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1200
1800	×	900

2.6.2 Thickness — The thickness shall be as given in the specification.

2.7 Particle Board for Insulation

2.7.1 Size — Particle boards for insulation shall be of the sizes specified below :

<i>Length</i>		<i>Width</i>
mm		mm
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1200
1800	x	900

2.7.2 Thickness —The thicknesses shall be as given in the specification.

2.8 Wood Particle Board (High Density)

2.8.1 Size — Wood particle boards (high density) shall be of the sizes specified below :

<i>Length</i>		<i>Width</i>
mm		mm
2400	×	1200
2100	×	1200
2100	×	900
1800	×	1200
1800	×	900

2.8.2 Thickness —The thicknesses shall be as given in the specification.

3. Tolerances —

3.1 The following tolerances for the dimensions shall be permitted.

3.1.1 Length +6 mm
–0 mm

3.1.2 Width +3 mm
–0 mm

3.1.3 Thickness — as specified in relevant standard.

3.2 Edge Straightness — 2 mm per 1000 mm.

3.3 Squareness — 2 mm per 1000 mm.

3.4 Variation in thickness on a board thickness variation between any two points on a board shall not be more than 0.5 mm.

For detailed information, refer to IS 12049 :1987 Specification for dimensions and tolerances relating to wood based panel materials.

SUMMARY OF
IS 849 : 1994 COLD SETTING CASEIN GLUE FOR WOOD
(First Revision)

1. Scope – Requirements for cold setting casein glue used in the wood panel industry, wood-work and joinery industry.

2. General Quality – The glue shall be in the form of powder, the adhesive constituent of which shall be mainly casein conforming to IS 850 : 1994*. When prepared in water in accordance with the manufacturer's instruction, it shall yield a homogeneous pasty fluid, free from grit and of satisfactory consistency. The glue shall be supplied in non-absorbent airtight containers.

3. Tests

3.1 Adhesive Strength— The mean failing load shall be not less than 270 kg and 45 kg (2 700 N and 450 N) for dry and wet tests, respectively.

3.2 Mycological Test— Where specified by the purchaser, the mycological test shall be conducted. The test pieces shall comply with the requirements specified

under **3.1** for wet test.

3.3 Test for Chloride Content—The aqueous extract of the paper joined with casein glue shall not contain chlorides calculated as sodium chloride exceeding 0.1 percent. This test shall only be conducted when specifically required by the purchaser.

3.4 Test for Sulphate Content—When specifically required by the purchaser, the aqueous extract of the paper joined with casein glue shall not contain sulphates calculated as anhydrous sodium sulphate exceeding 0.6 percent.

4. Storage Properties –The glue after being manufactured when stored in the original closed containers in a cool place for 12 months or for the period specified by the manufacturer shall comply with the requirements specified under **3.1**.

* Natural sour [(lactic)] casein for glue manufacture (first revision).

Note: For method of tests, refer to Appendices A to C of the standard.

For detailed information, refer to IS 849 : 1994 Specification for cold setting casein glue for wood (first revision)

SUMMARY OF
IS 851 : 1978 SYNTHETIC RESIN ADHESIVES FOR CONSTRUCTION
WORK (NON-STRUCTURAL) IN WOOD
(First Revision)

1. Scope – Requirements for synthetic resin adhesives suitable for wood work (non-structural) and joinery.

2. Types – Synthetic resin adhesives for wood shall be of the following four types :

Boiling Water Proof	BWP
Boiling Water Resistance	BWR
Warm Water Resistance	WWR
Cold Water Resistance	CWR

Type	Symbol
	<i>Gap-Filling Adhesive</i> <i>Close Contact Adhesive</i>
Boiling Water Proof	BWP/GF BWP/CC
Boiling Water Resistance	BWR/GF BWR/CC
Warm Water Resistance	WWR/GF WWR/CC
Cold Water Resistance	CWR/GF BWP/CC

2.1 Gap filling and close contact adhesives of four types shall have following symbols :

3. Keeping Properties —Adhesives shall comply with the test requirements given in Table 1, after the resin and hardener have been stored in the original closed containers according to the manufacturer's instructions and up to the date recommended by the manufacturer.

TABLE 1 TEST REQUIREMENTS FOR SYNTHETIC RESIN ADHESIVES

Test Requirements	Dry Test		Resistance To Water						Resistance to Micro-Organism	
	Gap Joint	Close Contact Joint	Boiling Water Test		Hot Water Test		Cold Water Test			
			Gap Joint	Close Contact Joint	Gap Joint	Close Contact Joint	Gap Joint	Close Contact Joint	Gap Joint	Close Contact Joint
Mean Failing Load, kg, Min	205	275	100 for BWP 90 for BWR	150 for BWP 115 for BWR	100	150	180	200	180	200

4. Resistance to water

4.1 Gap joints — See Table 2.

TABLE 2 RESISTANCE TO WATER (GAPJOINTS)

Type	Temperature of Water in Which Test Pieces shall be immersed	Time of Immersion	Mean Failing Load
(1)	(2)	(3)	(4)
	°C	h	kg
BWP	100 (or at the boiling point of water)	6	100
BWR	do	3	90
WWR	70 ± 2	3	100
CWR	27 ± 2	16 to 24	180

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4.2 Close-Contact Joints — See Table 3.

TABLE 3 RESISTANCE TO WATER (CLOSE-CONTACT JOINTS)

Type	Temperature of Water in Which Test Pieces Shall be Immersed	Time of Immersion	Mean Failing Load
(1)	(2)	(3)	(4)
	°C	h	kg
BWP	100 (or at the boiling point of water)	6	150
BWR	100 (or at the boiling point of water)	3	115
WWR	70 ± 2	3	150
CWR	27 ± 2	16 to 24	200

5. Resistance to Micro-organism (Mycological Test)

5.1 Gap Joints— Average failing load shall not be less than 180 kg for all types.

5.2 Close- Contact Joint — Average failing load shall not be less than 200 kg for all types

Note – For methods of tests, refer to Appendices B to G of the standard and IS1734 (Part 7) : 1983 Methods of test for plywood Part 7 Mycological test.

For detailed Information, refer to IS 851: 1978 Specification for synthetic resin adhesives for construction work (nonstructural) in wood (first revision).

SUMMARY OF
IS 852 : 1994 ANIMAL GLUE FOR GENERAL WOOD-WORKING
PURPOSES
(Second Revision)

1. Scope – Requirements of animal glue for general wood-working purposes.

2. Material—The glue shall be prepared from skin or bone material. It shall be supplied in the form of sheets, cakes, granules, pearls, flakes or powder, or in a kibbled form, as specified by the purchaser.

3. Requirements

3.1 Odour – The odour of a freshly prepared hot solution of the glue shall not be objectionable.

3.2 Keeping Quality —The glue shall keep not less than six days without evidence of liquefaction, purefaction or mould growth.

3.3 Storage Properties – The glue shall retain all the properties specified under **3.1** and **3.4** to **3.7** for at least 12 months from the date of manufacture, when stored in a cool dry place.

3.4. Moisture Content

3.4.1 The average moisture content of the glue, shall be not greater than 14 percent and no individual value shall be greater than 18 percent.

3.4.2 Should the average moisture content be more than 14 percent (not to exceed 18 percent under any

circumstances), the supplier shall make good the deficiency in the mass delivered in the manner stated below:

The mass of the material delivered (as weighed on delivery) shall be equal to —

$$N = \frac{86}{100 - M}$$

Where

N = nominal mass of the consignment ordered,
and

M = average percentage moisture content.

3.5 Chloride – The chloride content shall not exceed 2 percent calculated as sodium chloride.

3.6 Acidity and Alkalinity (pH) – The pH value of the glue, shall be not lower than 4.0 and nor higher than 8.2.

3.7 Overlap Joint Strength in Longitudinal Shear – The average failing load of six test specimens, prepared and tested shall be not less than 275 kg.

Note — For methods of tests, refer to Appendices A to E of *the standard*.

For detailed information, refer to IS 852 : 1994 Specification for animal glue for general wood-working purposes (second revision).

SUMMARY

IS 303 : 1989 PLYWOOD FOR GENERAL PURPOSE

(Third Revision)

1. Scope – Requirements of different grades and types of plywood used for general purposes.

2. Grades

- a) Boiling water resistant or BWR grade, and
- b) Moisture resistant or MR grade.

3. Types based on classification by appearance.

3.1 Plywood for general purposes shall be classified into three types, namely, AA, AB and BB based on the quality of the two surfaces, namely, A and B in terms of general permissible defects.

4. Materials

4.1. Timber – Any species of timber may be used for plywood manufacture. However, a list of species, for the manufacture of plywood is given in Annex B of the standard for guidance.

4.2 Adhesive – See IS 848 : 1974*.

4.2.1. Extenders may be used with the synthetic resin adhesive (aminoresins). However, synthetic resin adhesives (aminoresins) when extended by more than 25 percent shall contain suitable preservative chemicals in sufficient concentration to satisfy the mycological test described in the standard.

5. Quality — See Tables 1 and 2.

TABLE 1 QUALITY REQUIREMENTS OF PLYWOOD FOR GENERAL PURPOSES.

Sl. No.	Defect Categories	Types of Surfaces	
		A	B
(1)	(2)	(3)	(4)
i)	Blister	Nil	Nil
ii)	Checks	Individual check not more than 50 mm in length	Individual check not more than 100 mm in length and the total

* Synthetic resin adhesives for plywood (phenolic and amino plastic) (first revision).

+ Extruders for use in synthetic resin adhesive (Urea formaldehyde) for plywood (first revision).

		and the total length not more than 300 mm/m ²	length not more than 1000 mm/m ²
iii)	Discoloration	Nil	5 percent
iv)	Dot	5cm/m ²	15cm/m ²
v)	Insect hole	Scattered up to 12 holes/ m ²	Scattered up to 24 holes/ m ²
vi)	Joints	One joint for every multiple of 200 mm provided no individual piece is less than 100 mm in width.	No Restriction
vii)	Knots (dead)	2up to 12 mm dia/m ²	4up to 20 mm dia/m ²
vii)	Pin knots (dead)	6 2/m ²	6/m ²
ix)	Pin Knots (Live)	No restriction	No restriction
x)	Knots (tight)	6 upto 25 mm dia/m ²	No Restriction
xi)	Patches	4 patches/m ² provided they are all tight patches and do not mar the appearance	Any number provided they are all tight patches and do not mar the appearance
xii)	Splits	2 splits, each not more than 1mm wide and length not more than 100 mm provided they are filled with suitable filler	3 splits, each not more than 4 mm wide and length not more than 150 mm provided they are filled with suitable Veneer inserts. Split up to 25 mm long and 0.8mm wide may be ignored provided they are suitably filled with a filler.
xiii)	Swirl	Unlimited, provided they do not mar the appearance	No restriction

TABLE 2 PERMISSIBLE CATEGORIES OF DEFECTS

Type of Surface	Maximum Number of Categories of Permissible Defects per sq metre
A	3
B	5

6. Dimensions and Tolerances—**6.1** The dimension of plyboards shall be as follows

2400mm	×	1200mm
2100mm	×	1200mm
1800mm	×	1200mm
2100mm	×	900mm
1800mm	×	1200mm

Note — Any other dimension as agreed to between the manufacturer and the purchaser may also be used.

6.2 Thickness — See Table 3.**TABLE 3 THICKNESS OF PLYWOOD BOARDS**

BOARD	THICKNESS mm
(1)	(2)
3 ply	3,4,5,6,
5 ply	5, 6, 8, 9
7ply	9,12,15,16,
9 ply	12, 15, 16, 16
11 ply	19, 22, 25
Above 11 ply	As ordered

The thickness shall be measured up to one place of decimal.

6.3 Tolerances

Dimensions	Tolerance
a) Length	: + 6 mm
	: - 0 mm
b) Width	: + 3 mm
	: - 0 mm
c) Thickness	
(1) Less than 6 mm	: ± 10%
(2) 6 mm and above	: ± 5%
d) Squareness	: 0.2%
e) Edge straightness	: 0.2%

7. Tests

7.1 Glue adhesion — Shall have an average and minimum shear strength not less than the values specified in Table 4, against each grade.

TABLE 4 AVERAGE AND MINIMUM INDIVIDUAL SHEAR STRENGTH OF PLYWOOD

Sl.No.	Grade	Shear strength, Min(N)		
		Drystate	Mycological	Water
		Resistance		
i)	BWR			
	Minimum average	1350	1000	1000
	Individual	1100	800	800
ii)	MR			
	Minimum average	1000	800	800
	Individual	800	650	650

7.2 Moisture Content — Not less than 5 percent and not more than 15 percent.

Note— For method of tests refer to the standard and various parts of IS 1734. Method of test for plywood.

For detailed Information, refer to IS 303 :1989 Specification for plywood for general purposes (third revision)

SUMMARY OF

IS 1328 : 1996 VENEERED DECORATIVE PLYWOOD

(Third Revision)

1. Scope – Covers types of plywood with ornamental veneers on one or both faces used for decorative purposes, such as furniture making, panelling of all kinds, including panelling for railway coaches, buses and ships.

2. Grades and Types .

2.1 Determine decorative plywood shall be of two grades, namely BWR and MR

2.2 Decorative plywood shall be of two types, namely Type 1 and Type 2

3. Materials – The species of timber commonly used for decorative veneers or decorative plywood shall be specified by the purchaser. Commonly used species are given in Annex. B of the standard.

Any species of timber may be used for cores and backs of decorative veneered plywood. However, a list of species, given in Annex B of IS 303 : 1989* may be used for guidance

The adhesive for bonding of veneers shall be MR and BWR type synthetic resin adhesive, conforming to IS 848: 1974.+ for MR and BWR grade veneered decorative ply respectively. Plywood, when used in the manufacture of veneered decorative plywood of MR and BWR grade shall be MR and BWR type conforming to IS 303 : 1989.*

4. Requirements

4.1 Type 1—Open splits, checks or open joints not more than 150 mm in length and 0.5 mm in width shall be permissible provided the same are rectified with a veneer insert bonded with synthetic resin adhesive.

Shall be free from torn grain, dead knots, dote, discolouration and sapwood. The decorative veneered

* Plywood for general purpose (first revision)

+ Synthetic resin adhesive for plywood (phenolic and aminoplastic) (first revision)

surface shall be selected for figure, texture, colour and grain characteristics. It shall be free from all manufacturing and wood defects except to the extent permitted above.

4.2 Type 2 — Open splits, checks, or open joints not more than 200 mm in length and 1 mm in width shall be permissible, provided these are rectified in the manner specified under **4.1**. Tight knots and patches not more than 25 mm in diameter, and pin knots not more than 4 mm in diameter, shall be permissible.

4.2.1 Shall be free from the torn grain, dead knots, dote and discolouration. Sapwood, if it does not affect the appearance, shall be permissible.

4.2.2 Surface shall be selected for figure, texture, colour and grain characteristics. It shall be free from all manufacturing and wood defects, except to the extent permitted above.

5. Designation of Dimensions and Tolerances

5.1 The dimensions and tolerances (including on thickness) of plywood shall be as given in IS 12049 : 1987⁺⁺.

Note – Any other dimension as agreed to between the manufacture and for chaser may be used

5.2 Thickness — Thickness of the plywood boards shall be 3 mm, 4 mm, 6 mm, 9 mm, 12 mm, 19 mm or 25 mm.

6. Tests

- a) *Moisture content* — Not less than 5 percent and more than 15 percent.
- b) *Water resistance test*—Shall not show delamination or blister formation when tested as per the standard.

7. Finish —The edges of the decorative plywood shall be trimmed square within 3 mm and sanded to a smooth finish.

⁺⁺Dimensions and tolerances relating to wood based panel materials.

Note—For method of tests, refer to the standard and IS 1734 (Part 1) : 1983 Method of tests for plywood, Part1 determination of density and moisture(second revision).

For detailed Information, refer to IS 1328 : 1996 Specification for veneered decorative plywood (third revision).

SUMMARY OF
IS 4990 : 1993 PLYWOOD FOR CONCRETE SHUTTERING WORK
(Second Revision)

1. Scope – Requirements of plywood for concrete shuttering and form work.

2. Types – Plywood for concrete shuttering work shall be preservative treated, of BWP grade and shall be of three types as given below

Type	Description	Designation
1	Plywood for concrete shuttering work (plain)	CS
2	Plywood for concrete shuttering work with plastic coating (coated)	CSC
3	Plywood for concrete shuttering work with suitable overlay (film faced)	CSFF

3. Materials

3.1 Timber — Any species of timber may be used, However a list of species given in Annex B of the standard may be used for selection of species.

3.2 Adhesives for Bonding of Veneers—Shall be of the hot press synthetic resin (phenol formaldehyde) type and shall conform to BWP type specified in IS 848 : 1974.*

4. Dimensions and Tolerances

4.1. Size

Unless otherwise specified, plywood boards for concrete shuttering work shall be of length and width as specified below—

mm		mm	mm		mm
2400	×	1200	1500	×	1200
2400	×	900	1500	×	900
2100	×	1200	1200	×	1200
2100	×	900	1200	×	900
1800	×	1200	1200	×	600
1800	×	900	900	×	900

Note – Plywood boards for concrete shuttering may also be manufactured under the following alternative sizes if specified by the purchaser

mm		mm	mm		mm
2400	×	1220	1540	×	1220
2440	×	920	1540	×	920
2140	×	1220	1220	×	1220
2140	×	920	1220	×	920
1840	×	1220	1220	×	610
1840	×	920	920	×	920

* Synthetic resin adhesives for plywood (Phenolic and amino plastic *(first revision)*)

4.2 Thickness – Unless other wise specified, thickness of plywood board shall be as specified below for the respective number of plies

Board	Thickness
3-ply	4 mm 5 mm 6 mm
5-ply	6 mm 8 mm 9 mm
7-ply	12 mm 16 mm
9-ply	16 mm 19 mm
More than 9- ply	22 mm 25 mm 30 mm 35 mm 40 mm

4.3 Tolerances— The tolerances on the nominal sizes of finished boards shall be as specified in IS 12049 : 1987*.

5. Workmanship and Finish— Shall be smooth and the faces and back shall be free from harmful discolouration, pleats, overlaps and loose knots. The edges shall be of smooth uniform finish.

* Dimensions and tolerances relating to wood based panel materials.

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Gaps and open joints shall be permitted as follows

- a) *In Face* — The gap or opening shall not exceed a width of 0.4 mm. If it exceeds 0.4 mm this may be rectified by well-fitted veneer inserts of suitable width provided the grain of the veneer insert does not deviate by more than 10 percent from the grain direction of the surrounding veneer.
- b) *In Core (Cross-Band)* — The width of the opening shall not exceed 1 mm in the case of 3-ply and 5-ply, and 2 mm in the case of plywood of more than 5 ply, provided that such openings are not less than 300 mm apart in any veneer and staggered not less than 150 mm between any veneer and the next one with the same direction.

The faces of plywood for concrete shuttering work with plastic coating, or with suitable overlay shall be dense smooth, without blisters and patch marks and of uniform colour.

6. Tests —

6.1 Moisture Content — Shall be not less than 5 percent and not more than 15 percent.

6.2 Glue Adhesion in Dry State

6.2.1 Glue shear strength — Average failing load shall be not less than 1350 N (135 kgf) and no individual value shall be less than 1100 N (110 kgf).

6.2.2 Adhesion of plies — The veneers shall offer appreciable resistance to separation and the fractured samples shall show some adherent fibres distributed more or less uniformly.

6.3 Water Resistance Test

6.3.1 Glue shear strength — The average failing load shall be not less than 1000 N (100 kgf) and no individual value shall be less than 800 N (80 kgf).

6.3.2 Adhesion of plies — Same as in 6.2.2

6.3.3 Plywood for concrete shuttering work with plastic coating or with suitable overlay, after being subjected to 72 hours boiling, shall not show any softening, checking, cracking or deterioration of the surface layer.

6.3.4 When tested plywood shall have retention of preservative chemical not less than 12 kg/m³

6.4 Tensile Strength — The tensile strength, shall comply with the following requirements—

- a) Tensile strength shall be not less than 32.5 N/mm² (325 kgf/cm²) in the direction parallel to the grain direction of the face veneers,
- b) Tensile strength shall be not less than 22.5 N/mm² (225 kgf/cm²) in the direction of the face veneers, and
- c) The sum of the tensile strengths in both directions shall be not less than 60.0 N/mm² (60 kgf/cm²).

6.5 Mycological Test — The test piece shall show no appreciable signs of separation at the edges of the veneers.

6.6 Modulus of Elasticity — The modulus of elasticity shall be not less than 8000 N/mm² along the direction parallel to the grain direction of the face veneer and not less than 4000 N/mm² perpendicular to the grain direction of the face veneers, when tested in dry condition.

Note — For method of tests, refer to various parts of IS 1734 : 1983 Method of tests for plywood (second revision)

For detailed informations, refer to IS 4990 : 1993 Specification for plywood for concrete shuttering work (second revision).

SUMMARY OF
IS 5509 : 2000 FIRE RETARDANT PLYWOOD
(Second Revision)

1. Scope—Covers the fire retardant chemicals, method of treatment, retentions and requirements of fire retardant plywood.

2. Types

2.1. Flame Retardants—Flame retardant chemicals used for treatments of plywood shall generally be the following—

- Type 1 Ammonium phosphate
- Type 2 Boron compounds
- Type 3 Ammonium sulphate
- Type 4 Combination of ammonium phosphate and boron compounds
- Type 5 Combination of ammonium sulphate and ammonium phosphate

2.2 Where flame retardant treatment and preservative treatment are required together, the types of chemical and their retention, shall be as given IS 12120 : 1987⁺

3. Preparation of Plywood for Treatment—Plywood shall conform to BWR grade of IS 303:1989† and shall have a moisture content of not exceeding 15 percent.

4. Fire Retardant Treatment—Type of treatment shall be either of the two below :

- a) Pressure impregnation, and
- b) Soaking treatment

5. Conditioning after Treatment—Plywood after treatment shall be conditioned to suitable equilibrium moisture content of not more than 20 percent.

6. Dimensions and Tolerances—The dimensions and tolerance of fire retardant plywood shall conform IS 12049 : 1987[‡]

7. Workmanship and Finish—The finished plywood shall be reasonably clean to handle and free of dirt and stain other than any uniform colour of the flame retardant solution.

8. Tests Requirement

8.1. Moisture Content—Shall not exceed 20 percent

8.2 Flammability—The time taken for the second ignition shall not be less than 30 minutes.

8.3 Flame Penetration—Time taken for flame penetration shall not be less than 15 minutes for every 6 mm thickness.

8.4 Rate of Burning—The time taken to lose weight from 30 percent to 70 percent shall not be less than 20 minutes.

8.5 Other Tests—Glue shear strength in dry state mycological test, water resistance test and any other mechanical property as per IS 303 : 1989.

[‡] Dimensions and tolerances relating to wood based panel materials.

[†] Plywood for general purposes (and revision).

* Code of practice for preservation of plywood and other panel products.

† Plywood for general purposes (*third revision*)

Note — For method of test refer IS 1734. (Part 1) : 1983 Method of test for plywood – Part 1– 1983. Determination of density and moisture content (*second revision*) Methods of test for plywood. Part 3 – 1983. Determination of fire resistance (*second revision*)

For detailed information, refer to IS : 5509-1980. Specification for fire retardant plywood.(first revision)

SUMMARY OF

IS 5539 : 1969 PRESERVATIVE TREATED PLYWOOD

1. Scope – Treatment of plywood for protection against fungi, termites and other insects and marine borers and requirements of preservatives treated plywood.

2. Type of Preservatives

- Type 1 (Oil Type)* – Coal tar creosote with or without admixture with various grades of petroleum and other oils having high boiling point.
- Type 2 (Organic Solvent Type)* – Copper/zinc naphthenate, trichlorophenol, Lindane.
- Type 3 (Water Soluble Non- fixing Type)* – Zinc chloride, boric acid, borax, sodium fluoride and sodium pentachlorophenate.
- Type 4 (Water Soluble 'Fixed' Type)* – Copper-chrome arsenic composition, acid Copper chrome composition, chromated zinc chloride and copper chrome boric composition.

3. Preparation of Plywood for Treatment – Plywood for preservative treatment shall have moisture content not exceeding 16 percent and shall have been bonded with water resistant glue of BWR type.

4. Choice of Treatment – This is governed by the timber species in the plywood, sapwood content and use after treatment. Recommended practice on choice of preservative and amount of absorption and service conditions is given in Table 1.

Note – For information regarding natural durability and degree of treatability of different species of timber see Appendix B of the standard.

5. Modes of Treatment

- By pressure impregnation after manufacture.
- By soaking or surface application after manufacture.
- By treatment of dry or wet veneers before assembly.

6. Conditioning – Plywood after treatment shall be conditioned to a moisture content of not more than 14 percent for interior use and 18 percent for exterior uses. If the plywood is to be painted subsequently the moisture content shall be between 6 and 14 percent.

TABLE 1 RECOMMENDED PRACTICE FOR PRESERVATIVE TREATMENT OF PLYWOOD FOR VARIOUS CONDITIONS

<i>Sl. No</i>	<i>Service Conditions for Treated Plywood</i>	<i>Timber used in Plywood According to Relevant Indian Standard on Plywood Required to be Treated</i>	<i>Type of Preservative Recommended</i>	<i>Mode of Treatment Recommended</i>	<i>Minimum Retention kg/m³</i>
(1)	(2)	(3)	(4)	(5)	(6)
i)	Plywood in direct contact with water or ground and required to be painted as for pontoons, boats, rafts, tugs, fence posts, box, columns, etc (IS 710 : 1976*)	All	Type 4 (Copper chrome-arsenic composition or acid- copper-chorme composition)	Pressure process Veneer treatment	12.0 12.0
ii)	Plywood in direct contact with water or ground and required to be painted as for pontoons,, boats, rafts, tugs, fence posts, box columns, etc (IS 710 : 1976) but plywood not requiring light painting or only back coal tar base (IS 710 : 1976)	All	a) Type 4(Copper chrome-arsenic composition or acid-copper chrome composition) b) Type 1 [Creosote or creosote fuel oil mixture (50 : 50)]	Pressure process Pressure process	12.0 100.0

* Marine plywood (*first revision*)

<i>Sl No</i>	<i>Service Conditions for Treated Plywood</i>	<i>Timber used in plywood According to Relevant Indian Standard on Plywood Required to be Treated</i>	<i>Type of Preservative Recommended</i>	<i>Mode of Treatment Recommended</i>	<i>Minimum Retention</i>
(1)	(2)	(3)	(4)	(5)	(6)
iii)	Marine structures exposed to marine borer danger (IS : 710 -1976) +	All	Type 1[Creosote or creosote fuel oil mixture (50:50)]	Pressure process	200.0
iv)	Concrete shuttering plywood (IS : 4990 -1993†)	All	Type 4 (Copper-chrome arsenic composition or acid-copper-chrome-composition)	Pressure process	12.0
v)	Wood for outer cladding of houses, roofing, bunkers and shelters, and in other conditions exposed to rain, sun and outer weather but requiring paintin (IS 303: 1989*) (BWR Grade)	All	Type 4 (Copper-chrome arsenic composition or acid-copper-chrome composition)	Veneer treatment	12.0
vi)	Plywood for outer cladding of houses, roofing bunkers and shelters, and in other conditions exposed to rain, sun and outer weather but requiring painting, but paint and colour not important (IS 303 :1989 BWR Grade)	All	Type 1 [Creosote or creosote fuel oil mixture (50:50)]	Pressure process	100.0
vii)	Plywood for bus flooring or rail coach flooring (IS : 303 : 1989 BWR Grade)	All	Type 4 (Copper-chrome-arsenic composition or acid-copper -chrome composition) or Type 1 [Creosote or creosote fuel oil mixture (50:50)]	Pressure process	7.5.0
viii)	Plywood not in direct contact with ground or water but exposed and of given paint or varnish regularly as in plywood used for rail coach ceilings partitioning and other interior use, bus interior, ammunition boxes, exterior doors, etc.(IS 303:1989) BWR Grade	All timbers except when only heart-wood durable timber is used.	Type 4(Copper-chrome-arsenic composition or acid-copper-chrome composition) or Type 2	Pressure or soaking	75.0 5.5 4.5
ix)	Decorative panelling on rail coaches and ship building(IS 303 : 1989) BWR Grade)	do	Type 2 or Type 3 not colour imparting or soaking	Pressure process	4.0
x)	Plywood for internal uses in dry localities, such as inner partitions, panelling, wall boarding, ceiling and furniture	do	Type 2 or Type 3 or Type 4	Pressure process or soaking	4.0

(IS 303 : 1989 and IS 1328 : 1996)@

* Marine plywood (*first revision*).

† Plywood for concrete shuttering work.(*second revision*).

* Plywood for general purpose (*third revision*).

@ Veenerd decorative plywood (*third revision*).

Note—For information regarding natural durability and degree of treatability of different species of timber see Appendix B of the standard.

For detailed information, refer to IS 5539 : 1969 Specification for preservative treated plywood.

SUMMARY OF

IS 7316 : 1974 DECORATIVE PLYWOOD USING PLURALITY OF VENEER FOR DECORATIVE FACES

1. Scope – Covers decorative plywood with ornamental faces produced by use of plurality of veneers meant for decorative use, such as interior panelling of buildings, buses, ships, etc. and for decorative furniture of all types.

2. Material

2.1 Timber – Shall be according to IS 303 : 1989*. Non durable timbers and sapwood of all other timber shall be given a preservative treatment.

2.2 Adhesive – Synthetic resin adhesive BWR or WMR.

2.3 Plywood – When used, shall be BWR or WWR synthetic resin bonded type.

3. Permissible Defects—Open splits, checks or open joints not more than 150 mm long and 0.5 mm wide, provided the same are rectified with a matching veneer insert bonded with BWR or WWR adhesive. Decorative veneered surface shall be free from torn grain, dote, worm hole, discolouration or other visual defects.

4. Standard Dimensions

Length	240, 210, 180, 150, 120 and 90 cm
Width	120 and 90 mm
Thickness	3, 4, 6, 9, 12, 19, and 25 mm

5. Tolerances

Length up to 120 cm	+3 mm –0 mm
Length over 120 cm	+6 mm –0 mm
Width up to 90 cm	+3 mm –0 mm
Width above 90 cm	+6 mm –0 mm

Thickness = + 0.2 mm +5 percent of nominal thickness
= – 0.1 mm +2.5 percent of nominal thickness

Rectangular panels shall have their diagonal length not varying beyond 9mm

6. Finish – Trimmed square and sanded to a smooth finish.

7. Tests

7.1 Moisture Content— Not less than 5 percent and not more than 15 percent .

7.2 Water Resistance Test— Shall not show delamination or blister formation

*Plywood for general purposes (*third revision*)

Note — For method of test refer to the standard and IS1734 (Part 1) 1983 Method tests for plywood Part 1 Determination of density and moisture content (*second revision*).

For detailed information, refer to IS 7316 : 1974 Specification of decorative plywood using plurality of veneers for decorative faces.

SUMMARY OF IS 10701 : 1983 STRUCTURAL PLYWOOD

1. Scope – Requirements of plywood for structural purposes, such as stressed skin panels, plywood web beams, sheathing, silos, rail and ship containers.

2. Materials

2.1 Timber – The species of timber recommended for use shall be from the species mentioned in Appendix A of the standard.

2.2 Adhesive – Shall conform to BWP type specified in IS 848 : 1974*.

3. Plywood – Shall conform to BMP grade in accordance with IS 303 : 1989⁺.

4. Treatment – Shall be given preservative treatment with fixed type of preservatives as per IS 5539 : 1969⁺⁺.

5. Quality Requirements — See Table 1.

6.2. Thickness – Thickness of plywood panels shall be as given below –

No. of Plies	Thickness mm
3	4
5	{ 6 9
7	{ 12 16
9	{ 16 19
11	{ 19 25

6. Dimensions and Tolerances

6.1. Size – Structural plywood panels shall be of

the sizes given below:

240 × 120 cm; 210 × 120 cm; 180 × 120 cm;

240 × 90 cm; 210 × 90 cm; 180 × 90 cm;

* Synthetic resin adhesives for plywood (phenolic and aminoplastic) (*first revision*)

⁺ Plywood for general purposes (*third revision*)

⁺⁺ Preservative treated plywood.

TABLE 1 QUALITY REQUIREMENTS ON VENEERS USED IN MANUFACTURE OF PLYWOOD FOR STRUCTURAL PURPOSES

<i>Requirements</i>			
Sl. No.	Defects	Face	Core
i)	Blister	Nil	Nil
ii)	Checks	Nil	No restriction
iii)	Discolouration	3 percent of the area if it will not impair the board properties.	6 percent of the area if it will not impair the board properties.
iv)	Dote	Nil	5 cm/m ²
v)	Insect holes	Nil	No restriction
vi)	Knots (dead)	Nil	2 up to 12mm dia/m ²
	Pin knots (dead)	Nil	2/m ²
	Pin knots (live)	Permitted provided they do not mar the appearance	No restriction
	Knots (tight)	3 up to 25 mm dia/m ²	6 up to 25 mm dia/ m ²
vii)	Split on each panel	One split not more than 0.8 mm wide and length 50mm provided it is filled with suitable filler.	2 splits not more than 6 mm wide and length 200 mm provided it is filled with suitable filler.
viii)	Swirl	Up to 4/m ² provided they do not mar the appearance.	No restriction.

6.3. Tolerance—The tolerances on the nominal sizes of finished panels shall be as given below:

Length	± 6 mm
	– 0 mm
Width	± 3 mm
	– 0 mm
Thickness up to and excluding 6 mm	±10 percent
6 to 9 mm	
Above 9 mm	
	±7 percent
	±5 percent

7. Workmanship and Finish—The faces of plywood panels shall be smooth.

8. Tests

8.1 Moisture Content— Shall not be less than 5 percent and not more than 15 percent.

8.2 Glue Shear Strength in Dry State— See Table 2

8.3 Resistance to Water—See Table 2

8.4 Resistance to Micro Organism— See Table 2

8.5 Preservation Retention— Shall not be less than 12 kg m³ for water soluble fixed type.

8.6 Tensile strength— See Table 3

TABLE 2 MINIMUM AVERAGE FAILING LOAD AND WOOD FAILURE REQUIREMENTS OF PLYWOOD FOR STRUCTURAL PURPOSES

<i>Dry State</i>		<i>Resistance to Water</i>		<i>Resistance to Micro Organism</i>	
Average Failing Load, N	Average Wood Failure Percent	Average Failing Load, N	Average Wood Failure Percent	Average Failing Load, N	Average Wood Failure Percent
1324 and above	No restriction	981 and above	No restriction	981 and above	No restriction
1226-1323	60	883- 980	60	883- 980	60
1079-1225	80	785- 882	80	785- 882	80
<1079	Panel to be considered as failed irrespective of percentage	<785	Panel to be considered as failed irrespective of percentage	<785	Panel to be considered as failed irrespective of percentage

TABLE 3 MINIMUM STRENGTH REQUIREMENTS OF PLYWOOD FOR STRUCTURAL PURPOSES

Sl. No.	Property	Strength Requirement N/mm ²
i)	Ultimate tensile strength	:
	Along the grain	54
	Across the grain	34
ii)	Compressive strength	:
	Along the grain	34
	Across the grain	29
iii)	Modulus of rupture	:
	Along the grain	49
	Across the grain	29
iv)	Modulus of elasticity	:
	Along the grain	7 355
	Across the grain	3 923
v)	Panel shear strength	125
vi)	Modulus of rigidity	588
vii)	Rolling shear strength	3

Note— For methods of tests refer to various parts of IS 1734. Methods of tests for plywood and all parts of IS 2753 :1991. Methods for estimation of preservatives in treated timber and in treating solutions (*first revision*).

For detailed information, refer to IS 10701:1983 specification for Structural plywood.

SUMMARY OF

IS 13957 : 1994 METAL FACED PLYWOOD

1. Scope – Covers manufacture and requirements of metal faced plywood composite. The scope is limited to the use of galvanized iron sheet or aluminium sheet only, as metal sheet.

2. Materials

2.1 Plywood — Shall be BWR grade conforming to IS 303 : 1989*.

2.2 Galvanised Iron Sheets— Shall conform to IS 277 : 1992⁺⁺.

2.3 Aluminium Sheet — Shall conform to IS 737 : 1986[@].

2.4 Adhesive

2.4.1 Phenol formaldehyde (PF) resin — Phenol formaldehyde resin shall be used for bonding galvanized sheet or aluminium sheet with plywood.

2.4.2 Polyvinyl acetal resin ? Polyvinyl formal or polyvinyl butyral resin shall be used in combination with phenol formaldehyde resin.

3. Dimensions and Tolerances—The dimensions of metal faced plywood boards shall be as given for plywood in IS 12049:1987§.

Thickness of metal faced plywood boards shall be as given in Table 1.

TABLE 1 THICKNESS OF METAL FACED PLYWOOD

Board	Thickness mm
(1)	(2)
3 ply	3, 4, 5, 6
5 Ply	5, 6, 8, 9
7 Ply	9, 12, 15, 16
9 Ply	12, 15, 16, 19
11 Ply	19, 22, 25
Above 11 Ply	As ordered

3.1 Tolerances – The tolerances on the nominal sizes of finished boards shall be as specified in IS 12049:1987.

4. Workmanship and Finish—The metal faced plywood boards shall be of uniform thickness within the tolerance limits specified.

5. Tests

5.1 Bond Quality Test—A specimen shall be considered to have passed the test if :

- No visible delamination has occurred in the glue lines of plywood and if no visible delamination has occurred between the plywood faces and the metal sheet, and
- On forcible separation using a suitable lever, wood fibres are found adhered to the metal sheet uniformly over the entire surface.

5.2 Optional Tests :

- Modulus of elasticity
- Modulus of rupture
- Core shear stress
- Facing stress

⁺⁺ Galvanized steel sheet (plain and corrugated) (fifth revision).

* Plywood for general purposes (third revision).

[@] Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes (third revision)

§ Dimensions and tolerances relating to wood based panel materials.

Note—For method of tests refer to the standard.

For detailed Information, refer to IS 13957 : 1994. Specification for metal faced plywood.

SUMMARY OF
IS 1658 : 1977 FIBRE HARD BOARDS
(Second Revision)

1. Scope – Requirements of fibre hardboards for general purposes. This standard does not cover requirements of insulation boards, wood particle boards (chip boards), and similar boards.

2. Types – Classified according to their method of manufacture, density, mechanical and physical properties:

- a) *Medium hardboard* – Density between 0.35 g/cm³ and 0.8 g/cm³
- b) *Standard hardboard* – Density more than 0.80 g/cm³
- c) *Tempered hardboard* – Hardboard further treated during manufacture to modify their properties.

3. Dimensions and Tolerances—

- a) Thickness (mm)
 - i) Medium hard board 6 8 10 12
 Tolerance(mm) ±0.5 ±0.7 ±0.7 ±0.9
 - ii) Standard hardboard }
 iii) Tempered hardboard } 3 4 5 6 9
 Tolerance (mm) } ±0.4 ±0.4 ±0.4 ±0.5 ±0.7
- b) Width 1.2 m; tolerance ±0.3 mm
- c) Length – 1.2, 1.8, 2.4, 3.0, 3.6, 4.8 and 5.5m; tolerance ±0.5 mm
- d) Boards shall be rectangular and shall have square edges. Difference between lengths of two diagonals shall exceed ±3 mm per metre length of diagonal

4. Requirements

<i>Thickness</i>	<i>Bending Strength (Modulus of Rupture Average)</i>	<i>Water Absorption after 24th immersion Percent</i>
mm	Mpa	Max
a) Medium hardboard		
all thicknesses	6	40
b) Standard hardboard		
3 } 4 }	30	40
5 } 6 } 9 }	30	30
c) Tempered hardboard		
all thickness	50	20

5. Workability and Finish

- a) Hardboards shall not crack, split or chip when drilled, sawed or nailed perpendicular to the surface.
- b) Shall be free from warp.

Note — For method of tests, refer to Appendices A to C of the standard

For detailed information, refer to IS 1658 : 1977 Specification for fibre hardboards (second revision).

SUMMARY OF
IS 1659 : 2004 BLOCK BOARDS
(Fourth Revision)

1. Scope – Essential requirements of commercial and decorative blockboards meant for interior and exterior uses.

2. Grades and Types

2.1 Block boards shall be of the following two grades:

- a) *BWP Grade* – Such block board may be used for bus bodies, railway coaches, prefabricated houses, etc, where it is likely to be exposed to high humidity and for external use.
- b) *MR Grade* – Such block board may be used for interior use such as furniture, partition, panelling, ceiling, etc.

2.2 Each of the grades specified in 4.1 shall be of the following two types.

- a) *Decorative Type* – These are block boards with decorative face veneers on one or both sides for use in high class furniture, panelling, interior decoration, partitions, etc.
- b) *Commercial Type* – These are block boards with veneers of commercial timber on both sides and are used for ordinary furniture, table tops, partitions and panelling to be painted over flooring and seats of bus bodies, railway carriages, etc.

2.3 The grades and types of block boards shall be represented by the symbols given below:

<i>Grade and Type</i>	<i>Symbol</i>
BWP Grade, Decorative type	BWP-DEC
BWP Grade, Commercial type	BWP - COM
MR Grade, Decorative type	MR - DEC
MR Grade, Commercial type	MR - COM

3. Materials

3.1 Timber

3.1.1 Any suitable species of timber may be used for blockboard manufacture. A list of species for

manufacture of blockboard is given in Annex B of the Standard for guidance.

3.1.2 Face Veneers for Decorative Type of Blockboards – The species of timber for the decorative face veneer in decorative type of block board shall be specified by the purchaser while placing the order. The species of timber commonly used for face veneers of decorative type of block boards is given in Annex C of the standard for guidance only.

3.2 Adhesives – The adhesives used for bonding purposes shall be the BWP type conforming to IS 848 for BWP Grade block boards. For MR Grade block board, the adhesives shall be MR type conforming to IS 848.

4. Dimensions and Tolerance

4.1 Thickness – The thickness of blockboards shall be 12, 15, 19, 25, 30, 35, 40, 45 or 50mm.

4.2 Sizes & Tolerances – Shall be as per 7.2 and 7.3 of the standard.

5. Tests

5.1 Dimensional Changes Caused by Humidity – when tested according to Annex E the dimensions shall not change by more than ± 1 mm at relative humidities of 90 percent and 40 percent compared to the dimensions of the specimens conditioned at 65 percent relative humidity. There shall be no delamination at the extreme ranges of humidity and the changes in local planeness measured as d/L shall be as follows:

$$d/L < 1/150$$

where

d = Vertical gap between any two points, and
 L = horizontal distance between these points.

5.2 Resistance to Water

When tested according to the methods specified in 9.2.2.1 and 9.2.2.2 of the standard the block boards shall satisfy the requirements given therein.

5.3 Adhesion of Plies

The adhesion of plies shall be tested as in Annex G of the standard and the fractured surface of the specimen shall show adherent fibres of a 'pass standard'.

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5.4 Mycological Test

MR Grade block board specimens, when tested according to Annex H of the standard shall show no visible signs of separation at the edges.

5.5 Modulus of Rupture and Modulus of Elasticity

The modulus of rupture and modulus of elasticity when tested according to the method given in Annex J of the standard, BWP Grade and MR Grade boards shall have average and minimum individual values as given below:

	<i>BWP</i> <i>Grade</i>	<i>MR</i> <i>Grade</i>
Modulus of rupture, N/mm ² :		
Average	50	40
Minimum, individual	42	34
Modulus of elasticity, N/mm ² :		
Average	5 000	4 000
Minimum individual	4 200	3 400

5.6 Spot Test

The preservative treatment when tested according to the method given in Annex K, at any given place after cutting across entire cross-sectional area for the width of block board shall show through and through penetration of preservative chemical.

+ Synthetic resin adhesives for plywood (phenolic and aminoplastic (*first revision*)).

Note — For test procedures *see* Appendices D to K of the standard and IS 1734 (Part 11): 1983 Methods of test for plywood, Part 11 Determination of static bending strength (*second revision*)

For detailed information, refer to IS 1659 : 2004 Specification for Blockboard (*fourth revision*).

SUMMARY OF
IS 3087 : 1985 WOOD PARTICLE BOARDS (MEDIUM DENSITY)
FOR GENERAL PURPOSES
(First Revision)

1. Scope— Requirements of medium density wood particle boards for general purposes, having specific gravity in the range 0.5 to 0.9. This standard does not cover veneered particle boards, moulded particle boards, high and low density particle boards or particle boards faced by impregnated paper surfaces.

2. Classes and Grades

2.1 *The particle boards shall be of the following classes :*

<i>Class</i>	<i>Grade</i>	<i>Designation</i>
Flat pressed, single layers	—	FPS
Flat pressed, three layer, } multilayer and }	1	FPT-1
graded	II	FPT-2
Extrusion } pressed solid }	—	XPS
Extrusion pressed, tubular	—	XPT

3. Materials

3.1 Any species of wood or any other ligno-cellulosic material may be used in the manufacture of particle board.

3.2 Adhesive —Any suitable type of synthetic resin conforming to IS 848:1974* may be used. However, for flat-pressed three layer, multilayer and graded boards of Grade I, BWR or BWP type adhesive should be used.

* Synthetic resin adhesives for plywood (Phenolic and aminoplastic) *(first revision)*

3.3 Sizing Material— Paraffin wax dissolved in mineral spirit or alternatively emulsified with water or melted shall be used as sizing material.

4. Dimensions and tolerances

4.1 The sizes of wood particle boards in mm shall be as follows :

Length —	4850	(4800),	3650	3600),
	<u>3000</u> ,	2750	(<u>2700</u>),	<u>2400</u> ,
	<u>2100</u> ,	<u>1800</u> ,	<u>1500</u> ,	<u>1200</u> ,
	1000	and	<u>900</u>	
Width —	1850,	<u>1800</u> ,	<u>1500</u> ,	<u>1200</u> ,
	1000,	<u>900</u> ,	<u>600</u> ,	and
	450			

Note— Values which are underlined are multiples of the 300 mm module for building boards.

4.2 Thickness — The thickness of particle boards shall be as given below—6, 9, 12, 15, 18, 19, 22, 25, 27, 30, 35 and 40 mm

4.3 Dimensional Tolerance

<i>Dimensions</i>	<i>Tolerance</i>	
a) Length : for all lengths	± 8 mm	
b) Width : for all width	± 8 mm	
c) thickness : Above 25 mm	± 2.5 per.	
	up to and	± 5 per.
	including 25 mm	

The lengths of two diagonals of a rectangular panel shall not differ by more than 2.5 mm. The edge of the board shall be straight with a tolerance of 3 mm.

5. Physical, Mechanical Properties — See Table 1

TABLE 1 PHYSICAL AND MECHANICAL PROPERTIES OF VARIOUS TYPES OF PARTICLES
BOARDS

S.I. No.	Properties	Flat Presses Single Layer	Flat Presses Three Layers multi Layers & Graded		Extrusion Pressed Solid (XPS)	Extrusion Pressed Tubular (XPT)
			Grade 1	Grade 2		
	(1)	(2)	(3)	(4)	(5)	(6)
1.1	Density variation	±10	±10	±10	±10	±10
1.2	Water absorption percent, 2 h soaking 24 h soaking	25 50	10 20	40 80	40 80	40 80
1.3	a) Linear expansion (Swelling in water) percent 2 h soaking i) Length ii) Width b) Thickness swelling percent 2 h soaking	0.5 0.5 10	0.5 0.5 8	0.5 0.5 12	2 0.5 5	2 0.5 5
1.4	Swelling due to surface absorption percent,	9	6	9	4	4
1.5	Modulus of rupture, N/mm ² up to 20 mm thickness above 20 mm thickness	11 11	15.0 12.5	11 11	2 2	1 1
1.6	Tensile strength perpendicular to surface, N/mm ² up to 20 mm thickness above 20 mm thickness	0.8 0.8	0.45 0.40	0.3 0.3	1.2 1.2	0.4 0.4
1.7	Tensile Strength perpendicular to surface N/mm ² *a) After cycle test †b) Accelerated water resistance test	-- --	0.2 0.15	-- --	-- --	-- --
1.8	Screw withdrawal strength, N Face Edge	1250 850	1250 850	1250 700	-- --	-- --

* Cyclic test: specimens are immersed in water at 27± 2°C for a period of 72 h, followed by drying in air at 27± 2°C for 24h and then heating dry air at 70°C for 72h. Three such cycles are to be followed, and then the specimens are tested for tensile strength perpendicular to surface.

† Accelerated water resistance test- Specimens are immersed in water at 27± 2°C and water is brought to boiling and kept at boiling temperature for 2 h. Specimens are then cooled in water to 27 ±2°C and then tested for tensile strength perpendicular to surface.

6. Physical Characteristics

6.1 *Density* – Between 500 and 900 kg

6.2 *Moisture Content* – Between 5 and 15 percent.

6.3 See Table 1 for other tests.

6.4 *Workability* – The particle boards shall not crack or split when drilled, sawed and nailed perpendicular to the surface.

7. **Preservative Treatment** – A suitable preservative may be added to the particle mix at the time of rinsing of the adhesive. The following percentages of preservatives are regarded as suitable :

- a) *Sodium pentachlorophenate* – 1 percent on the basis of oven dry weight of particles, or
- b) *Trichlorophenol* – 5 percent on the basis of resin adhesive mix.

Note — For methods of tests, refer to various parts of IS 2380 : 1977 Methods of tests for wood particle boards and boards from other lignocellulosic materials. (first revision)

For detailed Information, refer to IS 3087 : 1985 Specification for wood particle boards (medium density) for general purposes (first revision).

SUMMARY OF
IS 3097 : 1980 VENEERED PARTICLE BOARDS
(First Revision)

1. Scope – Requirements, such as, grades and types, material, manufacture, dimensions and tests for veneered particle boards.

2. Grades and Types – Shall be of two grades, namely, Grade I and Grade II

2.1 Each grade of veneered particle board shall be of the following four types :

- a) *Type 1* — Solid core, general purpose (boards with faces of veneer of general purpose type).
- b) *Type 2* — Solid core, decorative (boards with solid core but faced with ornamental veneers on one or both sides).
- c) *Type 3* — Tubular core, general purpose boards with tubular core and faced with veneer of general purpose type).
- d) *Type 4* — Tubular core, decorative (boards with tubular core faced with decorative veneers on one or both sides).

2.2 Designation —The grades and types shall be designated as follows :

<i>Sl .Grade No.</i>	<i>Type</i>	<i>Designation</i>
1. Grade I	Solid core, general purpose	SO GP - I
2. Grade I	Solid core, decorative	SO D - I
3. Grade I	Tubular core, general purpose	TU GP - I
4. Grade I	Tubular core, decorative	TU D - I
5. Grade II	Solid core, general purpose	SO GP- II
6. Grade II	Solid core, decorative	SO D - II
7. Grade II	Tubular core, general purpose	TU GP - II
8. Grade II	Tubular core, decorative	TU D - II

3. Material

- a) Particle boards shall be of medium density.

- b) Veneers for cross-band and faces shall be either sawn or rotary cut or sliced and shall be smooth

- c) Adhesive used for bonding veneers shall be BWP or BWR for Grade I boards and MR for Grade II boards.

4. Finish — All boards shall be flat and squarely cut. Both faces shall be sanded to a smooth even surface.

5. Dimensions and Tolerances

- a) Length — 480, 365, 300, 270, 240, 210, 180, 150, 120, 100 and 90 cm.

Tolerance ± 5 mm up to 150cm and ± 10 mm above 150 cm.

- b) Width — 180, 150, 120, 100, 90 and 45 cm.
Tolerance same as for length.

- c) Thickness — 6, 10, 12, 20, 25, 30, 40, 45 and 50 mm
Tolerance ± 1 mm.

- d) Length of two diagonals shall not differ by more than 2.5 mm.

- e) Edges shall be straight with a maximum deviation of 3 mm.

Note — Other thickness or sizes may be manufactured on special demand as specified by the manufacturer.

6. Tests

6.1 Density —Density of each specimen shall not vary from mean density by more than ± 10 percent.

6.2 Moisture Content — Average value shall be between 7 to 16 percent.

6.3 Water Absorption — Value shall not exceed 25 percent for 2 h soaking and 50 percent for 20 h soaking.

6.4 Water Resistance Test — Boards shall not show signs of disintegration and /or shall not delaminate.

6.5 Swelling in Water —Swelling in thickness in percentage of original thickness shall not be more than 7 percent due to general absorption and this shall be not be more than 5 percent in case of swelling due to

surface absorption.

6.6 Adhesion of Plies – Adhesion of face veneers to the board core shall offer appreciable resistance and the exposed surface of veneer shall show sizes of some adherent fibres distributed more or less uniformly.

6.7 Static Bending Strength – (Maximum Transverse Strength or Modulus of Rupture in Bending) - Average value of modulus of rupture shall not be less than 300 kg/cm²

6.8 Deflection Under Sustained Load (Long Time Loading Test) — The deflection under load and residual deflection after removal of load shall be as agreed to mutually.

Note—For test procedure, refer to the standard and various parts of IS 2380 : 1977 Method of test for wood particle boards and boards from other lignocellulosic materials (*first revision*).

For detailed information, refer to IS 3097 : 1980 Specification for veneered particle boards (first revision).

SUMMARY OF
IS 3129 : 1985 LOW DENSITY PARTICLE BOARDS
(First Revision)

1. Scope—Essential requirements of low density particle boards having specific gravity not exceeding 0.4

2. Material

2.1 Timber and Other Ligno-Cellulosic Material — Timber and other ligno-cellulosic material like bagasse, solapith, jute sticks, rice husk, pea-nut shells, etc, may be used for the manufacture of these boards. These shall be light weight materials of bulk density preferably not exceeding 400 kg/m³ and shall be free from extraneous matter and dust.

2.2 Adhesive— Shall be BWR or BWP type conforming to IS 848 : 1974*, and shall be either a phenol-formaldehyde or urea-formaldehyde type fortified with melamine.

3. Dimensions and Tolerances

3.1 *The sizes of insulation particle boards shall be as given below :*

Length in mm : 3 650, 3 000, 2 700, 2 400,
2 100, 1 800, 1 500, 1 200, 1 000,
900, 600, 450, and 300

Width in mm : 1 800, 1 500, 1 200, 1 000, 900,
600, 450 and 300

3.2. Thickness—The thickness of insulation particle boards in mm shall be 50, 45, 40, 30, 27, 25, 22, 19, 16 and 12.

3.3. Tolerances:

<i>Dimension</i>	<i>Nominal Size</i>	<i>Tolerance</i>
Length	for all lengths	± 8 mm
Width	for all width	± 8 mm
Thickness	above 25 mm	± 1 mm
	up to and including 25 mm	± 0.8 mm

4. Preservative Treatment—A suitable preservative may be added to the particle mix at the time of rinsing of adhesive.

a) *Sodium pentachlorophenate*— 1 percent on the basis of oven dry weight of particles or

b) *Trichlorophenol* – 5 percent on the basis of resin adhesive mix.

4.1 Sizing Material – A suitable sizing material like paraffin wax or wax emulsion with not exceeding 1.5 percent of the oven dry weight of the particles. Suitable fire retardant chemicals like mono or diammonium phosphate, tri-sodium phosphate, borax or boric acid shall be added to the particle mix at the manufacturing stage or alternatively the board shall be coated or painted on their surface and edges with fire retardant formulations or both the treatment given at their respective stages so that the board meets the requirements given in Table 1.

5. Finish – The surface of the boards may be plain, embossed with design or perforated. It may be treated or coated with fire-retardant composition and should be able to take a coat of oil distemper or plastic emulsion paint.

6. Physical Properties

6.1 Water Absorption — There shall be no splitting of edges and no signs of disintegration of board when tested as per standard.

6.2 See Table 1— for other tests.

* Synthetic resin adhesives for plywood (phenolic and aminoplastic) *(first revision.)*

TABLE 1 PHYSICAL REQUIREMENTS OF LOW DENSITY PARTICLES BOARDS

<i>Maximum Minimum Density Resistance</i>	<i>Maximum Variation kg/m³</i>	<i>Maximum Moisture In Density</i>	<i>Maximum Modulus Content</i>	<i>Maximum Swelling Of Rupture Surface Absorption*</i>	<i>Maximum Thermal Due to</i>	<i>Minimum Sound Absorption† Conductivity Frequency</i>	<i>Absorption coefficient</i>	<i>Fire Ignitability</i>	<i>Surface spread of flame</i>
(1)	(2) Percent	(3) Percent	(4) N/mm ²	(5) Percent	(6) kcal. cm/cm ² h°C	(7) Hz 1250.05 250	(8)	(9)	(10)
400	±10	16	1.5	5	5.6	500	0.2	Not easily Ignitable 'p'	Not lower than class 2
						1000	0.3		
						2000	0.5		

* On two hours immersion.

† For boards of 12 mm thickness.

Note —For test procedure, refer to the standard and various parts of IS 2380:1977. Method of test for wood particle boards and boards from other lignocellulosic materials (*first revision*)

For detailed information, refer to IS 3129 : 1985. Specification for low density particle boards (*first revision*)

SUMMARY OF
IS 3308 : 1981 WOOD WOOL BUILDING SLABS
(First Revision)

1. Scope – Requirements regarding dimensions, weight and strength for wood wool building slabs.

2. Types

- a) *Type 1*– Light weight slabs, intended for non-load bearing partitions, ceilings, wall linings, permanent shuttering and roof insulation.
- b) *Type 2*– Heavy duty slabs, intended for load bearing situations and for use in roof construction.

3. Form and Texture – Slabs shall be uniform thickness with rectangular parallel faces and shall have clean reasonable square edges and shall be of uniform texture.

4. Dimensions, Weights and Tolerances

<i>Length</i>	<i>Width</i>	<i>Type</i>	<i>Thickness</i>	<i>Weight of the slab, max</i>
mm	mm		mm	kg
2000	500	1	12	5
			20	8
			25	11
			40	12.5
			50	16
2000	500	2	75	22
			100	27.5
			40	25.0
			50	30.0
			75	40.0
1220	610	1	12	3.5
			20	6
			25	8
			40	9.5
			50	12
1220	610	2	75	16
			100	20
			40	18.5
			50	22
			75	30

4.1 Tolerances

In length : ± 6 mm
 In width : ± 4 mm and
 In thickness : ± 2 mm

Deviation from rectangular shape not more, than 5 mm

5. Requirements

5.1 Deflection Under Test Load— shall not exceed the following—

<i>Type</i>	<i>Size</i>	<i>Thick-ness</i>	<i>Test Load</i>	<i>Test Span</i>	<i>Deflection (Max)</i>
	mm × mm	mm	kg	mm	mm
1	2000×500	25	100	45	6
	1220×610	25	165	27.5	6
	2000×500	40	90	75	6
	1220×610	50	90	75	6
		75	120	75	5
		100	150	75	5
2	2000×500	40	120	75	6
	1220×610	50	160	75	6
		75	240	75	5

5.2 Thermal Conductivity — Shall not exceed 0.08 W/m²K

5.3 Sound Absorption

<i>Frequency Hertz</i>	<i>Minimum Sound Absorption Coefficient for 25 mm Thickness with Rigid Backing</i>
125	0.1
250	0.2
500	0.2
1000	0.3
2000	0.5
4000	0.5

Note— For test procedures, refer to Appendix B of the standard, IS 3346 : 1980 Method for the determination of thermal conductivity of thermal insulation materials (Two slab, guarded hot-plate method) (*first revision*) and IS 8225 : 1987 Method of measurement of sound absorption in a reverberation room (*first revision*).

For detailed information, refer to IS 3308 : 1981 Specification for wood wool building slabs (first revision).

SUMMARY OF

IS 3348 : 1965 FIBRE INSULATION BOARD

1. Scope – Requirements for insulating boards made of wood or sugarcane fibre. It also covers the following special types of fibre insulation boards

2. Dimensions and Tolerances:

- a) Bitumen – Bonded fibre insulating board, and
b) Flame – Retardant treated fibre insulating board.

Type of Board	Nominal Thickness mm	Tolerance on Thickness mm	Length cm	Width cm
Fibre insulation board, ordinary or flame retardant type	9 12 18 25	± 0.75 ± 0.75 ± 1.00 ± 1.25	365,300 270,240 210,180 150,120	180,150 120,100 90,60 45and
Bitumen bonded fibre Insulation board,	9 12 18 25	± 0.50 ± 0.50 ± 0.75 ± 0.75	100, 90 60, 45 and 30	30
Tolerance on length and width	± 3 mm upto 120cm and ± 6 mm above 120cm			

3. Requirements

3.1 Density — Shall not exceed 0.4g/cm³

3.2 Transverse Strength

Type of Board	Thickness mm	Mean Breaking Load min, kg	Approximate Modulus of Rupture for Nominal Thickness, kg/cm ²
Fibre insulation board ordinary or flame retardant type	9 12 18 25	7.2 12.8 23 44	20 20 16 16
Bitumen Bonded fibre insulation board	9 12 18 25	13 23 45 86	38 38 32 32

3.3 Water Absorption

Type of Board water	Nominal Thickness mm	Mean Absorption at 27± 2°C Max
Fibre insulation board ordinary or flame retardant type	9 12 18 25	30 30 25 25
Bitumen- bonded fibre insulation board	9 12 18 25	25 25 20 20

3.4 Thermal Conductivity – shall not exceed 5.6 K cal.cm/m² h°C..

3.5 Sound Absorption - Frequency, c/s 125, 250, 500, 1000, 2000 Absorption Coefficient, Min 0.1, 0.1, 0.2, 0.3, 0.5

4. Special Requirement for Flame Retardant Boards— Average maximum area of char, when tested for surface spread of flame, shall not exceed 75cm².

Note — For test procedures, refer to Appendices A to E of the standard

For detailed information, refer to IS 3348 : 1965 Specification for fibre insulation boards.

SUMMARY OF

IS 3478 : 1966 HIGH DENSITY WOOD PARTICLE BOARDS

1. Scope—Requirements of high density wood particle boards in flat sheet or moulded forms.

2. Types—(Depending on Synthetic Resin Used) and Grades (depending on extent of resin content)

Type1 — BWR type of resin—Grades A and B.

Type2 — MR type of resin —Grades A and B.

Each type and grade may be in flat sheet form or moulded form.

3. Materials

3.1 Timber — Any suitable species.

3.2 Adhesive —As in 2. In grade A resin content is 20 to 50 percent and in grade B, 8 to 12 percent

3.3 Sizing — Paraffin wax up to 1 percent, *Max.*

4. Dimension and Tolerances for Flat Sheet—

a) Length— 180, 150, 120, 100, 90, 60 and 45 cm

b) Width— 150, 120, 100, 90, and 45 cm.

c) Thickness— 50, 45, 40, 35, 30, 25, 22, 20, 16, 12, 9 mm and 4 mm.

d) Tolerance— Length and width, ± 6 mm

Thickness ± 5 percent up to 25 mm., ± 2.5 percent above 25 mm. Length of diagonals of a board shall not differ by more than 2.5 mm/m length of diagonal. Edge shall be straight with tolerance of 3 mm.

5. Physical Requirements — Shall be as specified in table given below:

Type	Grade	Density	Moisture Content	Minimum Modulus of Rupture	Minimum Tensile Strength	Water Absorption After 24 h Immersion	Resistance to Boiling Water After 3h Immersion
		g/cm ³	percent	kg/cm ²	kg/cm ²	percent,max	
Type 1	Grade A	1.2	3 to 7	450	350	10	shall not show any sign of delamination
	Grade B	0.9 Min	5 to 6	400	300	25	
	Grade A	1.2	5 to 10	300	225	15	Not specified
Type 2	Grade B	0.9 Min	5 to 16	250	200	25	
Maximum Permissible Variation in Individual Specimen				—	—	—	
from the Mean		Max +10 Percent	Max+2 Percent				

Note —For test procedures, refer to various parts of IS 2380 : 1997 Methods of test for wood particle boards and boards from other lignocellulosic materials (*first revision*) and 9.3 of the standard.

For detailed information, refer to IS 3478 :1966 Specification for high density wood particle board

SUMMARY OF

IS 12406 : 2003 MEDIUM DENSITY FIBRE BOARDS FOR GENERAL PURPOSES

1. Scope — Requirements of medium density fibre boards for general purposes having density in the range of 600 – 900 kg/m³. This standard does not cover veneered or laminated or other specially treated boards, moulded boards, etc.

2. Types—Medium density fibreboards for general purpose shall be of one type only, that is flat pressed single layer. It may, however, be of two grades, designated as follows—

<i>Grade</i>	<i>Designation</i>
<i>Solid board Grade-1</i>	<i>SBF-I</i>
<i>Solid board Grade-2</i>	<i>SBG-II</i>

3. Materials

3.1 Wood —Any species of wood or any other lignocellulosic material may be used

3.2 Adhesive—Any suitable type of synthetic resin adhesive be used. For the purpose of bonding to comply with physical and mechanical requirements given in Table 1.

3.3 Sizing Material—Paraffin wax dissolved in mineral spirit, or alternatively emulsified with water, or melted shall be used as sizing material.

⁺ Synthetic resin adhesives for plywood (phenolic and aminoplastic) (*first revision*).

4. Finish — Medium density fibre board shall be flat and of uniform thickness and density throughout the length and width of the boards. Both surfaces of the boards shall be sanded to a smooth finish.

5. Dimensions and Tolerances — The boards shall be rectangular and, unless otherwise specified, shall have square edges. The lengths of the two diagonals of the board shall not differ by more than ±3 mm per metre length of the diagonal.

a) *Thickness* — The thickness of medium density fibreboard shall be as given below— 6, 9, 12, 15, 18, 22, 25, 30, 35, 40 mm the tolerance on thickness shall be ±0.3 mm

b) *Width and Length*—Unless otherwise specified, the width and length of medium density fibreboard shall be as given below—

a) Width — 1.22 m

b) Length — 5.49, 4.89, 3.66, 3.05, 2.44, 1.83, 1.22m

Any other dimensions as agreed to between the purchaser and the manufacturer may be used. Tolerance on length and width shall be ±3 mm /m.

TABLE 1 PHYSICAL AND MECHANICAL REQUIREMENTS OF MEDIUM DENSITY FIBRE BOARDS

Sl. No.	Properties	Grade II (SBG II)	Grade I (SBG I)
(1)	(2)	(3)	(4)
i)	Density (Kg/m ³)	600–900	600–900
ii)	Variation from mean density, percent	± 10	± 10
iii)	Moisture content, percent	5–10	5–10
iv)	Variation from mean moisture content percent (absolute)	± 3	± 3
v)	Water absorption percent, Max		
	a) After 2 h soaking	9	6
	b) After 24 h soaking:		
	Up to and including 6 mm thick	45	30
	7 to 12 mm thick	30	20
	13 to 19 mm thick	20	13
	20 mm thick and above	18	12
vi)	Linear expansion (swelling in water) percent, Max		
	a) Due to general absorption after 24 h soaking:		
	Thickness	7	4
	Length	0.4	0.3
	Width	0.4	0.
	b) Due to surface absorption (in thickness) after 2 h soaking	5	4
vii)	Modulus of rupture, N/mm ²		
	a) Up to 20 mm thickness:		
	Average	28	28
	Minimum individual	25	25
	b) Above 20 mm thickness:		
	Average	25	25
	Minimum individual	22	22
viii)	Modulus of elasticity, N/mm ²		
	a) Up to 20 mm thickness:		
	Average	2 800	2 800
	Minimum individual	2 300	2 300
	b) Above 20 mm thickness:		
	Average	2 500	2 500
	Minimum individual	2 300	2 300
ix)	Internal bond, N/mm ²		
	a) Up to 20 mm thickness:		
	Average	0.8	0.9
	Minimum individual	0.7	0.8
	b) Above 20 mm thickness:		
	Average	0.7	0.8
	Minimum individual	0.6	0.7
x)	Internal bond, N/mm ²		
	a) After cyclic test		
	Average	—	0.45
	Minimum individual	—	0.4
	b) After accelerated water resistance test		
	Average	—	0.30
	Minimum individual	—	0.25
xi)	Screw withdrawal strength (Min).N		
	a) F Ace	1 500	1 500
	b) Edge (for thickness 12 mm)	1 250	1 250

Cyclic test – Specimens are immersed in water at $27 \pm 2^\circ\text{C}$ for a period of 72 h, followed by drying in air at $27 \pm 2^\circ\text{C}$ for 24 h and then heating in dry air at 70°C for 72 h. These such cycles are to be followed and then the specimens are tested for internal bond strength.

Accelerated water resistance test – Specimens are immersed in water $27 \pm 2^\circ\text{C}$ and water is brought to boiling and kept at boiling temperature for 2 hours. Specimens are then cooled in water $27 \pm 2^\circ\text{C}$ and then tested for internal bond strength.

SUMMARY OF

IS 12823 : 1990 WOOD PRODUCTS-PRELAMINATED PARTICLES BOARDS

1. Scope – Requirement of prelaminated particle boards for general purpose and also for special applications.

2. Grades and Types—Prelaminated particle boards shall be of two grades, namely, Grade I and Grade II corresponding to IS 3087 : 1985⁺.

2.1 Each of the grades shall be of four types, namely, Type I, II, III and IV. Classified by surface abrasion characteristics specified in Table 1.

2.2 The grades and types shall represented by the symbols.

<i>Grade and Type</i>	<i>Designation</i>
Grade I – Type I	PLB-11
Type II	PLB-12
Type III	PLB-13
Type IV	PLB-14
Grade II – Type I	PLB-21
Type II	PLB-22
Type III	PLB-23
Type IV	PLB-24

3. Materials

3.1 Particle Board – Synthetic resin bonded flat pressed three layer or multi-layer or graded particle boards conforming to IS 3087 : 1985⁺ shall be used.

3.2 Impregnated Base Paper — Printed or plain coloured absorbent base paper having a weight of 60-140 g/m² impregnated in a suitable synthetic resin and dried to a volatile content of 4-8 percent shall be used.

⁺ Wood particle boards (medium density) for general purposes (first revision).

3.3 Impregnated Overlay—An absorbent tissue paper having a weight of 18-40 g/m² impregnated in a suitable synthetic resin and dried to a volatile content of 4-8 percent.

4. Finish —The finish of the paper overlaid board depends on the surface of caul plates used.

5. Dimensions and Tolerances —Dimensions and tolerances shall conform to IS 12049:1987.*

6. Tests

6.1 Density — 500 to 900 kg/m³

6.2 Moisture Content — 5 to 15 percent

6.3 Resistance to Steam – Shall not show any sign of blister, delamination or change in surface finish. There may be slight colour change in dark colours/ patterns.

6.4 Crack Resistance – Shall not show any sign of cracks or delamination.

6.5 Resistance to cigarette Burn — shall not leave any mark or stain on the specimen after cleaning with water or solvent.

6.6 Resistance to Stain — Shall not leave any stain on the specimen after cleaning with water, solvent or detergent.

6.7 For Other Tests —See Table 1.

7. Physical and Mechanical Properties – See Table 1.

* Dimensions and tolerances relating to wood based panel materials

TABLE 1 PHYSICAL AND MECHANICAL PROPERTIES

Properties	Flat, Pressed three layers, Multilayer and Graded	
	Grade I ±10	Grade II ±10
i) Density variation <i>Max</i> , percent		
ii) absorption, <i>Max</i> , percent		
a) 2 hours	7.0	15.0
b) 24 hours	15.0	30.0
iii) Thickness swelling, <i>Max</i> , percent,		
a) 2 hours	5.0	8.0
iv) Modulus of rupture, <i>Min</i> , N/mm ² —		
a) Up to 20 mm thickness	15.0	11.0
b) Above 20 mm thickness	12.5	11.0
v) Tensile strength perpendicular to surface, <i>Min</i> , N/mm ² —		
a) Up to 20 mm thickness	0.45	0.3
b) Above 20 mm thickness	0.4	0.3
vi) Tensile strength perpendicular to surface, <i>Min</i> , N/mm ²		
a) After cyclic test	0.2	—
b) After accelerated water resistance test	0.15	—
vii) Screw withdrawal strength, <i>Min</i> , N:		
a) Face	1250	1250
b) Edge	850	750
viii) Abrasion resistance, <i>Min</i> in number of revolutions—		
a) Type I	1000	1000
b) Type II	450	450
c) Type III	250	250
d) Type IV	75	75

Note— For method of test, refer to the standard and various parts of IS 2380 : 1977 Methods of test for wood particle boards and boards from other lignocellulosic materials (*first revision*).

For detailed Information, refer to IS 12823 : 1990 Specification for wood products- prelaminated particle boards

SUMMARY OF

IS 14276 : 1995 CEMENT BONDED PARTICLE BOARDS

1. Scope – Requirements of cement bonded wood particle boards. This standard does not cover particle boards bonded with synthetic resin adhesives.

2. Materials – Species of wood which do not hinder the process of setting of cement shall be used. Suitable additives such as sodium silicate conforming to IS 381 : 1995* and aluminium sulphate conforming to IS 260 : 1969⁺ shall be used to prevent inhibitive effect of setting of cement when other species are used. Cement conforming to IS 8112 : 1989⁺⁺ shall be used.

3. Finish

The particle boards shall be of uniform thickness and density throughout the length and width of the boards. All particle boards shall be flat and smooth.

4. Dimensions and Tolerances – The sizes of cement bonded particle boards shall be as follows :

Length	3050 mm and 2440 mm
Width	1220 mm

Thickness—The thickness of cement bonded particle boards shall be as given below

6, 8, 10, 12, 16, 20, 25, 30 and 40 mm.

Tolerances – The following tolerances for the dimensions shall be permitted:

<i>Length</i>	± 5 mm
<i>Width</i>	± 5 mm
<i>Thickness</i>	
i) <i>Unsanded boards</i>	
6 mm to 12 mm	± 1 mm
12 mm to 20 mm	± 1.5 mm
20 mm and more	± 2 mm
ii) <i>Sanded boards</i>	
For all thickness)	± 0.3 mm
Edge straightness	2 mm per 1000 mm
Squareness	2 mm per 1000 mm

⁺ Aluminium sulphate, non-ferric (*first revision*)

^{*} Sodium silicate (*second revision*).

⁺⁺ 43 Grade ordinary portland cement (*first revision*).

5. Physical characteristics : See Table 1

TABLE REQUIREMENT OF PHYSICAL AND MECHANICAL PROPERTIES FOR CEMENT BONDED PARTICLE BOARDS

SL. No	PROPERTY	REQUIREMENT
i)	Density <i>Min</i> kg/ m ³	1250
ii)	Moisture content, percent	6 to 12
iii)	Water absorption, <i>Max</i> , percent	
	2 h Soaking	13
	24 h Soaking	25
iv)	Swelling in Water <i>Max</i> , percent (after 2 h soaking)	
	a) Thickness	2.0
	b) Length	0.5
	c) Width	0.5
v)	Modulus of rupture, <i>Min</i> , N/mm ²	
	Dry condition	9
	Wet condition	5.5
vi)	Modulus of elasticity, <i>Min</i> , N/mm ²	3 000
vii)	Tensile strength Perpendicular to surface, <i>Min</i> , N/mm ²	
	a) Dry	0.4
	b) Accelerated ageing	0.25
viii)	Screw withdrawal strength, <i>Min</i> , N	
	Face	1250
	Edge	850
ix)	pH	11 to 13

For detailed information, refer to IS 14276 : 1995 Specification for cement bonded particle board.

SUMMARY OF

IS 14587 : 1998 PRE-LAMINATED MEDIUM DENSITY FIBRE BOARD

1. Scope – Requirement of prelaminated medium density fibre board for general purposes and also for special applications.

2. Grades and Types – Based on surface abrasion characteristics. The grades and types of prelaminated medium density fibre boards shall be represented by symbols as follows :

	<i>Grade and Type</i>	<i>Designation</i>
Grade I	Type I	PLMDF-11
	Type II	PLMDF-12
	Type III	PLMDF-13
	Type IV	PLMDF-14
Grade II	Type I	PLMDF-21
	Type II	PLMDF-22
	Type III	PLMDF-23
	Type IV	PLMDF-24

3. Materials

3.1 Medium Density Fibre Board —Synthetic resin bonded medium density fibre board shall conform to

IS 12406 : 1988⁺

3.2 Impregnated Base Paper – Printed or plain colour absorbant basepaper having a weight of 60-140 g/m² impregnated in a suitable synthetic resin and dried to a volatile content of 4-8 percent shall be used:

3. Impregnated Overlay – An absorbant tissue paper having a weight of 18-40 g/m² impregnated in a suitable synthetic resin and dried to a volatile content of 4-8 percent, shall be used.

4. Finish — The finish of the paper overlaid board depends on the surface of caul plates used. .

5. Dimensions and Tolerances —Dimensions and tolerances shall conform to IS 12049 : 1987⁺⁺

6. Physical and Mechanical Properties—see Table 1.

⁺ Medium density fibre boards for general purposes.

⁺⁺Dimensions and tolerances relating to wood based panel material

TABLE 1 PHYSICAL AND MECHANICAL PROPERTIES

<i>PROPERTY</i>		<i>REQUIREMENT</i>	
		Grade I	Grade II
1.1	Density variation <i>Max</i> , percent	±10	±10
1.2	Water absorption <i>Max</i> , percent:		
	a) 2 hours	6	9
	b) 24 hours	12	18
1.3	Thickness swelling <i>Max</i> , percent, 2 hours	4	7
1.4	Modulus of rupture <i>Min</i> , N/mm ² :		
	a) Up to 20mm thickness	28	28
	b) Above 20mm thickness	25	25
1.5	Tensile strength perpendicular to surface <i>Min</i> , N/mm ² :		
	a) Up to 20mm thickness	0.8	0.7
	b) Above 20mm thickness	0.7	0.6
1.6	Tensile strength perpendicular to surface <i>Min</i> , N/mm ² :		
	a) After cyclic test	0.4	—
	b) After accelerated water resistance test	0.25	—
1.7	Screw withdrawal strength (<i>Min</i>), N:		
	a) Face	1500	1500
	b) Edge	1250	1250
1.8	Abrasion resistance (<i>Min</i>) in number of revolutions:		
	a) Type I	1000	1000
	b) Type II	450	450
	c) Type III	250	250
	d) Type IV	75	75

6.1 Density – 500 to 900 kg/m³

6.2 Moisture Content – 5 to 15 percent.

6.3 Resistance to Steam — Shall not show any sign of blister, delamination or change in surface finish. There may be slight colour change in dark colour/patterns.

6.4 Crack Resistance – Shall not show any sign of cracks or delamination.

6.5 Resistance to Cigarette Burn — Shall not leave any mark or stain on the specimen after cleaning with water or solvent.

6.6 Resistance to Stain — Shall not leave any stain on the specimen after cleaning with water, solvent or detergent.

6.7 For Other Tests – See Table 1

Note: For methods of tests, refer to various parts of IS 2380 : 1977 Methods of tests for wood particle boards and boards from other lignocellulosic materials (*first revision*).

For detailed Information, refer to IS 14587:1998 Specification for prelaminated medium density fibre board.

SUMMARY OF

IS 3513 (PART 1) 1989 : RESIN TREATED COMPRESSED WOOD LAMINATES (COMPREGS) PART 1 – FOR ELECTRICAL PURPOSE (First Revision)

1. Scope – Requirements of resin treated compressed wood laminates (compregs) for electrical purposes. This standard does not cover the requirements for solid compressed wood.

2. Types – Compreg for electrical purposes shall be a fully impregnated, high density materials suitable for HV and LV electrical insulation requirements and for certain general mechanical purposes. This grade shall have six types, that is Type I to VI

a) Type I – In this type, the grain orientation of the constituent veneers shall be substantially tangential to the periphery of the board or the round. The joints in the adjacent layers of laminae shall be staggered. This type is suited for fabrication of large circular rings.

b) Type II – In this type, the grain orientation of the constituent veneers shall be more than 75 percent in the direction of the major mechanical stress. Every fourth veneer comprising this type shall have its grain direction at right angle to the grain direction of adjacent three veneers which will have their grains in the same direction. This arrangement is specially suitable for tensile links.

c) Type III – In this type, the grain orientation of the constituent veneers shall be approximately equal in all radial directions. This type shall have each successive lamination angularly disposed in relation to the adjacent one. This type is suited for fabrication of gears, chucks and wheels.

d) Type IV – In this type, the grain orientation of constituent veneers shall be oriented mainly at 45° to the load axis. This

arrangement is suitable for parts under high voltage stress with limited clearances.

e) Type V – In this type, the grain orientation of the constituent veneers shall be in the direction of the axis of load. This type is suitable for parts subject to tensile stress and is thus suited for fabrication of sticks, flats, rods, turned parts and threading.

f) Type VI – In this type, the grain orientation of the constituent veneers shall be more or less equal in each axis, at right angles to each other. This type is of high compressive strength in the direction of its thickness and is also rigid. It is suited for sheet and block forms.

3. Timber Material – Any non-resinous species of timber can be used for the manufacture of veneers required for making compreg.

3.1 Synthetic Resins – The synthetic resins used for impregnation and bonding of veneers shall be of thermosetting phenol or cresol formaldehyde type and shall generally conform to IS 848 : 1974.

3.2 Solvents – Denatured spirit conforming to IS 324 : 1959* or any suitable solvent conforming to its Indian Standard Specifications,

3.3 Varnishes – Insulating oils and varnishes used for treating compreg boards and the machined components of compreg shall conform to IS 10026 (Part 3/ Sec 1 to 7) : 1983.**

* Synthetic resin adhesives for plywood (Phenolic and amino plastic) (first revision) –

+ Ordinary denatured spirit (revised).

** Insulating varnishes containing solvents, Part 3 For Individual materials.

4. Dimensions and Tolerances

4.1 Size – The stock sizes for compreg boards shall generally be the following :

mm		mm		mm		mm
2100	×	1200		1200	×	300
2100	×	900		1200	×	150
1800	×	1200		900	×	900
1800	×	900		900	×	600
1500	×	1200		900	×	300
1500	×	900		900	×	150
1500	×	600		600	×	600
1500	×	300		600	×	300
1500	×	150		600	×	150
1200	×	1200				
1200	×	600				

4.2 Thickness – The preferred thickness of compreg boards shall be 3, 4.5, 6, 8, 12, 16, 20, 25, 32, 40, 50, 60 and 70 mm

4.3 Tolerances – The following tolerances on the nominal size of finished compreg boards shall be permissible :

Dimension		Tolerances
a) Length	:	+6 mm – 0 mm
b) Width	:	+3 mm – 0 mm
c) Thickness		
less than 6 mm	:	±10 percent
6 mm and above	:	±5 percent

4.4 Rods – The sizes for round rods of compreg shall generally be the following :

Length	Diameter
1500	8 to 50
1200	3 to 50
900	50 to 80
600	6 to 40

The tolerance on diameters for compreg rods shall be as follows :

Rods up to and including	
40 mm dia	+ 0 mm – 0.20 mm
Rods 50 mm dia and above	+ 0.00 mm – 0.25 mm

5. Physical and Mechanical Properties

5.1 Physical Properties – See Table 1

TABLE 1 PHYSICA PROPERTIES OF COMPREGS

S. No.	Property	Requirement
i)	Specific gravity	1.25 <i>Min</i>
ii)	Moisture content and volatile matter	4 percent, <i>Max</i>
iii)	Water absorption at 27± 20°C	1.2 percent, <i>Max</i>
iv)	Sporadic working temperature	90°C, <i>Max</i>

5.2 Electrical Properties – See Table 2. In case of electrical components, the following further test requirements shall be complied with :

- All components shall stand a minimum flashover voltage of 4 KV per cm length between cylindrical electrodes.
- The varnished components for electrical grades shall have a minimum tracking time of 20 minutes.

5.3. Mechanical Properties – See Table 3

6. Workmanship and Finish — Shall be free from checks, splits, blisters, discoloration, overlaps, gaps and open joints and the boards shall be free from warp.

TABLE 2 – ELECTRICAL PROPERTIES OF COMPREG FOR ELECTRICAL PURPOSE (ALL TYPES)

SNo.	Test	Requirement
i)	Insulation resistance after immersion in water at 27±2°C	– 10 Megohms, <i>Min</i>
ii)	Volume and surface resistivity ohm-cm	– 2-5 × 10 ⁹
iii)	Flatwise electric strength in oil at 90 ± 2°C	– 4KV/mm for 6mm
iv)	Edgewise electric strength in oil at 90°C	– 25k V for 25 mm wide specimen
v)	Power factor (tanδ)	– 0.019 at 50 cycle at 20° C (Typical, not mandatory)
vi)	Comparative tracking index for varnished components	– CTI 100

TABLE 3-MECHANICAL PROPERTIES

Sl. No.	Test	Requirement	
		Type V	Type VI
(1)		(2)	(3)
1.	Minimum tensile strength (MPa)	175	90
2.	Minimum static bending strength (MPa)	195	95
3.	Minimum compressive strength (MPa) (Specimen 20 mm × 20 mm × 20 mm)		
	a) Parallel to laminae	170	120
	b) Perpendicular to laminae	95	185
4.	Minimum shear strength (MPa)		
	a) Parallel to grain and laminae	14	20
	b) Perpendicular to grain and perpendicular to laminae (Flatwise)	60	45
5.	Minimum hardness Rockwell M Scale	70	70
6.	Minimum impact strength (Izod) Unnotched sample (kg.m/m ²)		
	a) Perpendicular to laminae	0.50	0.35
	b) Parallel to laminae	0.30	0.25

Note — For the methods of tests, refer to

- i) IS 1586 :1988 Method of Rockwell hardness test for metallic materials (*second revision*).
- ii) IS 1708 :1986 Methods of testing of small clear specimens of timber (*second revision*).
- iii) IS 1734 (Part 9) : 1983 Method of test for plywood, Part 9 Determination of tensile strength (*second revision*).
- iv) IS 1998 :1962 Method of test for thermosetting synthetic resin bonded laminated sheets.
- v) IS 2259 : 1963 Method of test for determination of insulation resistance of solid insulating material.
- vi) IS 2824 :1975 Method of determining comparative tracking index of solid insulating materials under moist conditions (*first revision*).
- vii) IS 3396 :1979 Method of test for volume and surface resistivities of solid electrical insulating materials (*first revision*).
- viii) IS 3513 (Part 4) :1966 High and medium density wood based laminates, Part 4 sampling and tests.

For detailed information, refer to IS 3513 (Part 1) : 1989 Specification for resin treated compressed wood laminates (compregs) : Part I For electrical purposes (first revision).

SUMMARY OF

IS 3513 (PART 2) 1989 : RESIN TREATED COMPRESSED WOOD LAMINATES (COMPREGS) PART 2 FOR CHEMICAL PURPOSES

(First Revision)

1. Scope – Requirements of resin treated compressed wood laminates (compregs) for use in chemical industry. This standard does not cover the requirements of solid compressed wood.

2. Types

2.1 Compreg for chemical purposes shall be fully impregnated and high density materials suitable for chemical resistant structures and components.

- a) *Type V* – In this type, the grain orientation of the constituent veneers shall be in the direction of the axis of load. This type is suitable for parts subject to tensile stress and is thus suited for fabrication of sticks, flats, rods, turned parts and threading.
- b) *Type VI* – In this type, the grain orientation of the constituent Veneers shall be more or less equal in each axis, at right angles to each other. It is suited for sheet and block forms.

3. Material

3.1 Timber – Any non resinous species of timber may be used for the manufacture of veneers required for making compreg.

3.2 Synthetic Resins – Shall be of phenol or cresol formaldehyde type and shall conform to IS 848 : 1974*.

3.3 Varnishes – Shall conform to IS 524 : 1983⁺ and IS 525 : 1968⁺⁺.

3.4 The thickness of veneers for the manufacture of compreg shall be between 0.7 and 2 mm. The thickness of individual veneers shall not vary beyond ± 5 percent of the average thickness.

* Synthetic resin adhesives for plywood (Phenolic and amino plastic) (first revision).

⁺ Varnish, finishing, exterior, synthetic, air drying (second revision).

⁺⁺ Varnish, finishing, exterior and general purpose (first revision)

4.1 Dimensions and Tolerances

Size – The stock sizes for compreg boards shall generally be the following :

mm		mm		mm		mm
2100	×	1200		1200	×	600
2100	×	900		1200	×	300
1800	×	1200		1200	×	150
1800	×	900		900	×	900
1500	×	1200		900	×	600
1500	×	900		900	×	300
1500	×	600		900	×	150
1500	×	300		600	×	600
1500	×	150		600	×	300
1200	×	1200		600	×	150

4.2 Thickness— The preferred thickness of compreg boards shall be 3, 4, 5, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50, 60 and 70 mm.

4.3 Tolerances—The following tolerances on the nominal size of finished compreg boards shall be permissible.

Dimension	Tolerances
a) Length	+6 mm – 0 mm
b) Width	+3 mm – 0 mm
c) Thickness less than 6 mm 6 mm and above	± 10 percent ± 5 percent

4.3 Rods – The sizes for round rods of compreg shall generally be the following :

Length	Diameter
mm	mm
1500	8 to 50
1200	3 to 50
900	50 to 80
600	6 to 40

The tolerance on diameters for compreg rods shall be as follows :

Up to and including 40 mm dia	:	0 mm – 0.20 mm
50 mm dia and above	:	0 mm – 0.25 mm

5. Physical and Mechanical Properties :**TABLE 1 PHYSICAL PROPERTIES**

<i>S. No.</i>	<i>Test</i>	<i>Requirement</i>
i)	Specific gravity	1.25, <i>Min</i>
ii)	Moisture content and volatile matter	4 Percent, <i>Max</i>
iii)	Water absorption at 27± 2°C	1.2 Per cent, <i>Max</i>
iv)	Sporadic working temperature	90°C, <i>Max</i>

TABLE 2 MECHANICAL REQUIREMENTS

<i>Sl. No.</i>	<i>Test</i>	<i>Requirement</i>	
(1)	(2)	Type V (3)	Type VI (4)
1.	Minimum tensile strength (MPa)	200	100
2.	Minimum static bending strength (MPa)	200	90
3.	Minimum compressive strength (MPa) (Specimen 20 mm × 20 mm × 20 mm)		
	a) Parallel to laminae	100	120
	b) Perpendicular to laminae	70	150
4.	Minimum shear strength (MPa)		
	a) Parallel to grain and laminae (edgewise)	14	20
	b) Perpendicular to grain and perpendicular to lamina e (flatwise)	35	30
5.	Minimum hardness (Rockwell H scale)	70	80
6.	Minimum impact strength (Izod) (Unnotched sample kg.m/cm ²)		
	a) Perpendicular to laminae	-----	0.20
	b) Parallel to laminae	-----	0.50

5.1 Chemical Properties after Chemical Treatment — See Table 3**TABLE 3 PROPERTIES OF CHEMICAL GRADE COMPREG AFTER CHEMICAL TREATMENT**

<i>Strength</i>	<i>Size of Relation mm</i>	<i>Specimen</i>	<i>Chemicals</i>	<i>Minimum Strength Value as percentage of Original</i>
(1)	(2)	(3)	(4)	(5)
Impact	12 x 12 x 64 (uncoated)		{ 20% Sulphuric acid 20% Nitric acid 20% Hydrochloric acid	80 80 75
Bending	Length : 24-30times the thickness Width : 15± 0.5 mm Thickness : thickness of the sheet (up to 10 mm) from which the test specimen is cut reduce the thickness to 10 mm in case of higher thickness		{ 20% Sulphuric acid 20% Nitric acid 20% Hydrochloric acid	70 40 45
Compression	20 × 20 × 20		{ 20% Sulphuric acid 20% Nitric acid 20% Hydrochloric acid	80 70 70

6. Workmanship and Finish— Board shall be free from checks, splits, blisters, discolouration, overlaps, gaps and open joints and the boards shall be free from warp.

Note – For method of tests refer to –

- i) IS 1586 : 1988 Method for Rockwell hardness test for metallic material (*second revision*)
- ii) IS 1708 : 1986 Methods of testing of small clear specimen of Timber (*second revision*)
- iii) IS 1734 (Part 9) : 1983 Methods of test of plywood : Part 9 Determination of tensile strength. (*second revision*)
- iv) IS 1998 : 1962 Method of test for thermosetting synthetic resin bonded laminated sheets.
- v) IS 3513 (Part 4) : 1966 High and medium density wood based laminates (compreg) : Part 4 Sampling and tests.

For detailed information, refer to IS 3513 (Part 2) : 1989. Specification for resin treated compressed wood laminates (compregs) : Part 2 For chemical purposes (first revision).

SUMMARY OF
IS 3513 (PART 3) 1989 : RESIN TREATED COMPRESSED WOOD
LAMINATES (COMPREGS) PART 3 FOR GENERAL PURPOSES
(First Revision)

1. Scope— Requirements of resin treated compressed wood laminates (compregs) for general purposes. This standard does not cover the requirements for solid compressed wood.

2. Grades and Types

2.1 Grades

- a) High density
- b) Medium density

2.1.1. General purpose high density grade (or Grade GH)— This shall be a partially impregnated high density material suitable for textile and jute mills accessories and tools, engineering and general engineering applications. This grade shall have four types, namely, Type II, III, V and VI.

2.1.2 General purpose medium density grade (or Grade GM)—This shall be a partially impregnated medium density material suitable for general purposes. This shall have four types, namely, Type II, III, V and VI

2.2. Types—

a) *Type II*— The grain orientation of the constituent veneers shall be more than 75 percent in the direction of the major mechanical stress. Every fourth veneer comprising this type shall have its grain direction at right angle to the grain direction of adjacent three veneers which will have their grain in the same direction. This arrangement is specially suitable for tensile links where the end fixings are in the form of bolts or rivets located close to the end of the components.

b) *Type III*— In this type, the grain orientation of the constituent veneers shall be approximately equal in all radial

directions. This type shall have each successive lamination angularly disposed in relation to the adjacent one. This type is suited for fabrication of gears, chuck and wheels.

c) *Type IV*— In this type, the grain orientation of the constituent veneers shall be in the direction of the axis of load. This type is suitable for parts subject to tensile stress and is thus suited for fabrication of sticks, flats, rods, turn- parts and threading.

d) *Type V*— In this type, the grain orientation of the constituent veneers shall be more or less equal in each axis, at right angles to each other.

3. Materials

3.1 Timber— Any non-resinous species of timber may be used for the manufacture of veneers required for making compreg.

3.2 Synthetic Resins— Shall be of thermosetting phenol or cresol formaldehyde type and shall generally conform to IS 848 : 1974.*

3.3. Varnishes— Shall conform to IS 524 : 1983[†] and IS 525 : 1968[‡].

4. Dimensions and Tolerances—

4.1 Boards

4.1.1 Sizes— Shall generally be the following :

mm mm mm mm

* Synthetic resin adhesives for plywood (Phenolic and amino plastic) (*first revision*)

† Varnish, finishing, exterior, synthetic, air drying (*second revision*)

‡ Varnish, finishing, exterior and general purpose (*first revision*)

mm		mm		mm		mm
2100	×	1200	×	1200	×	600
2100	×	900	×	1200	×	300
1800	×	1200	×	1200	×	150
1800	×	900	×	900	×	900
1500	×	1200	×	900	×	600
1500	×	900	×	900	×	300
1500	×	600	×	900	×	150
1500	×	300	×	600	×	600
1500	×	150	×	600	×	300
1200	×	1200	×	600	×	150

4.1.2 Thickness—The preferred thickness of compreg boards shall be 3, 4, 5, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50, 60 and 70 mm

4.1.3 Tolerances

<i>Dimension</i>	<i>Tolerances</i>
a) Length	: + 6 mm – 0 mm
b) Width	: + 3 mm – 0 mm
c) Thickness less than 6 mm	: ± 10 Percent
6 mm and above	: ± 5 Percent

4.2 Rods –

4.2.1 The sizes for round rods of compreg shall generally be the following—

Length	Diameter
mm	mm
1500	8 to 50
1200	3 to 50
900	50 to 80
600	6 to 40

4.2.2 The tolerance on diameters for compreg rods shall be as follows :

Rods up to and including 40 mm dia	+0 mm –0.20 mm
Rods 50 mm dia and above	+0. mm –0.25 mm

5. Physical and Mechanical Properties

5.1 Physical Properties — See Table 1

TABLE 1 PHYSICAL PROPERTIES, ALL TYPES

S. No.	Test	Requirement	
(1)	(2)	Grade GH (3)	Grade GM (4)
i)	Specific gravity	1.25 <i>Min</i> 1.35 <i>Max</i>	0.95 <i>Min</i> 1.25 <i>Max</i>
ii)	Moisture content and volatile matter	6-12 percent	6-12 percent

5.2 Mechanical Properties : See Table 2

TABLE 2 MECHANICAL PROPERTIES

<i>SL.No.</i>	<i>TEST</i>	Requirement			
(1)	(2)	Type V GH (3)	Type VI GH (4)	Type V GM (5)	Type VI GM (6)
i.	Tensile strength, MPa, <i>Min</i>	155	90	108	59
ii.	Static bending strength, MPa	145	100	88	59
iii.	Compressive strength, (Specimen 20 mm × 20 mm × 20 mm)				
	a) Parallel to laminate, MPa <i>Min</i>	130	90	55	75
	b) Perpendicular to laminate, MPa, <i>Min</i>	70	160	70	130
iv.	Shear strength (MPa) <i>Min</i>				
	a) Parallel to grain and laminate (edgewise)	14	14	--	--
	b) Perpendicular to grain and perpendicular to lamine (flatwise)	60	45	--	--
v.	Hardness (Rockwell H scale) <i>Min</i>	—	80	--	80
vi.	Impact strength (Unnotched sample), kg. m/cm ² , <i>Min</i>				
	a) Perpendicular to lamine	—	0.3	—	0.2
	b) Parallel to laminae	—	0.5	--	0.5

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6. Workmanship and Finish

6.1 The face and the back of a board shall be free from checks, splits, blisters, discoloration, overlaps, gaps and open joints and the boards shall be free from warp.

Note—For method of tests refer to:

- i) IS 1586 : 1988 Method for rockwell hardness test for metallic material (*second revision*)
- ii) IS 1708 : 1986 Methods of testing of small clear specimen of timber (*second revision*)
- iii) IS 1734 (Part 9) Methods of testing of plywood, Part 9 Determination of tensile strength. (*sssecond revision*)
- iv) IS 1998 : 1962 Method of test for thermosetting synthetic resin bonded laminated sheets.
- v) IS 3513 (Part 4) : Specification for high and medium density wood based laminates (compreg) : Part 4 – Sampling tests.

For detailed information, refer to IS 3513 (Part 3) : 1989 Specification of resin treated compressed wood laminates (compregs) : Part 3 For general purposes (first revision).

SUMMARY OF

IS 14616 : 1999 LAMINATED VENEER LUMBER

1. Scope—Covers laminated veneer lumber (LVL) of density range 0.6 to 0.75 in which most natural structural wood fall. Its applications include all the end uses to which structural wood has been traditionally used, such as, beams, rafters, stringers, joists, posts and framework construction, stiles, rails and frames of doors and windows, vehicle bodies, railways coaches, containers, framework of furniture, cabinets, shelving etc.

2. Terminology

Laminated Veneer Lumber (LVL) — A structural composite made by laminating veneers, 1.5 to 4.2 mm thick, with suitable adhesive and with the grain of veneers in successive layers aligned along the longitudinal (length) dimension of the composite.

3. Materials

3.1 Veneers

3.1.1 Veneers of the required thickness shall be obtained from timber logs grown in plantations outside the natural forest system, such as, rubber wood, silver oak, eucalyptus, poplars, acacias, etc.

3.1.2 Veneers shall be free from knot holes, decayed knots except pin knots, unfilled wider than 3 mm, concentrated borer holes, shakes, objectionable decay or termite attack, except that for the face veneers none of these defects nor cross grain exceeding 1 in 10 shall be permitted. The nominal thickness of all the veneers used shall be identical and uniform within a tolerance of ± 5 percent.

3.2 Adhesive

3.2.1 Only BWP grade adhesive conforming to IS 848 : 1974⁺ shall be used for making LVL.

3.3 Preservatives

3.3.1 Veneers used for LVL shall be given suitable preservative treatment before lamination, with a preservative that is compatible with the adhesive to be used.

⁺ Synthetic resin adhesives for plywood (phenolic and aminoplastic) (*first revision*).

3.3.2 Only fixed type of water soluble preservatives, CCA or CCB, or non-leachable, solvent soluble preservatives as per IS 401 : 1982⁺⁺ shall be used for treating the veneers.

3.3.3 Retentions of preservative shall be as per IS 401 : 1982⁺⁺ depending upon the proposed end use.

4. Dimensions — Dimensions of LVL composite supplied shall be inclusive of margin required for dressing and finishing over and above the size of finished component desired, unless finished components (ready for painting) are ordered.

The margin for dressing and finishing shall not exceed 3 mm in the width and thickness and 12 mm in the length.

5. Permissible defects

<i>Defects</i>	<i>Permissible Limits</i>
Jointing	Not more than 3 mm wide,
Gaps	Provided they are well staggered in their spacing and position between the successive plies.
Slope of	Not exceeding 1 in 10 in
Grain	The face layers.
Tight knot	Three numbers up to 25 mm diameter in one square metre provided they are spaced 300 mm or more apart.
Warp	Not exceeding 1.5 mm per metre length.

6. Requirements :

6.1 Moisture Content —Between 5 to 15 percent.

⁺⁺ Code of practice for preservation of timber (*third revision*).

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6.2 Adhesion of Plies—Adhesion of plies shall be tested by knife test as described in IS 1734 (Part 5) on three specimens each under the following condition—

- a) In the dry state.
- b) After boiling in water for 72 h followed by cooling in water at room temperature, and

- c) After subjecting to attack by micro-organism as per Annex B. of the standard.

Under each condition the fractured specimens shall show some adherent fibres distributed more or less uniformly. Also the test should offer appreciable resistance to the separation of layers.

6.3 Strength — See Table 1.

6.4 Swelling in Water—Maximum 3 percent after 2 h.

TABLE 1 REQUIREMENTS OF LVL

Sl.No	Properties	Requirement
i)	Modulus of rupture (N/mm ²) <i>Min</i>	550
ii)	Modulus of elasticity (N/mm ²) <i>Min</i> ,	7500
iii)	Compressive strength parallel to grain (N/mm ²), <i>Min</i>	35
iv)	Compressive strength perpendicular to grain:	
	a) parallel to laminae (N/mm ²), <i>Min</i>	35
	b) Perpendicular to laminae (N/mm ²), <i>Min</i>	50
v)	Horizontal shear:	
	a) Parallel to grain (N/mm ²) <i>Min</i>	6
	b) Perpendicular to grain (N/mm ²), <i>Min</i>	8
vi)	Tensile strength parallel to grain (N/mm ²), <i>Min</i>	55
vii)	Screw holding power:	
	a) Edge(N), <i>Min</i>	2300
	b) Face (N), <i>Min</i>	2700

Note – For methods of tests, refer to various parts of IS 1734 : 1983 Methods of test for plywood (*second revision*), various parts of IS : 1708 Methods of testing small clear specimens of timber (*second revision*) and IS 2380 : 1977 Methods of tests for wood particle boards and boards from other lignocellulosic materials (*first revision*).

For detailed information, refer to IS 14616 : 1999 Specification for laminated veneer lumber.

SUMMARY OF

IS 13958 : 1994 BAMBOO MAT BOARD FOR GENERAL PURPOSES

1. Scope – Covers the method of manufacture and the requirements of bamboo mat board used for general purposes.

2. Materials

2.1 Bamboo – Any suitable species of bamboo may be used for making bamboo mat board.

2.2 Adhesive – Adhesive for bonding bamboo mat board shall be of phenolic type conforming to BWR type specified in IS848:1974.

3. Dimensions and Tolerances

3.1. The dimension of bamboo mat boards shall be as given for plywood in IS 12049 : 1987⁺. Thickness of bamboo mat boards shall be specified depending upon the number of plies. The thickness shall be measured up to one decimal place of millimetre.

3.2. Tolerances – The following tolerances on the nominal sizes of finished boards shall be permissible

<i>Dimension</i>	<i>Tolerance</i>
a) Length	+6mm – 0mm
b) Width	+3mm – 0mm

- c) Thickness
 - Less than 6 mm ±10 percent
 - 6mm and above ± 5 percent
- d) Squareness 0.2 percent
- e) Edge Straightness 0.2 percent

4. Workmanship and Finish – The bamboo mat boards shall be of uniform thickness within the tolerance limit specified. The faces of bamboo mat boards shall be reasonably smooth and uniform in colour.

5. Tests

5.1 Internal Bond Strength Test

5.1.1 In Dry State – Shall give an average and a minimum individual value of 0.7 N/mm² and 0.5 N/mm² respectively.

5.1.2 In Wet State – Shall give an average and a minimum individual value of 0.5 N/mm² and 0.3 N/mm² respectively.

5.2 Mycological Test – Shall give an average and a minimum individual value of 0.5 N/mm² and of 0.3 N/mm²

5.3 Surface strength Test – (Alternate)

⁺ Synthetic resin adhesives for plywood (phenolic and amino plastic) (*first revision*)

⁺⁺ Dimensions and tolerances relating to wood based panel material

For detailed information, refer to IS 13958 : 1994 Specification for Bamboo mat board for general purposes.

SUMMARY OF

IS 14588 : 1999 BAMBOO MAT-VEENER COMPOSITE FOR GENERAL PURPOSES

1. Scope – Covers the method of manufacture and the requirement of bamboo mat-veneer composites for general purposes.

2. Terminology – Panel manufactured with a combination of bamboo mat and veneer. Bamboo mat can be either as outer skins or core/cross-bands. However, the composite panel shall be balanced construction on either side of central ply.

3. Material

3.1 Bamboo – Any suitable species of bamboo may be used.

3.2 Adhesive – Adhesive for bonding bamboo mat and veneer shall be of phenolic type conforming to BWR type specified in IS 848 : 1974⁺

3.3 Veneer – Any species of timber may be used for manufacture of veneers. However, a list of species is given in Annex B of the standard for guidance.

4. Dimensions and Tolerances

4.1 The dimensions of bamboo mat-veneer composite shall be as given for plywood in IS 12049: 1987⁺⁺

4.2 Thickness of bamboo veneer composites shall be 3.0 mm, 4.0 mm, 6.0 mm, 9.0 mm, 12.0 mm, 15.0 mm, 22.0 mm, and 25.0 mm.

4.4 Tolerances – The following tolerances on the nominal sizes of finished composite boards shall be permissible:

Dimension	Tolerance
a) Length	6 mm
	—0 mm
b) Width	+3 mm
	—0 mm
c) Thickness	
Less than 6.0 mm	±10 percent
6.0 mm and above	±5 percent
d) Squareness 2 mm per	1000 mm
e) Edge straightness 2 mm per	1000 mm

⁺ Synthetic resin adhesives for plywood (phenolic and amino plastic) (*first revision*)

⁺⁺ Dimension and tolerances relating to wood based panel materials

Note – For methods of tests, refer to IS 1734 (Part 4) : 1983. Method of test for plywood : Part 4 Determination of glue shear strength (*second revision*) and IS 2380 : 1977. Methods of tests for wood particle boards and boards from other lignocellulosic materials (*first revision*)

For detailed information, refer to IS 14588 : 1999 Specification for bamboo mat – veneer composite for general purposes.

5. Workmanship and Finish

5.1 The bamboo mat-veneer composite shall be of uniform thickness within the tolerance limit.

5.2 When bamboo mats are used for faces of the composite, the surface shall be reasonably smooth and uniform in colour.

6. Tests

6.1 Glue Shear Strength

6.1.1 In dry state — Shall give an average and individual glue shear strength value of not less than 1350 N and 1100 N respectively

6.1.2 Water resistance — Shall give an average and individual glue shear strength value of not less than 1000 N and 800 N respectively

6.1.3 Mycological — Shall give an average and individual glue shear strength value of not less than 1000 N and 800 N respectively.

6.2 Internal Bond Strength

6.2.1 In dry state — Shall give an average and individual value of not less than 1.5 N/mm² and 1.2 N/mm² respectively.

6.2.2 In wet state — Shall be subjected to attack by micro-organisms as per the method described in Annex C and then tested as per IS : 2380 (Part 5) shall give an average and individual value of not less than 1.2 N/mm² and 0.9 N/mm² respectively.

6.2.3 Mycological — Shall be subjected to attack by micro-organisms as per the method described in Annex C of the standard and then tested as per IS : 2380 (Part 5) shall give an average and individual value of not less than 1.2 N/mm² and 0.9 N/mm² respectively.

6.3 Surface strength test – (Alternate test)

SUMMARY OF

IS 14842 : 2000 COIR VENEER BOARD FOR GENERAL PURPOSES

1. Scope – Covers the method of manufacture and the requirement of coir veneer board (coconut fibre with veneer) for general purposes.

2. Grades – shall be of the following two grades—

- a) Boiling water resistant (BWR) grade and
- b) Moisture resistance (MR) grade.

3. Material

3.1 Coconut Fibre – Coconut fibre layer used in the manufacture of coir veneer board shall be uniform with a minimum of 600 g/m².

3.2 Jute —Jute fibre used in the manufacture of coir veneer board shall be uniform with a minimum of 60 g/m².

3.3 Adhesive – Adhesive for manufacture of coir veneer board shall conform to BWR/MR of IS 848* for BWR/MR grade of boards.

3.4 Veneer – Any species of timber may be used for the manufacture of veneers

3.5 Kraft Paper – Kraft Paper used in the manufacture of coir veneer board shall be uniform with a minimum of 40 g/m².

3.6 Thickness – The thickness of all veneers and minimum grammage of coconut fibre needled felt jute fibre and kraft paper shall be uniform with a tolerance of ± 5 percent

4. Permissible Defects—Gaps in cores and crossbands shall not be permitted. Splits in cores and crossbands may be permitted to an extent of 2 per core or crossband. Overlaps shall be permitted in core/crossbands only.

5 Dimensions and Tolerances— Shall be as prescribed for plywood in IS 12409* Thickness of coir veneer board shall be 3 mm, 4 mm, 5 mm, 6 mm, 9 mm, 12 mm, 16 mm, 18 mm, 20 mm and 25 mm.

The following tolerance on the nominal thickness shall be permissible :

<i>Dimension</i>	<i>Tolerance</i>
a) Less than 6 mm	$\pm 10\%$
b) 6 mm and above	$\pm 5\%$

Note – Any other dimension as agreed to between the manufacturer and the purchaser may be used.

6. Workmanship and Finish—Shall be of uniform thickness and density throughout the length and width of the boards. The squareness and edge straightness of the board shall be as specified in IS 12049.

7. Tests

7.1 Glue Adhesion – Shall be deemed satisfactory if the coir veneer board complies with requirements in Table 1 of the standard for

- a) *Glue shear strength in dry state*
- b) *Mycological test.*
- c) *Water resistant test.*

The minimum of the shear strength individual values specified in Table 1 of the standard

7.2 Moisture Content – Coir veneer board shall have a moisture content not less than 5 percent and not more than 15 percent

Note – For methods of tests, refer to IS 1734 (Part 1) IS 1734 (Part 6) IS 1734 (Part 7) and Annexure C of the standard.

For detailed information, refer to IS 14842 : 2000 Specification for bamboo mat – veneer composite for general purposes.

SUMMARY OF
IS 15476 : 2004 BAMBOO MAT CORRUGATED SHEETS

1. Scope

This standard covers the requirement of bamboo mat corrugated sheets (BMCS) for roofs of industrial, residential, agricultural, commercial and institutional types of buildings.

2. Materials

2.1 Bamboo

Any species of bamboo suitable for mat making may be used for BMCS

2.2 Adhesive

Resin for BMCS shall be phenolic type conforming to BWP grade specified in IS 848. For the outermost layers of mats of BMCS, resin admixed with suitable filler shall be used.

2.3 Preservative

Preservative treatment shall be given by incorporating the suitable preservatives like sodium pentachloro phenate into the resin before soaking the mats to protect against biodegradation.

3. Dimensions and Tolerances

3.1 The sheets shall conform to the dimensions and tolerances given in Table 1 and Fig. 1 of the standard.

3.1.1 Any other dimension as agreed to between the manufacturer and the purchaser may also be used.

4. Finish

4.1 The faces of bamboo mat corrugated sheet shall be reasonably smooth and uniform in colour.

4.2 The cut edge of sheet shall be given a brush coating with a suitable preservative and edge sealed with suitable resin.

5. Tests and Requirements

5.1 Requirements

BMCS shall conform to the requirements given in Table 2 of the standard when tested in accordance with the provision given in col 4 of Table 2.

For detailed information, refer to IS 15476: 2004 Specification for bamboo mat corrugated sheets.

SUMMARY OF

IS 15491 : 2004 MEDIUM DENSITY COIRBOARDS FOR GENERAL PURPOSES

1. Scope

1.1 This standard covers the requirement of medium density coirboards for general purposes having density in the range of 500-900 kg/m³.

1.2 This standard does not cover veneered or laminated or other specially treated boards, moulded boards, etc.

2. Grades

Medium density coirboards for general purpose shall be of three grades, and may be designated as follows:

Grade	Designation
Solid board, grade 1	Grade 1
Solid board, grade 2	Grade 2
Solid board, grade 3	Grade 3

3. Material

3.1 Coir

Coir fibre layer used in the manufacture of medium density coirboards shall be uniform having a minimum mass of 600 g/m². Coir needled felt is manufactured by mechanical inter-loop of coir fleece by use of barb needles to form a non woven felt of different densities.

3.2 Jute

Jute fiber layer or any other finer fiber used in the manufacture of medium density coirboards shall be uniform having a minimum mass of 60 g/m².

3.3 Paper

Paper used in the manufacture of medium density coirboards shall be uniform having a minimum mass of 40 g/m².

3.4 Adhesive

BWR type of synthetic resin adhesive conforming to IS 848 shall be used for the purpose of bonding for Grade 1, Grade 2 and Grade 3 boards to comply with physical and mechanical requirements given in Table 1.

4. Finish

Medium density coirboards shall be uniform in thickness and density throughout the length and width of the boards. All medium density coirboards shall be flat. Both surfaces of the boards shall have smooth finish.

5. Dimensions and Tolerance

5.1 The board shall be rectangular and shall have square edges. The length of the two diagonals of the board shall not differ by more than ± 3 mm/m, length of the diagonal.

5.2 Thickness

Thickness of the medium density coirboards shall be as given below:

3, 4, 6, 8, 9, 12, 15, 1 and 22 mm

Tolerance on thickness shall be ± 0.3 mm up to and including 9 mm and ± 0.6 mm for thickness above 9 mm

5.3 Width and Length

Unless otherwise specified, the width and length of medium density coirboards shall be as given below:

(a) Width – 1.22 m; and

(b) Length – 5.49, 4.89, 3.66, 3.05, 2.44, 1.83 and 1.22 m

Tolerance on length and width shall be ± 0.30 mm/m.

Note: Any other dimension as agreed to between the manufacturer and the purchaser may be used.

6. Physical and Mechanical Requirements

Density, moisture content, water absorption, linear expansion, modulus of elasticity, modulus of rupture, internal bond, screw withdrawal, nail withdrawal and resistance to spread of flame of medium density coirboards, when tested in accordance with 10 and 11 shall the standard shall meet the requirement specified in of the standard Table 1.

Table 1 Physical Land Mechanical Requirements of Medium Density Coirboard

Sl.No. (1)	Properties (2)	Grade 1 (3)	Grade 2 (4)	Grade 3 (5)
i)	Density, kg/m ³	650 – 900	500 – 900	500 – 900
ii)	Variation from mean density percent	± 10	± 10	± 10
iii)	Moisture content, percent	5–15	5–15	5–15
iv)	Variation from mean moisture content, percent absolute			
v)	Water absorption, percent, <i>Max</i>			
	1) After 2 h soaking	6	6	9
	2) After 24 h soaking			
	a) Up to and including 6 mm	30	30	45
	b) 8 - 12 mm	20	20	30
	c) 13 - 19 mm	13	13	20
	d) 20 mm and above	12	12	18
vi)	Linear expansion (swelling in water), percent, <i>Max</i>			
	a) Due to general absorption after 24 h soaking:			
	1) Thickness	4	4	7
	2) Length	0.3	0.3	0.4
	3) Width	0.3	0.3	0.4
	b) Due to surface absorption (in thickness) after 2 h soaking	4	4	5
vii)	Modulus of rupture, <i>Min</i> , N/mm ²			
	1) In dry condition:			
	a) Up to and including 20 mm thickness:			
	1) Average	31	29	29
	2) Minimum individual	27	25	25
	b) Above 20 mm thickness:			
	1) Average	27	25	25
	2) Minimum individual	23	22	22
	2) After 8 h boiling			
	a) Up to and including 20 mm thickness:			
	1) Average	17	NA	NA
	2) Minimum individual	15	NA	NA
	b) Above 20 mm thickness:			
	1) Average	15	NA	NA
	2) Minimum Individual	13	NA	NA
viii)	Modulus of elasticity, N/mm ² .			
	a) Up to and including 12 mm thickness:			
	1) Average	2 800	2 800	2 800
	2) Minimum individual	2 500	2 500	2 500
	b) Above 12 mm thickness			
	1) Average	2 500	2 500	2 500
	2) Minimum individual	2 300	2 300	2 300
ix)	Tensile strength perpendicular to surface (internal bond) <i>Min</i> , N/mm ² .			
	a) Up to and including 20 mm thickness:			
	1) Average	0.9	0.9	0.8
	2) Minimum individual	0.8	0.8	0.7
	b) Above 20 mm thickness:			
	1) Average	0.8	0.8	0.7
	2) Minimum individual	0.7	0.7	0.6
x)	Tensile strength perpendicular to surface (Internal bond) <i>Min</i> , N/mm ² .			
	After accelerated water resistance ¹			
	1) Average	0.45	0.45	-
	2) Minimum individual	0.40	0.40	-

Sl.No. (1)	Properties (2)	Grade 1 (3)	Grade 2 (4)	Grade 3 (5)
xi)	Screw withdrawal strength, N:			
	a) Average	2 300	1 725	1 725
	2) Minimum individual	2 00	1 500	1 500
	b) Edge (for thickness > 12 mm):			
	1) Average	1 700	1 400	1 400
	2) Minimum individual	1 500	1 250	1 250
xii)	Nail holding strength, N			
	a) Face:			
	1) Average	1 400	1 400	1 400
	2) Minimum individual	1 250	1 250	1 250
	b) Edge (for thickness > 12 mm):			
	1) Average	1 400	1 400	1 400
	2) Minimum individual	1 250	1 250	1 250
xiii)	Resistance to spread of flame	To pass the test (Annex C)		

¹ *Accelerated Water Resistance Test* – Specimens are immersed in water at $27 \pm 2^\circ\text{C}$ and water is brought to boiling and kept at boiling temperature for 4 h for Grade 1 and 2 h for Grade 2. Specimens are then cooled in water to $27 \pm 2^\circ\text{C}$ and dried in ambient condition before determining the tensile strength perpendicular to the surface (Internal bond).

SECTION 13

DOORS, WINDOWS AND SHUTTERS

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SUMMARY OF
IS 1003 (PART 1) : 2003 TIMBER PANELLED AND GLAZED
SHUTTERS
PART 1 DOOR SHUTTERS
(Fourth Revision)

1. Scope — Requirements regarding material, sizes, construction, workmanship, finish, inspection and testing of timber door shutters with timber, plywood, blockboard, veneered particle board, asbestos cement sheet, wire gauge and glass panels used in domestic buildings, offices, schools, hospitals, etc. The shutters could be single panelled or multipanelled with or without glazing.

This standard does not cover timber door shutters for industrial and other special buildings, such as, workshops and garages.

2. Timber — Timber suitable for manufacture of door shutters shall be in accordance with IS 12896 : 1990.*

2.1 Timber used for rails and stiles shall be of the same species. The maximum permissible moisture content in timber shall be as specified in IS 287 : 1993[†].

2.2 All timbers shall be kiln-seasoned. Sapwood of durable species and heartwood and sapwood of non-durable species shall be treated with suitable preservative (except the water soluble leachable type), as specified in IS 401‡.

2.3 The timber shall be free from decay, fungal growth, boxed heart, splits, pitch pockets or streaks on the exposed faces.

2.4 The timber shall be graded as First Grade and Second Grade on the basis of the permissible defects in the timber as given in Table 1 of the standard.

Note: For details of material see 5 of the standard.

3. Requirements

3.1 Timber Panelling — No single panel shall exceed 0.5m² in area.

3.2 Plywood Panelling — Shall be of one piece of thickness not less than 9 mm for 2 or more panel construction and 12 mm for single panel construction.

3.3 Blockboard Panelling — Shall be of one piece of

* Permissible moisture content for timber used for different purpose (*Third revision*)

+ Classification of Indian timbers for door and window shutters and frames.

‡Code of Practice for preservation of Timber

thickness 12 mm or more.

3.4 Veneered Particle Board Panelling — Shall be made of one piece of veneered particle board. Thickness shall not be less than 12 mm.

3.5 Asbestos Cement Board Panelling — Shall consist of two or more panels with thickness of each panel not less than 6 mm.

3.6 Medium Density Fibre Board Panelling — Thickness of boards shall not be less than 12 mm.

3.7 Prelaminated Particles Board Panelling — Thickness of boards shall not be less than 12 mm.

3.8 Wire Gauze Panelling — Shall be so designated that no single panel exceeds 0.5 m² in area

3.9 Medium Density Wood Particle Board Panelling — shall be made of one piece of medium density wood particle board. Thickness of boards used shall not be less than 12 mm.

4. Dimensions, Sizes and Tolerances

4.1 Dimensions of Components and Tolerances

Sl. No.	Description	Width mm	Thickness mm
i)	Vertical stile top and freeze rail	100±3	35±1 or 40±1
ii)	Lock rail	150±3	35±1 or 40±1
iii)	Bottom rail	200±3	35±1 or 40±1
iv)	Munting	100±3	35±1 or 40±1
v)	Glazing bar	40±1	35±1 or 40±1

4.2 Dimensions of Door Shutters —

Designation of Doors	Width mm	Height mm
8 DS 20	700	1905 (1945)
8 DS 21	700	2005 (2045)
9 DS 20	800	1905 (1945)
9 DS 21	800	2005 (2045)
10 DS 20	900	1905 (1945)
10 DS 21	900	2005 (2045)
12 DS 20	1100*	1905 (1945)
12 DS 21	1100*	2005 (2045)

* Combined width of double door leaf.

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Note 1 – The designation refers to modular sizes of door openings. First number stands for width and the last for height module (M=100mm); D= Doors, S–Single shutter and T–Double leaf shutters.

Note2 – The standard widths and heights for panel doors are arrived at as shown in Fig. 6 of the standard. In case the modular height is taken from finished floor level, the height of the door shall be given in bracket. In case of double leaf shutters, the rebate in the shutters shall be as given in 6.15 of the standard.

4.3 Tolerances — Tolerances on the sizes of door shutters shall be ± 3 mm.

5 Finish

5.1 All door shutters shall be sanded and finished smooth.

5.2 Panels of shutters shall be flat and well sanded to a smooth and level surface.

5.3 Defective knots, when permitted on surfaces exposed to view shall be completely bored or cut out and tightly plugged with the same timber species and properly glued in. The grains of the plug shall run in direction of the grains of the piece.

5.4 All the surface of door shutters which are required to be painted or polished or varnished ultimately shall be covered initially before delivery by protective coat

of primer polish or varnish. As specified in IS 2338 (Part 1)* and IS 2338 (Part 2)+.

6. Glazing –

6.1 The glass used for panels shall be weighing not less than 10 kg/m² and the thickness shall not be less than 4mm.

7. Tests — Door shutters shall be subjected to following tests as specified :

- (i) Dimensions and defects for squareness
- (ii) General flatness
- (iii) Local planeness
- (iv) Impact intendation
- (v) Flexure
- (vi) Edge loading
- (vii) Shock resistance
- (viii) Buckling
- (ix) Misuse
- (x) Slamming, and
- (xi) Screw withdrawal resistance.

*Code of practice for finishing of wood and wood based materials: Part 1 Operations and workmanship

+ Code of practice for finishing of wood and wood based materials: Part 2 Schedules

For detailed information, refer to IS 1003 (Part 1) : 2003 Specification for timber panelled and glazed shutter: Part1 door shutters (fourth revision).

SUMMARY OF
IS 1003 (PART 2) : 1994 TIMBER PANELLED AND
GLAZED SHUTTERS
PART 2 – WINDOW AND VENTILATOR SHUTTERS
(Third Revision)

1. Scope – Requirements regarding material, sizes, construction, workmanship, finish, inspection and testing of timber window and ventilator shutters with timber, plywood, blockboard, wireguaze and glass panels used in domestic buildings, offices, schools, hospitals, etc. The shutters of windows are usually double leaved depending upon the design of window, which could be single panelled or multipanelled and generally with glazing.

1.1 This standard does not cover timber window and ventilator shutters, shutters for industrial and other special buildings, such as, workshops, factories and garages having elaborate design and being subjected to rough treatment.

2. Timber – Timber suitable for manufacture of window and ventilator shutters shall be in accordance with IS 12896 : 1990*. The maximum permissible moisture content shall be as specified in IS 287 : 1993†. All timbers shall be kiln seasoned. Timber used for rails and stiles shall be of the same species.

Note— For details of materials see 5 of the standard.

3. Requirements

3.1 Timber Panelling — No single panel shall exceed 0.5 m² in area.

3.2 Plywood Panelling — Thickness not less than 9 mm for two or more panel construction and 12 mm for single panel construction.

3.3 Blockboard Panelling — Shall be of one piece of thickness 12 mm or more.

4. Dimensions, Sizes and Tolerances

4.1 Dimensions of components and Tolerances :

Description of Component	Window Width mm	Shutters Thickness mm	Ventilator Width mm	Shutters Thickness mm
Stiles and Rails	80 ± 3	25 ± 1	80 ± 3 30 ± 1	20 ± 1 22.5 ± 1 25 ± 1 7.5 ± 1 30 ± 1
Mounting	60 ± 3	25 ± 1 30 ± 1	60 ± 3	- do -
Glazing bars	40 ± 1	25 ± 1 30 ± 1	40 ± 1	- do -

4.2 Sizes –

a) Window Shutters

Designation (1)	Width (2)	Height (3)
6 WS 12	500	1000
10 WT 12	460	1100
12 WT 12	560	1100
6 WS 13	500	1200
10 WT 13	460	1200
12 WT 13	560	1200

b) Ventilator Shutters

Designation (1)	Width (2)	Height (3)
6 V 6	500	500
10 V 6	900	500
12 V 6	1100	500

Note 1 – Sizes are desired after allowing the thickness of the frame and a margin of 5 mm all round for fitting and fixing into a modular opening based on 100 mm module.

Note 2 – Window and ventilator shutters are designated by symbols denoting the width (number of modules in the width of opening), type (W = window, V = ventilator, S = single shutter, T = double shutter) and height (number of modules in the height of the opening).

* Classification of Indian timbers for doors and windows

† Permissible moisture contents for timber used for different purposes (*third revision*)

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4.3 Tolerances on overall dimensions shall be ± 3 mm.

5. Finish

5.1 Defective knots, when permitted on surfaces exposed to view shall be completely bored or cut out and tightly plugged with the same timber species and properly glued in. The grains of the plug shall run in the direction of the grains of the piece.

5.2 All the surface of shutters which are required to be painted or polished or varnished ultimately shall be covered initially before delivery by protective coat of primer polish or varnish.

6. Tests – Shutters shall be tested for resistance to slamming as per the procedure given in Annex C of the standard. there shall be no visible damage caused in any part of the shutter after 50 drops. This test is not applicable to glazed and wire gauzed panelled shutters.

For detailed information, refer to IS 1003 (Part 2) : 1994 Specification for timber panelled and glazed shutter: Part 2 Window and ventilator shutter (third revision)

SUMMARY OF

IS 1826 : 1961 VENETIAN BLINDS FOR WINDOWS

1. Scope – Covers material, constructional details, sizes and requirements of open head custom made Venetian blinds made of either wood or metal slats.

2. Grades

- a) *Grade 1*
 - i) Shall have aluminium slats,
 - ii) Shall have provision for locking slats or have dual ladder for each slat (so that may not flutter), and
 - iii) Shall be capable of being removed instantaneously.
- b) *Grade 2*
Shall have wooden slats.

3. Materials

3.1 Timber – Wooden slats and rails shall be made from timbers having durability of class I and II timbers as given in IS 399 : 1963.*

3.2 Metal – Aluminium alloy used for rolling of slats shall conform to the prescribed standard.

4. Requirements

- 4.1 Grade 1** – Shall not exceed 500 cm in width and 10 m² in area.
- Grade 2** – Shall not exceed 275 cm in width and 7.5 m² in area.

4.2 Slat Size

4.2.1 Wooden – 48 ± 0.5 mm wide and 2.5 ± 0.3 mm thick.

4.2.2 Aluminium – 48 ± 0.5 mm wide when formed. Thickness of coated aluminium slats shall be 0.254 to 0.375 mm with tolerance of ± 0.004 mm.

Note – For number of slats per blind of different heights (drops) see Table 1 of the standard.

4.3 Tilt Rail – 50 ± 1 mm wide and 20 ± 1 mm thick.

4.4 Tilting Device – Synchronised worm and gear design.

4.5 Cord Lock – Automatic; shall be so designed that the blind can be held at any desired height.

4.6 Cord – Made of cotton yarn, nylon yarn or a combination of cotton and rayon.

5. Finish

5.1 Aluminium Slats – Shall be given a pretreatment and then suitable coats of primer and upper coats of paint which shall be of high gloss and of baked enamel type.

5.2 Wooden Slats and Rails – For finishing one coat of sealer, one coat of primer-surfacer, putty and two coats of paint shall be applied. Paint used shall be of semi-gloss good quality enamel or cellulose paint.

6. Testing

6.1 Aluminium Slats

6.1.1 Physics tests

- a) Tensile strength, *Min* : 3375 kgf/cm²
- b) Yield stress, *Min* : 3100 kgf/cm²
- c) Elongation, *Max* : 2.5 percent.

6.1.2 Salt water test – Shall not show blistering, corrosion, caulking, change of colour and loss of gloss and adhesion.

6.1.3 Cold and hot water test for enamel – Backed enamel finish shall resist soaking in cold water for 48 hours and for 30 minutes in boiling water. The enamel shall not blister and shall recover same hardness after being out of water for 2 hours.

6.1.4 Light test – Shall withstand the prescribed test.

* Classification of commercial timber and their zonal distribution.

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6.1.5 Rigidity test – Slats shall have sufficient flexibility so as to permit a 180° bend around a 7.5 cm dia cyliner without harm or permanenet deformation or injury to finish when released to their original shape.

6.2 Ladder Web

6.2.1 Colour fastness and shrinkage – Face and cross tapes shall have good colour fastness to light and water, and shall not shrink more than 7 percent.

6.2.2 Breaking strength – Face tapes shall have breaking strength of 100 kgf, minimum and cross tapes, a minimum strength of 7 kgf without breaking or tearing away from the face tapes.

6.3 Breaking Strength of Cords – At least 80 kgf.

For detailed information, refer to IS 1826 : 1961. Specification for venetian blinds for windows.

SUMMARY OF

**IS 2191 (PART 1) : 1983 WOODEN FLUSH DOOR SHUTTERS
(CELLULAR AND HOLLOW CORE TYPE)
PART 1 PLYWOOD FACE PANELS
(Fourth Revision)**

1. Scope – Requirements regarding types, sizes, material, construction, workmanship and finish, and tests of cellular and hollow core wooden flush door shutters with face panels of plywood or cross-band and face veneers.

2. Types

Core	Type	Abbreviation
Cellular	Decorative	CD
	Non-decorative	CN
Hollow	Decorative	HD
	Non-decorative	HN

3. Sizes

Designation	Width mm	Height mm
8 DS 20	700	1905 (1945)
8 DS 21	700	2005 (2045)
9 DS 20	800	1905 (1945)
9 DS 21	800	2005 (2045)
10 DS 20	900	1905 (1945)
10 DS 21	900	2005 (2045)
12 DS 20	1100	1905 (1945)
12 DS 21	1100	2005 (2045)

Note 1 – In case the modular height is taken from the finished floor level, the height of the doors shall be the one given in bracket.

Note 2 – In arriving at the standard widths and heights, an allowance has been made of 60 mm for door frames, 40 mm for floor finish and 5 mm clearance all round for the shutter into the frame.

Note 3 – D = Doors, S = Single shutter, and T = Double shutter

Note 4 – The designation indicates the size of door openings. The first number denoting width in modules of 100 mm and the last number, the height in modules.

3.1 Thickness – 25, 30 or 35 mm nominal.

3.2 Tolerances

Nominal width and height	+3 mm -0 mm
Nominal thickness	±1.2 mm

3.2.1. Thickness shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

4. Materials

4.1 Timber – Moisture content shall not be more than 12 percent. For species of timber *see* Appendix A of the standard.

4.1.1 Timber shall be free from decay and insect attack. Knots and knot holes less than half the width of cross section of the members in which they occur may be permitted. Pitch pockets, pitch streaks and harmless pin-holes shall be permissible except in the exposed edges of the core members where they shall be cut out and filled in with carefully fitted glued pieces of wood of similar species and character with their grain running in the same direction.

Note— For details of materials *see* 5 of the standard.

5. Requirements**5.1 Plywood for Face Panels**

Minimum thickness for cellular core shutters – 3mm
Minimum thickness for hollow core shutters for 25 mm thickness – 4 mm.

Minimum thickness for hollow core shutters of other thickness – 6 mm

5.2 Rebating – One third thickness for double leaved shutters.

5.3 Shutters – Shall be shop prepared for taking mortice locks or latches.

6. Workmanship and Finish — All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane.

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6.1 Both faces of door shutter shall be sanded to a smooth even texture. If required by the purchaser, all surfaces of shutters which are required to be painted shall be covered evenly by brush painting with a priming coat or primer. In the case of shutters to be polished or varnished, a priming coat of suitable polish or varnish shall be given before delivery. However, only unpainted doors shall be subjected to the tests.

7. Tests – Shall satisfy the following tests:

7.1 *End Immersion Test*

7.2 *Knife Test*

7.3 *Adhesion Test*

Note : For methods of test, refer to **9** of the standard.

For detailed information, refer to IS 2191 (Part 1) : 1983 Specification for wooden flush door shutters (cellular and hollow core type) : Part 1 Plywood face panels (fourth revision).

SUMMARY OF

IS 2191 (PART 2) : 1983 WOODEN FLUSH DOOR SHUTTERS (CELLULAR AND HOLLOW CORE TYPE)

PART 2 – PARTICLE BOARD AND HARDBOARD FACE PANELS

(Third Revision)

1. Scope – Requirements regarding material, grade, types, sizes, construction, finishes and tests of wooden flush door shutters of cellular and hollow core type with particle board face panels (both veneered and unveneered) and hard board face panels.

2. Types and designation

- | | |
|--|------|
| 2.1 Cellular— | |
| Decorative with skins of decorative veneered particle board. | CDPV |
| Non-decorative with skins of particle boards unveneered | CNP |
| Non-decorative with skins of particle boards veneered with commercial veneers. | CNPV |
| 2.2 Hollow — | |
| Decorative with skins of decorative veneered particle board. | HDPV |
| Non-decorative with skins of particle boards unveneered. | HNP |
| Non-decorative with skins of particle boards veneered with commercial veneers. | HNPV |

3. Sizes and Tolerance – Shall be as given in IS 2191 (Part 1) : 1983.

4. Materials

4.1 Timber – As specified in IS 2191 (Part 1) : 1983

Note : For details of materials see 4 of the standard.

5. Requirements

5.1 Face Panels — Particle board or veneered particle board shall not be less than 6 mm thick for cellular core and not less than 9 mm thick for hollow core shutters. Hardboard thickness shall not be less than 4 mm for cellular core and not less than 6 mm for hollow core shutters.

5.2 Shutter shall be shop-prepared for taking mortice locks or latches.

6. Workmanship and Finish – All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane. Both faces of door shutter shall be sanded to a smooth even texture.

7. Tests — As per 9 of IS 2191 (Part 1) : 1983.

For detailed information, refer to IS 2191 (Part 2) : 1983 Specification for wooden flush door shutters (cellular and hollow core type) : Part 2 Particle board and hard board face panels (third revision).

SUMMARY OF
IS 2202 (PART 1) : 1999 WOODEN FLUSH DOOR SHUTTERS
(SOLID CORE TYPE)
PART 1 PLYWOOD FACE PANELS
(Sixth Revision)

1. Scope – Requirements regarding types, sizes, material, construction, workmanship and finish, and tests, of solid core wooden flush door shutters with face panels of plywood or cross-band and face veneers.

2. Type and Construction

<i>Sl.No.</i>	<i>Core</i>	<i>Type</i>	<i>Abbreviation</i>
(1)	(2)	(3)	(4)
i)	Blockboard	Decorative Non-decorative	BD BN
ii)	Particle board with or without blockboard	Decorative Non-decorative	PD PN
iii)	Medium density fibreboard with or without blockboard	Decorative Non-decorative	MD MN

3. Sizes

<i>Sl. No.</i>	<i>Designation of doors</i>	<i>Width mm</i>	<i>Height mm</i>
i)	8 DS 20	700	1905 (1945)
ii)	8 DS 21	700	2005 (2045)
iii)	9 DS 20	800	1905 (1945)
iv)	9 DS 21	800	2005 (2045)
v)	10 DS 20	900	1905 (1945)
vi)	10 DS 21	900	2005 (2045)
vii)	12 DT 20	1100*	1905 (1945)
viii)	12 DT 21	1100*	2005 (2045)

Note 1 – D–Doors, S – Single shutter, and T– Double leaf shutter.

Note 2 —The designation indicates the size of door openings. the first number referring to width in modules of 100 mm and the last number, the height in modules of 100 mm.

*Combined width of two shutters in closed position.

3.1 Thickness – Nominal thickness shall be 25 mm, 30 mm and 35 mm.

4. Material

4.1 Timber – Moisture content shall not exceed 12 percent. Timber shall be free from decay and insect attack. Knots and knot holes less than half the width of cross section of the members in which they occur may be permitted. Pitch pockets, pitch streaks and harmless pin holes shall be permissible except in the exposed edges of the core members where they shall be cut out and filled in with carefully fitted glued pieces of wood of similar species and character with their grain running in the same direction.

Note 1 – For species of timber *see* Annex B of the standard.

Note 2 – For details of materials *see* 6 of the standard.

Note 3 – In arriving at the standard width and heights for flush door shutters an allowance of 60 mm has been made for door frames 40 mm for floor finish, 5 mm for clearance all round and 15 mm for rebate all round for shutter in to the frame.

Note 4 – If modular height of door opening is taken from finished floor level. The height of flush door shall be the one given in the brackets.

5. Construction

5.1 Face Panels – Thickness of crossbands shall be between 1 mm and 3 mm. Thickness of face veneers shall be between 0.4 mm to 1.5 mm for commercial veneer and 0.35 mm to 1.0 mm for decorative veneers provided the combined thickness of both is not less than 2.2 mm.

5.2 Stiles and Rails – Stiles shall be made with maximum one finger or scarf type joint as per 7.3 of the standard. The rails shall be made without any joint.

5.3 Rebating – Shall be 8 mm to 10 mm in case of double leaved shutters.

Note – for details of materials *see* 7 of the standard.

6. Workmanship and Finish – All the four edges of the door shutter shall be square. Both faces of the door shutter shall be sanded to a smooth even texture.

7. Tests – Flush door shutters shall be subjected to the following tests –

- i) Dimensions and squareness test
- ii) General flatness test
- iii) Local planeness test
- iv) Impact indentation test
- v) Flexure test
- vi) Edge loading test

- vii) Shock resistance test
- viii) Buckling test
- ix) Slamming test
- x) Misuse test
- xi) Varying humidity test
- xii) End immersion test
- xiii) Knife test
- xiv) Glue adhesion test
- xv) Screw withdrawal test.

Note - For details of requirements please refer **11** of the standard.

Note — For methods of test, refer to IS 4020 (Part 1 to 16) : 1998 Door shutters - methods of test.

For detailed information, refer to IS 2202 : 1999 Specification for wooden flush door shutters (solid core type) Part 1 Plywood face panels (sixth revision).

SUMMARY OF

IS 2202 (PART 2) : 1983 WOODEN FLUSH DOOR SHUTTERS
(SOLID CORE TYPE)

PART 2 PARTICLE BOARD AND HARDBOARD FACE PANELS

(Third Revision)

1. Scope – Requirements regarding material, grade, types, sizes, construction, finishes and tests of wooden flush door shutters of solid core type with particle board face panels (both veneered and unveneered) and hard-board face panels.

2. Types and designation

- 2.1 Block board** Decorative with skins of BDPV decorative veneered particle board.
Non-decorative with skins BNP of particle boards unveneered.
Non-decorative with skins BNPV of particle boards veneered with commercial veneers.
- 2.2 Particle Board with or without Blockboard** Decorative with skins of PDPV* decorative veneered particle board.
Non-decorative with skins PNP* of particle boards unveneered.
Non-decorative with skins PNPV* of particle boards veneered with commercial veneers.

* Where particle board beaded core is used, the designations will be PEDPV, PENP and PENPV respectively.

3. Sizes and Tolerance

Designation of Doors	Width mm	Height mm
8 DS 20	700	1905 (1945)
8 DS 21	700	2005 (2045)
9 DS 20	800	1905 (1945)
9 DS 21	800	2005 (2045)
10 DS 20	900	1905 (1945)
10 DS 21	900	2005 (2045)
12 DT 20	1100 ⁺	1905 (1945)
12 DT 21	1100 ⁺	2005 (2045)

Note 1 —D = Doors, S = Single shutter and T = Double shutter.

Note 2— The designation indicates the size of door opening, the first number referring to width in modules of 100 mm and that last number, the height in modules.

Note 3—In case the modular height is taken from the finished floor level, the height of the door shall be the one given in bracket.

For detailed information, refer to IS 2202 (Part 2) : 1983 Specification for wooden flush door shutters (solid core type) : Part 2 Particle board and hard board face panels (third revision).

Note 4 — In arriving at the standard widths and heights, an allowance has been made of 60 mm for door frames, 40 mm for floor finish and 5 mm clearance all round and 15 mm for rebate for the shutter into the frame.

[†] Combined width of two shutters in closed position.

3.1 Thickness —

Flush Door Designation	Thickness of Shutter
8 DS 20 and 8 DS 21	25
9 DS 20 and 9 DS 21	30 or 35
10 DS 20 and 10 DS 21	35
12 DT 20 and 12 DT 21	35

3.2 Tolerances — Tolerances on nominal width and height shall be and the tolerance on nominal thickness

shall be $\frac{+3}{-0} \pm 1.2$ mm. The thickness of the door

shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

4. Materials

4.1 Timber — As per IS 2202 (Part 1) : 1999.

Note— For details of materials see 4 of the standard.

5. Requirements

5.1 Face Panels — Thickness of the face panels of particle board shall be not less than 4 mm and of hardboard not less than 3 mm.

5.2 Locks — Shutters shall be shop-prepared for taking mortice locks or latches.

6. Workmanship and Finish — All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane.

6.1 Both faces of door shutter shall be sanded to a smooth even texture.

7. Tests — Shall satisfy the tests prescribed in the standard.

SUMMARY OF

IS 4021 : 1995 TIMBER DOOR, WINDOW AND VENTILATOR
FRAMES*(Third Revision)*

1. Scope – Requirements regarding material, construction, workmanship and sizes of timber door, window and ventilator frames generally used in residential and institutional buildings.

1.1 This standard does not cover timber door, window and ventilator frames for commercial, industrial and other special buildings, such as, workshops and garages.

2. Timber

2.1 Indian timbers suitable shall be in accordance with IS 12896 : 1990.* For imported timber see Annex B of the standard.

2.2 Moisture Content—Shall be as per IS 287:1993†.

2.3 Seasoning and Treatment – Shall be well seasoned as per IS 1141 : 1993‡. and treated as per IS 401 : 1982§.

2.4 Defects Prohibited – Timber for frames shall be free from decay, fungal growth, boxed heart, splits, pitch pocket or streaks on exposed faces.

2.5 Defects Permitted— Shall be graded as first or

second grade on the basis of permissible defects as given in Table 1 of the standard.

3. Workmanship—All members of frame shall be exactly at right angles. The depth of rebate in frame for housing the shutter shall in all cases be 15 mm except for small window and ventilator frames where it shall be 12 mm.

3.1 Joinery

Frames of timber doors, windows and ventilators shall be assembled by any of the following simple, neat and strong joints:

- Single dovetail joint
- Closed mortice and tenon joint.
- Haunched mortice and tenon joint.

4. Dimensions, Sizes and Tolerances

4.1 Dimensions — See Table 1.

TABLE 1 DIMENSIONS OF DOORS, WINDOWS AND VENTILATORS				
Requirements	Dimensions, mm			
	Door	Window		Ventilator
		Size > 120 cm	< 120 cm	
(1)	(2)	(3)	(4)	(5)
a) Width of frame carrying one set of shutter				
i) For 35, 40 mm shutter	100	100	90	90
ii) For 25, 30 mm shutter	90	90	90	90
b) Width of frame carrying two sets of shutters				
i) For 30, 35 and 40 mm shutter	120	120	120	120
ii) For 25 mm shutter	90	90	90	90
c) Thickness	60	60	50	50

* Classification of Indian timber for door and window shutters and frames.

† Permissible moisture content for timber used for different purposes (*third revision*)

‡ Seasoning of timber (*second revision*)

§ Preservation of timber (*third revision*)

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4.2 Tolerance

+3	mm for width and
—0	
+2	
—3	mm for thickness

4.3 Designation—In the order of width, type and height.

- a) *Width* — It shall be indicated by the number of modules in the width of opening.
- b) *Type* — It shall be indicated by the following letter of alphabet.

D for door
W for window
V for ventilator
S for single shutter
T for double shutter

Note—where a frame is intended to carry two sets of shutters, the frame shall be designated as DD, WW and VV.

- c) *Height*— It shall be indicated by the number of modules in height of opening.

Example —‘12 DT 20’ would mean a frame of double shutter door with a width of 12 modules (119 cm) and height of 20 modules (199 cm).

4.4 Combination of Frames of Doors, windows and Ventilators – When frames of door and windows are

combined with those of windows and ventilators, they shall be designated as illustrated below. However size of frame for such combination shall be uniform for doors, windows and ventilators, by choosing the highest recommended dimension.

Example 1—‘6 WS 12/12 DT 20/6WS 12’ means 12 modules wide and 20 modules high double shutter door frame combined in its two sides with two windows, 6 modules wide and 12 modules high.

Example 2

6 V 6	6 V 6
6 WS 12	6 WS 12

Two single windows of 6 modules wide and 12 modules high combined side by side and with two ventilators at top 6 modules wide and 6 modules high.

5. Finish – The unexposed surfaces in contact with either wall or lintel shall be properly painted with coal tar pitch.

5.1 All surfaces of door, window and ventilator frame which are required to be painted ultimately shall be covered evenly by brush painting with a priming coat of wood primer.

5.2 In the case of frames to be polished or varnished, a priming coat of suitable polish or varnish shall be given.

For detailed information, refer to IS 4021 : 1995 Timber door, window and ventilator frames (third revision)

SUMMARY OF IS 4962 : 1968 WOODEN SIDE SLIDING DOORS

1. Scope — Requirements regarding material, type, shape fabrication, assembly and finish of wooden side sliding doors (of the straight sliding type), its gear components and fittings.

2. Types and Sizes — Classified in accordance with mode of sliding of panels into the frame unit. Types 1 to 5 give clear opening, while Types 6 and 7 need no space at the sides. Overall size of door shall be such as to cover modular opening completely.

Note — For typical arrangement of panels of side sliding door see Fig. 2 of the standard.

3. Materials

3.1 Rolled steel sections shall be of weldable quality conforming to the prescribed standard.

3.2 Tracks — Made of 2 mm thick structural steel sheet, galvanized.

3.3 Roller — Shall conform to the prescribed standard.

3.4 Guides — Gun metal.

3.5 Brackets — Cast iron.

3.6 Shutter — Made of wood in accordance with the prescribed standard.

4. Operation — Shall be capable of being operated in either direction with force not exceeding 3 kg/m of panel width, when panel is in motion.

5. Finish — All components machined and finished smooth. Roller guides, fittings for locking arrangement, brackets, etc may be hot-dip galvanized.

For detailed information, refer to IS 4962 : 1968 Specification for wooden side sliding doors.

SUMMARY OF

IS 6198 : 1992 LEDGED, BRACED AND BATTENED TIMBER DOOR SHUTTERS

(Second Revision)

1. Scope – Requirements regarding material, sizes, construction, workmanship and finish of ledged, braced and battened timber door shutters.

2. Material

2.1 Timber – Suitable for manufacture shall be as per IS 12896 : 1990.* Moisture content shall be between 8 to 14 percent.

2.2 All timbers shall be kiln seasoned. Sapwood of durable species and heartwood and sapwood of non-durable species shall be treated with suitable preservative (except the water soluble leachable type).

2.3 Timber shall be free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, splits and cracks.

2.4 Timber shall be graded as first or second grade as given in Table 1 of the standard on the basis of permissible defects.

3. Designation – Door shutter shall be designated by symbols denoting the width, type and height of door in succession in the following manner :

- a) *Width* – It shall be indicated by the number of modules of 100 mm in the width of door opening.
- b) *Type* – D = Door, S = Single shutter, T = Double leaf shutter.
- c) *Height* – It shall be indicated by the number of modules of 100 mm in the height of door opening.

TABLE 1 DIMENSION OF DOOR SHUTTERS

Designation of Doors	Width mm	Height mm
8 DS 20	700	1905 (1945)
8 DS 21	700	2005 (2045)
9 DS 20	800	1905 (1945)
9 DS 21	800	2005 (2045)
10 DS 20	900	1905 (1945)
10 DS 21	900	2005 (2045)
12 DT 20	1100 ⁺	1905 (1945)
12 DT 21	1100 ⁺	2005 (2045)

* Classification of indian timbers for doors and window shutters and frames.

⁺ Combined width of double leaf shutter in closed position.

Note – In arriving at the standard widths and heights, and allowance has been made of 60 mm for door frames, 40 mm for floor finish and 5 mm clearance all round and 15 mm for rebate all round for the shutter into the frame.

Example – 8 DS 21 would mean a shutter suitable for a single shutter door of 8 module width and 21 module height.

4. Dimension and Tolerances

Description	Width mm	Thickness mm
Top and bottom edges	150±1.5	25±1.5
Middle Ledge	200±1.5	25±1.5
Braces	110 to 125	25±1.5
Battens	140 to 160	25±1.5

(depending upon the width of the shutter)

Tolerances of sizes of door shutter shall be ± 3mm.

5. Workmanship and Finish – All battens of the shutter shall be sanded and finished smooth.

5.1 Defective knots, where permitted in surfaces exposed to view, shall be completely bored or cut out and tightly plugged with cross-grained plug (round or dovetailed) of similar species of timber and shall be properly glued. All the surfaces of door shutters which are required to be painted or polished or varnished ultimately shall be covered initially before delivery by protective coat of primer polish or varnish.

6. Tests

- a) Slamming test,
- b) Shock resistance test,
- c) Edge loading test and
- d) Resistance to buckling test type tests only.

For detailed information, refer to IS 6198 : 1992. Specification for ledged, braced and battened timber door shutters (second revision).

SUMMARY OF

IS 15380 : 2003 MOULDED RAISED HIGH DENSITY FIBRE (HDF) PANEL DOORS

1. Scope – This standard lays down requirements regarding types, sizes, material, construction, workmanship and finish and tests for high density fibre (HDF) panel doors.

2. Types

Door shutters shall be of following two types:

- (a) *Heavy Duty* – having void area less than 35 percent, and
- (b) *Light Duty* – having void area not exceeding 65 percent

3. Size

3.1 Sizes of the door shutters shall generally conform to the sizes given in table 1. Other sizes, that is, width and height, as agreed to between the manufacturer and the purchaser, are also permitted provided they are in modules of 5 mm

3.2 The nominal thickness of the shutters shall be 30 mm, 35 mm and 40 mm

4. Material

4.1 Timber

4.1.1 Any species of timber having minimum bulk density of 450 kg/m³ at 12 percent moisture content may be used for rails, stiles and core fillings of door shutters.

Table 1 Dimensions of Door Shutters

(Clause 5.1)

Sl.No.	Width mm	Height	
		Option 1 mm	Option 2 mm
(1)	(2)	(3)	(4)
i)	700	2 005	–
ii)	700	2 045	2 070
iii)	800	2 045	2 070
iv)	900	2 045	2 070
v)	1 000	2 045	2 070
vi)	1 000	2 045	2 070

4.2 Raised Fibreboard Skin

Raised fibre board skin used in door shutters shall be of minimum thickness 3 mm of phenolic bonded high density fibre board conforming to the requirement given in Table 2.

4.3 Adhesive

Adhesive used for bonding the face skins and core shall be phenol formaldehyde synthetic resin adhesive conforming to BWP grade of IS 848. For details on materials refer 6 of the standard.

5. Fittings

5.1 Locks

Shutters shall be shop prepared for taking any suitable type of locks or latches as may be agreed to between the manufacturer and the purchaser. Shop preparing the door with morticed holes for lock fixing shall be done only when desired by the purchaser.

5.1.1 Other fittings such as pull bolt, etc, shall be provided as agreed to between the purchaser and the manufacturer.

6. Workmanship and finish

6.1 All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane.

6.2 The surface of the shutter shall be pre-rimmed. The shutter may be supplied either in textured or smooth surface finish as agreed to between the purchaser and the manufacturer.

7. Test

7.1 Classification of Tests

7.1.1 Acceptance Tests

The following tests shall constitute product acceptance

- (a) Dimension and squareness test
- (b) General flatness test,
- (c) Local planeness test,
- (d) End immersion test,
- (e) Glue adhesion test, and
- (f) Slamming test

SP 21 : 2005**7.1.2 Type Tests**

The following tests shall constitute product approval type tests:

- (a) Impact indentation test,
- (b) Flexure test
- (c) Edge loading test,
- (e) Shock resistance test:

- 1) Soft and light body impact test,
- 2) Soft and heavy body impact test,
- (f) Misuse test,
- (g) Screw withdrawal resistance test, and
- (h) Varying humidity test.

8. Requirements– For details refer **11** of the standard**TABLE 2 REQUIREMENTS FOR RAISED PANEL FIBREBOARD SKINS**

Sl. No.	Requirements	Permissible Limits	Method of Test
(1)	(2)	(3)	(4)
i)	Density, kg/m ³	> 1 000	2380 (Part 3)
ii)	Moisture content, percent <i>Max</i>	8	2380 (Part 3)
iii)	Water absorption, percent		2380 (Part 3)
	After 2 h	< 16	
	After 24 h	< 36	
iv)	Swelling in water, percent, <i>Max</i>		2380 (Part 17)
	a) General absorption, 24 h:		
	1) Thickness	20	
	2) Length	0.70	
	3) Width	0.70	
	b) Surface absorption	9	
v)	Modulus of rupture, N/mm ² <i>Min</i>	35	2380 (Part 4)
vi)	Internal bond strength, N/mm ² <i>Min.</i>		2380 (Part 5)
	a) Dry state	1.0	
	b) Wet state (2 h boiling)	0.3	
vii)	Immersion in boiling water at 100 ± 3°C for 4 h	No. Disintegration	
viii)	Formaldehyde emission	< 9 mg / 100 g	13745

For detailed information, refer to IS 15380 : 2003 Moulded raised high density fibre (HDF) panel doors - specification

SUMMARY OF

IS 1038 : 1983 STEEL DOOR, WINDOWS AND VENTILATORS

(Fifth Revision)

1. Scope – Requirements regarding material, fabrication and finish of steel doors, windows, ventilators and fixed-lights manufactured from rolled steel sections to specified sizes and designs.

This standard does not cover steel doors, windows, ventilators and fixed-lights for use in industrial buildings

2. Symbolic Designation – The direction of closing and faces of doors, windows and shutters shall be designated in accordance with IS 4043 : 1969.*

3. Sizes, Tolerances and Designation

3.1 Doors

6 HS 20	8 HS 20	10 HS 20	12 HS 20
6 HS 21	8 HS 21	10 HS 21	12 HS 21

3.2 Windows

5 HS 9	10 HS 9	15 HS 9
5 HS 12	10 HS 12	15 HS 12
5 HS 15	10 HS 15	15 HS 15
6 HS 9	12 HS 9	18 HS 9
6 HS 12	12 HS 12	18 HS 12
6 HS 15	12 HS 15	18 HS 15

3.3 Ventilators

5 HT 6	10 HT 6	15 HT 6
5 HC 6	10 HC 6	15 HC 6
5 HT 9	-	-
6 HT 6	-	-
6 HC 6	12 HT 6	18 HT 6
6 HT 9	12 HC 6	18 HC 6

3.4 Fixed - Lights

5 HF 6	10 HF 6	15 HF 6
5 HF 9	10 HF 9	15 HF 9
5 HF 12	10 HF 12	15 HF 12
5 HF 15	10 HF 15	15 HF 15
6 HF 6	12 HF 6	18 HF 6
6 HF 9	12 HF 9	18 HF 9
6 HF 12	12 HF 12	18 HF 12
6 HF 15	12 HF 15	18 HF 15

Note 1– Doors, windows and ventilators without horizontal glazing bars shall be designated by 'N' in place of 'H' in the range shown.

Note 2 – These sizes are derived after allowing 10 mm clearance on all the four sides for the purpose of fitting.

Note 3 – Doors, windows, ventilators and fixed light, shall be designated by symbols denoting their width (number of modules in the width of opening), type (C=centre hung shutter, F=fixed glass panes, H=with horizontal glazing bars, N=without horizontal glazing bars, S=side hung shutters, T= top hung shutters) and height (number of modules in the height of opening).

3.5 Tolerance – ± 1.5 mm.

3.6 Example

- A window of a width of 10 modules and height 12 modules having horizontal glazing bars and side hung shutters is designated by 10 HS 12.
- A 12 module wide and 21 module high horizontally glazed side hung door coupled on its two sides with two side hung horizontally glazed windows, 6 module wide and 12 module high is designated by 6 HS12/ 12 HS 21/ 6 HS 12.
- Two 10 module wide and 12 module high horizontally glazed side hung windows coupled side by side with two horizontally glazed fixed-lights at top, each 10 module wide and 6 module high, is designated by:

10 HF 6 / 10 HF 6

4. Materials 10 HS 12 / 10 HS 12

4.1 Rolled Steel Sections – Shall conform to IS 7452 : 1990.*

4.2 Glass Panes – Minimum 3 mm thick and shall conform to IS 2835 : 1987.**

Note – For sizes of glass panes see Table 1 of the standard.

* Hot rolled steel sections for doors, windows and ventilators (second revision)

** Flat transparent sheet glass (third revision)

* Symbolic designation of directions of closing and faces of doors, windows and shutters.

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5. Fabrication

5.1 Side Hung Shutters – Hinges projecting type 65 mm to 75 mm wide. Friction hinges or Non-projecting type of hinges may also be used.

5.1.1 Handle – Shall be of pressed brass, cast brass, aluminium or steel.

5.2 Centre Hung Windows and Ventilators – Windows shall be hung on two pairs of brass or aluminium cup pivots riveted to the inner or outer frames of window to swing to an angle of approximately 85°. The opening portion of the window shall be so balanced that it remains open at any desired angle under normal weather conditions.

5.3 Weather Bar – Where fixed light occurs over external opening shutter, a push fit weather bar shall be provided.

5.4 Doors – Hinges for doors shall be of 50 mm projecting type. Non-projecting type of hinges may also be used.

5.4.1 A mortice lock with not less than 4 levers or pins shall be provided for the doors. In case of double shutter doors the first closing shutter shall have a concealed brass extruded aluminium or steel bolt at top and bottom.

6. Finish – Painting or phosphating and painting or hot dipped galvanizing.

Note: For details regarding position of holes, fixing screws and lugs see 7 of the standard.

For detailed information, refer to IS 1038 : 1983 Specification for steel doors, windows and ventilators (third revision).

SUMMARY OF

IS 1361 : 1978 STEEL WINDOWS FOR INDUSTRIAL BUILDINGS

(First Revision)

1. Scope – Deals with steel windows suitable for use in industrial buildings and designed to suit openings based on a module of 10 cm.

2. Handing – Handing and direction of closing of sashes shall be according to IS 4042 : 1969. *

3. Designation – By symbols denoting in sequence, IN (to indicate industrial window) × Width expressed in number of modules × Type (F= fixed sash, C=centre-hung sash, B=bottom hung sash, T= top hung sash) × Height expressed in number of modules.

Examples

- a) IN 10 C 15 indicates industrial window for opening 10 module wide (100 cm) by 15 module high (150 cm) with centre hung ventilator.

b)
$$\frac{\text{IN 10 C 10 / IN 10 C 10}}{\text{IN 10 C 15 / IN 10 C 15}}$$

indicates the combination of four windows, two of the type IN10 C 10 on top and two of the type IN10 C 15 at the bottom, all the four of them coupled both horizontally and vertically.

4. Sizes and Tolerancesa) *Window Sizes*

IN 10 C 10	IN 22 C 10	IN 16 C 15
IN 10 T 10	IN 22 T 10	IN 16 T 15
IN 10 B 10	IN 22 B 10	IN 16 B 15

IN 16 C 10	IN 10 C 15	IN 22 C 15
IN 16 T 10	IN 10 T 15	IN 22 T 15
IN 16 B 10	IN 10 B 15	IN 22 B 15

IN 10 C 20	IN 22 C 20	IN 22 F 10
IN 10 T 20	IN 22 T 20	IN 22 F 15
IN 10 B 20	IN 22 B 20	IN 22 F 20

IN 16 C 20	IN 10 F 10	IN 22 F 10
IN 16 T 20	IN 10 F 15	IN 22 F 15
IN 16 B 20	IN 10 F 20	IN 22 F 20

* Symbolic designations of directions of closing and faces of doors, windows and shutters.

b) Ventilator (Opening part of a Sash) – Shall be of one size and designed to fit into outer frame of IN 10 C 10 and with 1.2 mm clearance.

c) Tolerances – Manufacturing tolerances for overall dimensions ± 3 mm

Note— Overall heights and widths to the outside of frames shall be derived after allowing 10 mm clearance all round for the purpose of fitting the sashes into modular openings. Thus, width and depth of IN 16 C 10 shall be 158 cm and 98 cm.

5. Materials

5.1 Rolled steel sections shall conform to the prescribed standard.

5.2 *Pivots and Spring Catches* — Non ferrous metal.

5.3 *Glass* – Shall conform to the prescribed standard.

6. Holes for Fixing, Coupling and Glazing – Holes for fixing and coupling sashes shall be provided in the web of the outside frame sections (and of outer ventilator frame sections where these occur at the perimeter of the sash). Holes for glazing clips shall also be provided.

7. Fittings and Fixing Materials

7.1 Centre-hung ventilators shall be mounted on a pair of brass cup pivots, each pivot consisting of an inner and an outer cup, permitting the swinging of the ventilator through at least 85° and so balanced that the ventilator shall be capable of remaining open in any desired position.

7.2 Centre-hung ventilators shall be provided with a pulley with centre of the bottom section of the ventilator, and attached with screws.

7.3 Centre-hung and bottom hung ventilators shall have a bronze spring catch in the centre of the top section, suitable for operation by hand or pole (and by cord in case of centre-hung ventilators). The former shall be provided with a 30 cm peg stay of steel or a 30 cm bronze cam opener to hold the ventilator open in three different positions. Bottom-hung ventilators shall have folding side arms to limit the opening.

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8. Composite Windows — Shall be despatched unassembled, but complete with necessary coupling components. Each coupling member will increase the overall height or width by 25 mm maximum which includes manufacturing tolerances.

9. Glass — Sizes shall be as given below:

<i>Pane Designation—</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
<i>Width, mm</i>	269	304	292	304	304	292
<i>Height, mm</i>	425	425	460	460	492	492

Note — For number of glass panes for each type of window see Fig. 4 of the standard.

10. Finish — All sashes and coupling members shall be either galvanised or painted.

For detailed information, refer to IS 1361 : 1978 Specification for steel windows for Industrial buildings (first revision)

SUMMARY OF

IS 1948 : 1961 ALUMINIUM DOORS, WINDOWS AND VENTILATORS

1. Scope—Requirements regarding material, fabrication and dimensions of aluminium doors, windows and ventilators, manufactured from extruded aluminium alloy sections of standard sizes and designs, complete with fittings, ready for being fixed into the buildings. This standard does not cover the requirements for industrial doors, windows and ventilators.

2. Handing—Side-hung opening position of all doors and windows shall be said to be right hand or left hand according to the side on which they are hinged looking from the inside.

3. Standard Sizes, Tolerances and Designations

a) Types and Sizes —

6HF6,	10HF6,	12HF6,	15HF6,	18HF6
6HT6,	10HT6,	12HT6,	15HT6,	18HT6
6HC6,	10HC6,	12HC6,	15HC6,	18HC6
6HF9,	10HF9,	12HF9,	15HF9,	18HF9
6HS9,	10HS9,	12HS9,	15HS9,	18HS9
6HT9				
6HF12,	10HF12,	12HF12,	15HF12,	18HF12
6HS12,	10HS12,	12HS12,	15HS12,	18HS12
6HF15,	10HF15,	12HF15,	15HF15,	18HF15
6HS15,	10HS15,	12HS15,	15HS15,	18HS15
6HF21,	8HS21,	2HS21,	8HF6,	8HT6,
8HC6,				

b) Tolerances — For frames ± 1.5 mm.

Note 1 — The external dimensions of width and height derived after allowing 1.25 cm clearance all round for fitting into a modular opening based on 10 cm module.

Note 2 — Designated in by symbols denoting width (number of modules in width of opening) ; Type (C = centre hung shutters; F= fixed glass panes; H = with horizontal glazing bars; N = without horizontal glazing bars; S = side-hung shutters; T = top-hung shutter); and height (number of modules in height of opening).

Examples

- a) A window of width 10 modules (97.5 cm) and height 9 modules (87.5 cm), having horizontal glazing bars and side-hung shutters is designated by 10 HS 9.
- b) Two 10 module wide and 12 module high

horizontally glazed side-hung window coupled side by side with two fixed glass pane ventilators at top, each 10 module wide and 6 module high, is designated by:

10 HF 6 / 10 HF 6
 10 HS 12 / 10 HS 12

Note 3 — Windows without horizontal glazing bars shall be designated by 'N' in place of 'H' in the range shown above.

Note 4 — Doors and side lights shall only be coupled with 12 module (117.5 cm) high windows.

4. Materials

4.1 Aluminium Panes — Shall conform to the prescribed standard.

4.2 Glass Panes — Shall weigh at least 7.5 kg/m². Glazing shall be outside of frames.

Note— For sizes of glass panes see Table 1 of the standard.

5. Fabrication

5.1 Side – Hung Shutters – Hinges projecting type 67 mm wide. Friction hinges or peg stays (300 mm long) shall be provided.

5.2 Centre Hung Ventilators – Shall be hung on two pairs of cup pivots of aluminium alloy.

5.3 Doors – Outer fixed frame shall be of section A1 - FX 8. Shutter frame shall be of either hollow sections A1 - HF X 5 and A1 - HF X 6 or of solid sections A1-F X 5 and A1- F X 6 shown in Fig 5 of the standard.

5.3.1 Hinges shall be of 50 mm projecting type.

5.3.2 A suitable lock for the door operable either from inside or outside shall be provided.

5.3.3 In double shutter doors the first closing shutter shall have a concealed aluminium alloy bolt at top and bottom.

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5.4 Composite Units – Doors shall be coupled to windows or side lights by extruded aluminium sections made from aluminium conforming to IS Designation HE 9-WP.

5.5 Weather Bar – Where a coupling member is fitted over an external opening shutter, the coupling member should incorporate an integrally extruded weather bar.

6. Positions of Bolts, Fixing Screws and Lugs – Outer frames shall be provided with fixing holes centrally in the web of the sections.

Note — For details regarding positions of fixing holes and member of fixing lugs *see* 7 of the standard.

7. Finish

7.1 Matt, scratch-brush or polished. May be anodized additionally.

7.2 A thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate shall be applied by suppliers to protect the surface from wet cement during construction. This lacquer coating shall be removed after installation is completed.

For detailed information, refer to IS 1948 : 1961 Specification for aluminium doors, windows and ventilators.

SUMMARY OF

IS 1949 : 1961 ALUMINIUM WINDOWS FOR INDUSTRIAL BUILDINGS

1. Scope – Deals with aluminium windows suitable for use in industrial buildings and designed to suit openings based on a module of 10 cm.

2. Designation – By symbols IN (to indicate industrial window) × Width expressed in number of modules × Type (F = fixed sash; C=centre hung sash; B = bottom-hung sash; T = top-hung sash) × Height expressed in number of modules.

Examples

- a) IN 10 C 15 indicates window for opening 10 module wide (100 cm) by 15 module high (150 cm) with centre-hung ventilator.
- b) Composite windows

IN 10 C 10 / IN 10 C 10

IN 10 C 15 / IN 10 C 15

Indicates the combination of four windows, two of the types IN 10 C 10 on top and two of the type IN 10 C 15 at bottom, all the four of them coupled both horizontally and vertically.

3. Sizes and Tolerances

a) Sizes

IN10C10	IN22C10	IN16C15
IN10T10	IN22T10	IN16T15
IN10B10	IN22B10	IN16B15
IN16C10	IN10C15	IN22C15
IN16T10	IN10T15	IN22T15
IN16B10	IN10B15	IN22B15

IN10C20	IN22C20	IN16F15
IN10T20	IN22T20	IN16F15
IN10B20	IN22B20	IN16F20
IN16C20	IN10F10	IN22F10
IN16T20	IN10F15	IN22F15
IN16B20	IN10F20	IN22F20

- b) Ventilators (opening part of sash) shall be of one size and designed to fit into outer frame IN 10 C 10 and with 1.2 mm clearance.
- c) Tolerances for overall dimensions ±3mm.

Note—The overall width and height of window is smaller than dimension of modular opening by 2.5 cm, allowing a clearance of 1.25 cm all round. thus, width and height of IN 10 C 15 = 97.5 cm × 147.5 cm.

4. Materials

- a) *Aluminium extruded section*—Shall conform to the prescribed standard. The form of sections, dimensions and weights shall be as given in Fig 2 of the standard.
- b) *Cord-eyes, pulleys, brackets and catch plates*—Shall be of aluminium or galvanized or cadmium plated steel.
- c) *Pivots, peg stays and spring catches*—Shall be of non-ferrous metal.
- d) *Glass Panes*—Shall weigh 7.5 kg/m². Sizes of glass panes shall be as given below—

Pane Designation	a	b	c	d	e	f
Width (mm)	265	300	290	300	300	290
Height (mm)	420	420	455	455	490	490

Note— For number of glass panes for each type of window see Fig 5 of the standard.

5. Holes for Fixing, Coupling and Glazing – Holes for fixing and coupling sashes shall be provided in the web of the outside frame sections and of outer ventilator frame sections where these occur at the perimeter of the sash. Holes for glazing chips shall also be provided, one hole being located in web of the section or tee, on each side of each pane.

6. Fitting and Fixing Materials

6.1 Centre-hung ventilators shall be mounted on a pair of cup-pivots made out of aluminium alloy sheet or chromium plated brass and each pivot consisting of an inner and outer cup, permitting the swinging of the ventilator through at least 85°. The ventilator shall be so balanced that it can remain open in any desired position.

6.2 Centre-hung and bottom-hung ventilators shall have cast aluminium or bronze spring catch in the centre of the top section, suitable for operation by hand or pole (chord in case of centre-hung).

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6.3 Bottom-hung and top-hung ventilators shall be hung on aluminium alloy hinges. The former shall be provided with a pair of aluminium alloy folding side arms (to limit the opening) and the latter with a 300 mm long peg stay. Alternatively, top-hung ventilator may be provided with 30 cm cam opener.

6.4 Two spring glazing clips pane shall be provided.

7. Composite Windows

Shall be despatched unassembled, but complete with

necessary components. Each coupling member will increase the overall height or width by 25 mm.

8. Finish

Matt, scratch-brush or polished may be anodized additionally. A thick layer of transparent lacquer, based on methacrylates or cellulose butyrate, shall be applied, by the suppliers, to protect the surface from action of wet cement during installation. This lacquer coating shall be removed after installation is completed.

For detailed information, refer to IS 1949 : 1961 Specification for aluminium windows for Industrial buildings.

SUMMARY OF
IS 4351 : 2003 STEEL DOOR FRAMES
(Second Revision)

1. Scope – Requirements regarding material, dimensions and construction of steel door frames for internal and external use.

2. Material – Shall be manufactured from the materials conforming to relevant Indian standards as per Table 1 of the standard.

3. Standard Sizes, Tolerances and Designation – For details refer 6 of the standard.

4. Base Ties — Base ties of pressed mild steel angle size of 20 mm × 20 mm × 1.25 mm thick either screwed or welded as per Fig. 3 of the standard to suit floor thickness of 25, 30, 35 or 40 mm.

5. Fittings

5.1 Fixing Lugs – There shall be three adjustable lugs with split end tail to each jamb without fan light, and

four for jamb with fan light. For details refer 10.1 of the standard.

5.2 Hinges - Frames shall be provided with any one type of the hinges, conforming to the relevant Indian standards as given in Table 3 of the standard.

5.3 Lock-Strike Plate of Steel – A slot suitable for lock strike plate shall be pierced into the rebate of the frame and necessary fixing arrangement and mortar guard from the inside of the frame shall be provided (*see* Fig. 6A of the standard).

5.4 Shock Absorbers – Minimum 3 buffers, for side hung door, and 2 buffer for double shutter door.

6. Finish – For details refer 11 of the standard.

For detailed information, refer to IS 4351 : 2003 Specification for steel door frames (second revision).

SUMMARY OF

IS 6248 : 1979 METAL ROLLING SHUTTERS AND ROLLING GRILLS

(First Revision)

1. Scope – Requirements regarding materials, fabrication and finish of metal rolling shutters and rolling grills for normal use.

Note – Since the term ‘rolling shutters’ is more commonly used, the reference in this standard is mainly to rolling shutters. However, since rolling shutters and rolling grills are similar in design, construction and operation, all reference to rolling shutters in this standard shall apply of rolling grills also. Special features of rolling grills, as different from rolling shutters have also been given.

2. Sizes – Specified by clear width (W) and clear height (H) of the opening. Width shall always be mentioned first. Stopper height shall be 10 cm less than clear height, unless otherwise specified.

3. Types and Applicable Sizes

- a) *Self-Coiling Type (Push-Pull Type or Manual Type)* – For size up to a clear areas of 8m² without ball bearings and 12 m² with ballbearings.
- b) *Gear-Operated Type (Mechanical Type)*— Shall be fitted with ball bearings. Used for a clear area up to 25m² if operated by bevel gear-box and crank handle, and up to 35 m² if operated by chain wheel and hand chain, mounted directly on the worm shaft.
- c) *Electrically-Operated Type* — For use up to about 50m² clear area. Operated by electric motor on 400 / 440 V, 3 phase, 50 cycles AC supply. Speed of movement of curtain shall not exceed about 10 cm/s.

4. Requirements

4.1 Curtain shall be built up of interlocking lath section formed from cold rolled steel strips. Thickness of sheets not less than 0.9 mm for shutters up to 3.5 m width and 1.20 mm for 3.5 m width and above.

4.2 Lock Plate – Made of mild steel sheet not less than 3.15 mm thick, reinforced with mild steel angle section not less than 35×35×5 mm. Alternatively, it may be fabricated out of mild steel angles or ‘Tee’ sections not less than 5 mm thick.

4.3 Guide Channels and Brackets Plates — Fabricated out of mild steel sheets of minimum, 3.15 mm thickness.

4.4 Hood Covers – Made of mild steel sheets not less than 0.9 mm thick.

4.5 Safety Devices – For width up to 2.5 m, a properly fabricated and reinforced bottom lock plate shall be provided to give protection. For widths above 2.5 m, anchorage rods or central hasp and staple, or both may be provided.

5. Rolling Grills – Curtains may be built of aluminium alloy or cold rolled steel sheet links of 0.9 mm thickness assembled on tubes or rods, or out of 8 mm dia mild steel or aluminium alloy round bars.

5.1 Rolling Shutter-cum-Grill — In situations where a certain amount of ventilation combined with safety is called for the rolling shutter may have a small rolling grill portion either at top or at bottom or at both places. Height of grill portion shall be 0.5 m maximum.

6. Painting – All components parts (except springs and the inside of guide channels) shall be given one coat of a brushing quality ready mixed primer before despatch. Portions where there is contact between aluminium and steel shall be painted with zinc chromate primer.

Note – For details regarding types based on position of fixing, materials, fabrication, optional features, operation, etc, refer to the standard.

For detailed information, refer to IS 6248 : 1979 Specification for metal rolling shutters and rolling grills (first revision).

SUMMARY OF
IS 7452 : 1990 HOT ROLLED STEEL SECTIONS FOR DOORS,
WINDOWS AND VENTILATORS
(Second Revision)

1. Scope – Requirements regarding materials, nominal dimension and mass, dimensional and mass tolerances, surface finish and packing for hot rolled steel sections used for doors, windows, ventilators and sashes.

2. Designation and Mass

<i>Designation</i>	<i>Mass</i>	<i>Designation</i>	<i>Mass</i>
	(kg/m)		(kg/m)
T 2	1.036	F 500	1.955
T 3	1.14	F 501	2.250
T 6	0.839	F 502	1.955
F 2	1.46	F 503	2.840
F 3	2.280	F 4B	2.28
F 5	1.55	F 7D	1.419
F 8	1.75	F X 8	2.31
F X 6	2.52	F Z 5	2.52
F Z 7	1.90	K 12B	2.30
K 11B	1.80		

Note 1 – Profiles of the sections shall be as given in Fig 2 of the standard.

Note 2 – Mass of the sections as given have been arrived keeping in view the nominal dimensions of the sections and assuming density of the steel as 7.85 gm/cm³.

3. Material – Steel as per prescribed standards.

4. Dimensions and Tolerances

4.1 Dimensions – Shall be as given in Fig 2 of the standard.

4.2 Tolerances

4.2.1 Thickness of the sections — Rolling tolerances on thickness of section shall be ± 0.2 mm.

4.2.2 Radii of curvature – A tolerance of ± 0.5 mm shall be permitted on the nominal value of radii of curvature except where maximum radii has been indicated.

4.2.3 Mass tolerance – Mass tolerance per meter length for the various profiles shall be ± 5 percent of the nominal mass specified for the section.

5. Surface Finish – The rolled steel section shall be free from rolling defects, such as knot, steep bends, overlaps, waviness on edges, unparallel flanges, rolling marks and shall be suitable for punching and welding or both. The section shall be straightened by roller straightening machine or any other suitable machine ensuring that twist will not be more than 5 degree over a length of 3 m. The section shall be packed in such a way as to avoid damage in transit.

6. Bend Test – Shall satisfy the prescribed test in 9 of the standard.

Note – Refer to Annex A of the standard for recommended use of sections.

For detailed information, refer to IS 7452 : 1990 Hot rolled steel sections for doors, windows and ventilators (second revision).

SUMMARY OF
IS 10451 : 1983 STEEL SLIDING SHUTTERS
(TOP HUNG TYPE)

1. Scope – Requirements regarding materials, type, shape, fabrication, assembly and finish of the top hung steel sliding shutters.

2. Size – The size of the shutter shall be greater than the actual opening for weather protection. The height of the shutter shall be at least 150 mm more and width at least by 300 mm more than the size of the opening.

3. Material

3.1 Angles, Tees, Flats, Channels etc, shall be of rolled sections conforming to the prescribed standards.

3.2 Top Runner (Track) – These shall be of cold rolled mild steel conforming to the prescribed standard, capable of taking the design load for a smooth operation.

4. Fabrication

4.1 Angles of size not less than 50×50×5mm for shutter upto 2 m width and 2.5m height and 65×65×6mm for bigger sizes shall be used.

4.2 Top track shall be either of the following types–

Type A – Track made out of 12×80 mm flat securely anchored to the wall,

Type B – Cold rolled inverted U type mild steel track.

4.3 Bottom runner shall be channel of about 50 × 40 × 5mm.

4.4 Sliding gear or roller mechanism shall be as given in **5.4** of the standard.

5. Finish – The shutters shall be finished with a coat of red oxide primer.

For detailed information, refer to IS 10451 : 1983 Specification for steel sliding shutters (top hung type).

SUMMARY OF IS 10521 : 1983 COLLAPSIBLE GATES

1. Scope – Requirements regarding materials, fabrication and finish of different types of collapsible gates.

2. Types

- a) Gates fixed under the lintel,
- b) Gates fixed outside the opening,
- c) Gates fixed inside the opening, and
- d) Gates fixed on movable top and bottom channels with swinging arrangement on either side.

The above types may be with single panel collapsible at the right end or left end, or with double panels collapsible at respective ends with wheels attached to the gates rolling on bottom or top runners.

3. Sizes

3.1 Collapsible gates are recommended for a maximum height of 3 m. there is no restriction in width.

3.2 When the gate is fitted under the lintel, the width and height of the gate shall be the same as that of the opening. But when the gate is fixed inside or outside the opening, the width of the gate shall be the clear width of opening plus the width of the gate in the collapsed position and the height shall be 150 mm more than the clear height to enable usage of the full opening.

4. Materials

4.1 Vertical Channels – Shall be hot rolled medium channels of at least $18 \times 9 \times 3$ mm and shall be of weldable quality mild steel conforming to the prescribed standard.

4.2 Crossing or Lacings – These shall be flats of mild steel of at least 18×5 mm size conforming to the prescribed standard.

4.3 Top and Bottom Runner – Tees or 'E' used for bottom runner shall have minimum web of 40×12 mm and flange of 40×6 mm, and the flats used for top runner shall be of minimum size 40×12 mm.

Note — For details of material, see 5 of the standard.

5. Fabrication

5.1 Channels shall have a maximum spacing of 100 mm when the gate is in closed position.

5.2 One set of crossing shall extend from 450 to 600 mm in height and clear space between the two sets of crossings shall be within 150 mm.

5.3 Number and size of role wheels shall be dependent on the width of the gate and shall be as given in Table 1 of the standard.

6. Finish – Fabricated parts shall be finished with a coat of red oxide primer.

For detailed information, refer to IS 10521 : 1983 Specification for collapsible gates.

SUMMARY OF

IS 14856 : 2000 GLASS FIBRE REINFORCED PLASTIC (GRP) PANEL TYPE DOOR SHUTTERS FOR INTERNAL USE

1. Scope – Requirements regarding types, sizes, material, construction, workmanship, finish, performance requirements and sampling of fibre glass reinforced plastic door shutters for use in residential and industrial building.

2. Materials

2.1 Glass Fibre Chopped Strand Mat (CSM) – The glass fibre chopped strand mat used shall be as per IS 11551 : 1996*

2.2 Glass Fibre Rovings – The glass fibre rovings shall be as per IS 11320 : 1997. **

2.3 Isophthalic Resin – Isophthalic resin shall be as per IS 6746 : 1994.†

2.4 Curing Agents – Catalyst used shall be methyl ethyl ketone peroxide (MEKP), benzyl peroxide, acetyl acto peroxide etc.

Accelerator used shall be cobalt naphthalate, cobalt octonate, N.N.Dinethyl Anilene etc.

2.5 Fillers and Additives – Permissible fillers and french chalk powder (talc) and calcium carbonate.

Aluminium trihydrite, antimony trioxide, minimum 5 percent, by weight of isophthalic resin, shall be used for fire retardancy.

The fillers and additives content shall not exceed 10 percent by weight of isophthalic resin.

2.6 Auxiliary chemical – Polyvinyl alcohol (PVA) or other semipenetrant release agents and wax shall be used as a mould release agent.

2.7 Pigments – Pigments compatible with isophthalic resin and gelcoat shall be used to obtain the shade of finish as mutually agreed between the manufacturer and the purchaser.

* Glass fibre chopped strand mat for the reinforcement of , phenolic and polyester resin systems (first revision)

** Glass fibre rovings for the reinforcement of polyester and epoxide resin systems (first revision)

† Unsaturated polyester resin system (first revision)

2.8 Base Blocks – Base Blocks for fixing fixtures in shutter with screws shall be of seasoned and treated hard wood or any other suitable material.

2.9 Polyurethane Foam – Slabs of minimum density of 32 kg/m² and of thickness 4 mm less than the shutter thickness with ± 0.5 mm, tolerance shall be used.

3 Dimensions, Sizes and Tolerances – See Table 1 & 2

TABLE 1 DIMENSIONS AND TOLERANCES OF COMPONENTS OF DOOR SHUTTERS

Sl No.	Description	Width mm	Thickness mm
1.	Vertical stile, top and Freeze rail	90 \pm 3	30 \pm 1 or 35 \pm 1
2.	Lock rail	120 \pm 3	30 \pm 1 or 35 \pm 1
3.	Bottom rail	150 \pm 3	30 \pm 1 or 35 \pm 1

3.1 Minimum thickness of GRP laminate of hollow rails and stiles shall be 3 mm.

3.2 Minimum thickness of GRP laminate used for panel in the shutter shall be 5 mm.

TABLE 2 DIMENSIONS OF DOOR SHUTTERS

Designation of Doors	Width mm	Height mm
8 DS 20	700	1905 (1945)
8 DS 21	700	2005 (2045)
9 DS 20	800	1905 (1945)
9 DS 21	800	2005 (2045)
10 DS 20	900	1905 (1945)
10 DS 21	900	2005 (2045)
12 DT 20	1100 ⁺	1905 (1945)
12 DT 21	1100 ⁺	2005 (2045)

Note 1 – The dimensions refers to modular sizes of door openings. first number stands for width and the last for height in module (M = 100 mm). Alphabet ‘D’ refers to doors, ‘S’ to single shutter and ‘T’ to double leaf shutter.

Note 2—The standard widths and heights for panel doors are arrived at as shown in Fig 2 of the standard. In case the modular height is taken from the finished floor level, the height of the door shall be the one given in bracket.

⁺ Combined width of double leaf shutters.

Tolerances — Tolerances on the sizes of door shutters

shall be $\begin{matrix} +0 \\ -4 \end{matrix}$ mm

4. Finish — The surface of the moulded shutters shall be free from any visible defects such as small pores, crazing, blistering, wrinkling, impurities, defective impregnation, colour blots and aggregates defects.

Scattered pin holes duly repaired and finished by applying resing and not noticeable shall be acceptable.

Panels, rails and stiles of the doors shutters shall be flat and shall have smooth and level surface.

Surface shall be finished in colour and design as required by the purchaser.

5. Tests

5.1 Test on materials

TABLE 3 TESTS ON GRPLAMINATE

<i>Sl No. Test</i>	<i>Acceptable Value</i>
1. Fibre Glass content	25% (Min)
2. Barchol hardness	30 BHU (Min)
3. Tensile Strength (Mpa)	100 (Min)
4. Bending Strengths (Mpa)	120 (Min)
5. Elastic Modulus in bend (Mpa)	1500 (Min)
6. Water Absorption	5% (Max)
7. Fire Retardancy	100 mm length of the specimen shall not burn within 60 Seconds.

5.2 Requirements for shutters

5.2.1 Dimensions and Squareness Test — The dimensions of nominal width and height shall be within a limit ± 5 mm. The door shutter shall not deviate by more than 1 mm on a length of 500 mm. The thickness of the door shutter shall be uniform through out with the permissible variation of not more than 0.8 mm between any two points. The nominal thickness of the shutter shall be within a limit of ± 1.5 mm.

5.2.2 General Flatness Test — The twist, cuping and warping shall not exceed 6 mm.

5.2.3 Local Planeness Test — The depth of deviation measured at any points shall not be more than 0.5 mm.

5.2.4 Impact Indentation Test — Shall have no defects such as cracking, tearing or delamination and the depth of indentation shall not be more than 0.2 mm.

5.2.5 Edge Loading Test — The deflection of the edge at the maximum load shall not be more than 5 mm. On removal of the loads, the residual deflection shall not be more than 0.5 mm failing which the test may be repeated on the other edge in the reverse direction. Also there shall be no lateral buckling by more than 2 mm during loaded condition and no residual lateral buckling after removal of the load.

5.2.6 Shock Resistance Test — There shall be no visible damage in any part of the door after twenty-five blows on each end.

The normally hung shutter, with hangings, fixings and fastenings should withstand any significant permanent deformation and without deterioration the five impacts on both sides of the shutter.

5.2.7 Buckling Test — Shall not show any deterioration and any residual deformation more than 5 mm after 15 minutes of unloading and the initial deflection also shall not be more than 50 mm.

5.2.8 Slamming test — Shall not have any visible damage in any Slamming Test part of the door at the end of 50 successive impacts⁺ or. Shall not have any visible damage in any part of the door at the end of 100 successive impacts*.

5.2.9 Misuse Test, there shall not be any permanent deformation of the fixing or any other part of the door set in hindering its normal working after the test.

⁺ As per 2.1 of IS 4020 (Part 10). Door shutters methods of tests or * As per 3.1 of IS 4020 (Part 10)

For detailed information, refer to IS 14856 : 2000 Specification for glass fibre reinforced plastic (GRP) panel type door shutters for internal use.

SECTION 14

CONCRETE REINFORCEMENT

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SUMMARY OF
IS 280 : 1978 MILD STEEL WIRE FOR GENERAL
ENGINEERING PURPOSES
(Third Revision)

1. Scope – Requirement for mild steel wire of sizes 0.125 mm to 12.5 mm diameter for general engineering purposes.

Over 1.50 up to 2.50	±0.04
Over 2.50 up to 5.00	±0.05
Over 5.0	± 0.06

2. Sizes

Diameter in mm

0.125	0.315	0.80	2.00	5.00
0.140	0.355	0.90	2.24	5.60
0.160	0.400	1.00	2.50	6.30
0.180	0.450	1.12	2.80	7.10
0.200	0.500	1.25	3.15	8.00
0.224	0.560	1.40	3.55	9.00
0.250	0.630	1.60	4.00	10.00
0.280	0.710	1.80	4.50	11.2
				12.5

Note – Other sizes by mutual agreement.

3. Tolerance on Diameter

Applicable to coils only

- a) Galvanized – All sizes ± 2.5 percent with a minimum of ± 0.025 mm.

- b) Other finishes –

<i>Size of Wire (mm)</i>	<i>Tolerance (mm)</i>
Up to 0.25	±0.01
Over 0.25 up to 0.50	±0.015
Over 0.50 up to 1.00	±0.02
Over 1.00 up to 1.50	±0.03

4. Mechanical Properties

4.1 Tensile Test

Condition	Tensile Strength, MPa	
	Finishes other than	Galvanized
Annealed	500, Max	300-550
Soft drawn	550, Max	-
1/4 hard	450-650	-
1/2 hard	600-800	-
Hard	700-950	550-900

1 MPa = 1 N/mm² = 1 MN/m² = 0.102 0 kgf/mm².

4.2 Wrapping Test (For Wire smaller than 5 mm Dia) — Shall withstand without breaking or splitting being wrapped 8 times round its own diameter and subsequently straightened.

4.3 Bend Test (For Wire Dia 5 mm and Over) – Shall withstand being bent through 90° round a former of diameter equal to twice its own dia without breaking or splitting.

5. Finish – Annealed; annealed cleaned and limed; bright drawn; dull grey (dry drawn); galvanized; coppered; or tinned.

Note 1 – For test procedures, refer to IS 1608 : 1995 Mechanical testing of metals. Tensile testing (*second revision*), IS 1755 : 1983 Method for wrapping test for metallic wire (*first revision*). and 8 of the standard.

Note 2 — For chemical composition see 5 of the standard.

For detailed information, refer to IS 280 : 1978. Specification for mild steel wire for general engineering purposes (third revision).

SUMMARY OF

IS 432 (PART 1) : 1982 MILD STEEL AND MEDIUM TENSILE STEEL BARS AND HARD-DRAWN STEEL WIRE FOR CONCRETE REINFORCEMENT

PART 1 MILD STEEL AND MEDIUM TENSILE STEEL BARS

(Third Revision)

1. Scope – Requirements of mild steel and medium tensile steel plain bars in round and square sections for use as reinforcement in concrete.

2. Types and Grades

- Mild steel bars; Grade I and Grade II, and
- Medium tensile steel bars.

Note – Grade II bars are not recommended for use in structures located in earthquake zones subjected to severe damage and or structures subjected to dynamic loading (other than wind loading).

3. Freedom from Defects – Finished bars shall be sound and free from cracks, surface flaws, laminations and rough, jagged and imperfect edges, etc.

4. Nominal Sizes – Diameter of round bars or side of square bars shall be 5, 6, 8, 10, 12, 16, 20, 22, 25, 28, 32, 36, 40, 45 and 50 mm.

5. Tolerance

5.1 Bars in Straight Length

5.1.1 Size

Size		Tolerance
Over	Up to and Including	
mm	mm	mm
-	25	±0.5
25	35	±0.6
35	50	±0.8
50	80	±1.0
80	100	±1.3
100	-	± 6
		percent of dia or side width

5.1.2 Ovality and out-of-square— Permissible ovality for round bars and out-of-square of square bars shall be 75 percent of total tolerance (plus and minus) specified on size.

5.1.3 Weight

Size		Tolerance
Over	Up to and Including	Percent
mm	mm	
—	10	± 7
10	16	± 5
16	—	± 3

5.2 Coiled Rounds and Squares

5.2.1 Size – ± 0.5 mm for size up to and including 12 mm.

5.2.2 Out of shape – Permissible value at any cross section shall not exceed 0.65 mm.

Note 1 – Size shall be diameter in case of round bars and side width in case of square bars.

Note 2— No weight tolerance shall be applicable in case of coiled round and square bars.

6. Physical Requirements

6.1 Ultimate tensile stress, yield stress and percentage elongation shall be as given in Table 1.

6.2 Bend Test — Shall withstand the specified test.

TABLE 1 MECHANICAL PROPERTIES OF BARS

Sl No.	Type and Nominal Size of Bar	Ultimate Tensile Stress Min	Yield Stress Min	Elongation Percent*
i)	<i>Mild Steel Grade I</i>			
	For bars up to and including 20 mm.	410	250	23
	For bars over 20 mm, up to and including 50 mm	410	240	23
ii)	<i>Mild Steel Grade II</i>			
	For bars up to and including 20 mm.	370	225	23
	For bars over 20 mm, up to and including 50mm	370	215	23
iii)	<i>Medium Tensile Steel</i>			
	For bars up to and including 16 mm	540	350	20
	For bars over 16 mm, up to and including 32 mm	540	340	20
	For bars over 32 mm, up to and including 50 mm	510	330	20

*Elongation on a gauge length $5.65 \sqrt{S_o}$ where S_o is the cross-sectional area of the test piece.

Note 1 – For test procedures, refer to IS 1608 : 1995 Mechanical testing of metals- tensile testing (*second revision*), IS 1599 : 1985 Method for bend test (*second revision*), (IS 2062:1999 Steel for general structural purposes (*fifth revision*), and 9 of the standard.

Note 2 — For chemical composition refer to see 4 of the standard.

For detailed information, refer to IS 432 (Part I) : 1982 Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement : Part I Mild steel and medium tensile steel bars (third revision).

SUMMARY OF
**IS 432 (PART II) : 1982 MILD STEEL AND MEDIUM TENSILE STEEL
BARS AND HARD-DRAWN STEEL WIRE FOR CONCRETE
REINFORCEMENT**
PART 2 HARD-DRAWN STEEL WIRE
(Third Revision)

1. Scope – Requirements of hard-drawn steel wire of medium strength used as reinforcement in concrete.

2. Freedom from Defects – Finished wire shall be sound, free from splits, surface flaw, etc.

3. Nominal Sizes — 2.65, 3.0, 3.15, 3.55, 4.0, 4.5, 4.75, 5.0, 5.3, 5.6, 6.0, 6.3, 7.1, 7.5, 8.0, 9.0, 9.5 and 10 mm diameter.

4. Tolerance

Nominal diameter : +2 percent

: -1 percent

Length : ± 6 mm up to 3 m

: ± 13 mm over 3 m.

5. Physical Requirements

5.1 Tensile Properties

a) Ultimate tensile stress, *Min*, 570 N/mm²

b) Proof stress (0.2 percent), *Min*, 480 N/mm².

c) Elongation over gauge length of 8 diameter, *Min*, 7.5 percent.

5.2 Reverse Bend Test — Test piece shall withstand without showing any sign of fracture, one complete cycle of reverse bend.

Note 1 – For test procedures, refer to IS 1608 : 1995. Mechanical testing of metals- tensile testing (*Second revision*), IS 1716: 1985. Method for reverse bend testing of metallic wire (*second revision*) and 8 of the standard.

Note 2 — For chemical composition see 3 of the standard

For detailed information, refer to IS 432 (Part 2) : 1982 Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement : Part 2 hard-drawn steel wire (third revision).

SUMMARY OF
IS 1566 : 1982 HARD - DRAWN STEEL WIRE FABRIC FOR CON-
CRETE REINFORCEMENT
(Second Revision)

1. Scope – Requirements for hard-drawn steel wire fabric consisting of hard-drawn steel with cross wires electrically welded to them for use as concrete reinforcement

2. Types –

- a) Oblong mesh, and
- b) Square mesh

3. Material – Wire used shall be hard-drawn steel wire suitable for welding

4. Sizes of Sheets or Rolls – Width of fabric shall be such as to fit in with modular size of 10 cm module

5. Mass – Calculated on the basis that steel weighs 0.785 kg/cm² of nominal cross-sectional area per metre run. Actual weight is determined by weighing any convenient size and if possible at least one square metre.

6. Tolerances

- a) *Pitch* $\pm 7\frac{1}{2}$ Percent
- b) *Sizes of Sheet* ± 25 mm for dimensions upto 5 m. $\pm \frac{1}{2}$ percent for dimensions over 5 mm.
- c) *Mass* *Percent*
 - i) When neither maximum nor minimum mass is specified ± 6
 - ii) When maximum mass specified $+ 0$
 $- 12$
 - iii) When minimum mass specified $+12$

7. Mechanical Properties

7.1 Shall meet the minimum requirements for physical properties as prescribed in IS 432 (Part 2) : 1982*.

7.2. Bend Test – Test piece shall with stand one complete cycle of reverse bend around a pin of size indicated below–

<i>Diameter of Specimen Wire</i>	<i>Diameter of Pin</i>
7.5 mm and under	Equal to diameter of specimen
Over 7.5 mm	Equal to twice the diameter of specimen

* IS 432 (Part 2) : 1982 Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement : Part 2 Hard-drawn steel wire (*third revision*).

Note.1 – For mesh sizes, weights and sizes of wires for square and oblong welded wire fabric commonly manufactured see Appendix A of the standard.

Note.2 – For test procedures, refer to IS 1 608 : 1995 Mechanical testing of metals–Tensile testing (*second revision*), IS 1716 : 1985 Method for reverse bend test for metallic wire (*second revision*) and 11 of the standard.

For detailed information, refer to IS 1566 : 1982 Specification for hard-drawn steel wire fabric for concrete reinforcement (second revision).

SUMMARY OF
IS 1785 (PART I) : 1983 PLAIN HARD-DRAWN STEEL WIRE FOR
PRESTRESSED CONCRETE
PART I COLD DRAWN STRESS-RELIEVED WIRE
(Second Revision)

1. Scope – Requirements for the manufacture, supply and testing of plain, cold drawn, stress-relieved steel wire for use in prestressed concrete.

2. Chemical Composition and Manufacture

2.1 It shall not contain more than 0.040 percent of sulphur and not more than 0.040 percent of phosphorus in ladle analysis.

2.2 The surface of wire shall be clean uniform, smooth and free from harmful scratches, flat parts, longitudinal or transverse ribs etc.

3. Nominal Sizes – 2.50, 3.00, 4.00, 5.00, 7.00 and 8.00 mm diameter (finished).

4. Tolerances

4.1 On Nominal Diameter

<i>Nominal Diameter</i>	<i>Tolerances</i>
mm	mm
8.00	± 0.05
7.00	± 0.05
5.00	± 0.05
4.00	± 0.05

4.2 Where the diameter measurements (taken in two directions at right angles in the same plane) show an ovality of not more than half of the total diameter tolerance, no checks on section by weighing shall be necessary. Where ovality is more than half of the total diameter tolerance, check on section by weighing shall be made. Nominal mass and tolerance on nominal mass of the finished wire shall be as given below

<i>Nominal Diameter</i>	<i>Nominal Mass</i>	<i>Tolerance</i>
mm	g/m	g/m
8.00	395	± 5.9
7.00	302	± 4.3
5.00	154	± 3.1
4.00	98.9	± 2.0

5. Physical Requirements

5.1 Tensile Strength

<i>Nominal Diameter</i>	<i>Tensile Strength</i>
mm	Min. N/mm ²
4.00	1715
5.00	1570
7.00	1470
8.00	1375

Note 1 – Wires of diameter 5, 7 and 8 mm may be manufactured to give higher minimum tensile strength. In such cases, minimum tensile strength of 1715, 1570 and 1470 N/mm² are recommended for wires of nominal diameter 5, 7 and 8 mm respectively ; but other requirements shall remain the same.

Note 2 – The modulus of elasticity is to be taken as 205 10 kN/mm² unless otherwise indicated by the manufacturer.

5.2 Proof Stress – Not less than 85 percent of tensile strength.

5.3 Ductility – Shall withstand the reverse bend test.

5.4 Elongation After Fracture—Elongation after fracture, over a gauge length of 200 mm.

<i>Nominal Diameter</i>	<i>Elongation, Percent</i>
mm	Min
2.50	2.5
3.00	2.5
4.00	3.0
5.00	4.0
7.00	4.0
8.00	4.0

5.5 Relaxation – The relaxation stress in the wire, shall not exceed 5 percent of the initial stress of 1000 h at the end.

Note – For test procedures, refer to IS 1608 : 1995 Mechanical testing of metals – Tensile testing *(second revision)*

For detailed information, refer to IS 1785(Part I) : 1983 Specification for plain hard – drawn steel for prestressed concrete : Part I Cold drawn stress – relieved wire (second revision).

SUMMARY OF

IS 1785 (PART 2) : 1983 PLAIN HARD- DRAWNSTEEL WIRE FOR PRESTRESSED CONCRETE. PART 2 -AS DRAWN WIRE

(First Revision)

1. Scope – Requirements for manufacture supply and testing of plain ‘as-drawn’ steel wire for use in prestressed concrete pipes and similar other purposes.

2. Chemical Composition and Manufacture

2.1 The ladle analysis shall show that the steel contains not more than 0.040 percent of sulphur and not more than 0.040 percent of phosphorus.

2.2 The surface of wire shall be clean, uniform, smooth and free from harmful scratches and surface flaws, flat parts, longitudinal or transverse ribs etc.

3. Nominal Sizes – 2.50, 3.00, 4.00 and 5.00 mm diameter (finished).

4. Tolerances

4.1 On Nominal Diameter

Nominal Diameter	Tolerance
mm	mm
2.50	± 0.02 mm
3.00	± 0.02 mm
4.00	± 0.03 mm
5.00	± 0.03 mm

4.2 Where the diameter measurements (taken in two directions at right angles in the same plane) show an ovality of not more than half of the total diameter

tolerance, no checks on section by weighing shall be necessary. Where ovality is more than half of the total diameter tolerance, tolerance on nominal mass of the finished wire shall be given below:

Nominal Diameter	Nominal Mass	Tolerance
mm	g/m	g/m
5.00	154	± 3.1
4.00	98.9	± 2.0
3.00	55.5	± 1.5
2.50	38.5	± 1.25

5. Requirements

5.1 Tensile Strength

Nominal Diameter	Tensile Strength
mm	N/mm ²
2.50	1 800
3.00	1 765
4.00	1 715
5.00	1 570

5.2 Proof Stress – Not less than 75 percent of minimum tensile strength.

5.3 Ductility – Shall withstand the reverse bend test.

5.4 When uncoiled the wire shall remain flat and shall not spring up.

Note – For test procedures refer to 7 of the standard, and IS 1608 : 1995 Mechanical testing of metals – Tensile testing (second revision).

For detailed information, refer to IS 1785 (Part 2) : 1983. Specification for plain hard – drawn steel wire for prestressed concrete : Part 2 As drawn wire (first revision).

SUMMARY OF

IS 1786 : 1985 PLAIN HIGH STRENGTH DEFORMED STEEL BARS AND WIRES FOR CONCRETE REINFORCEMENT

(Third Revision)

1. Scope – Requirements of deformed steel bars and wires for use as reinforcement in concrete, in the following three strength grades.

- a) Fe 415,
- b) Fe 500 and
- c) Fe 550

Note — The figures following the symbol Fe indicates the specified minimum 0.2 percent proof stress or yield stress in N/mm²

2. Chemical Composition – The ladle analysis of steel shall be as follows :

Constituent	Percent, Maximum		
	Fe 415	Fe 500	Fe 550
Carbon	0.30	0.30	0.30
Sulphur	0.060	0.055	0.055
Phosphorus	0.060	0.055	0.050
Sulphur and Phosphorus	0.11	0.105	0.10

3. Nominal Sizes, Cross Sectional Area and Mass

Nominal Size mm	Cross-sectional Area mm ²	Mass per Metre Run kg
4	12.6	0.099
5	19.6	0.154
6	28.3	0.222
7	38.5	0.302
8	50.3	0.395
10	78.6	0.617
12	113.1	0.888
16	201.2	1.58
18	254.6	2.00
20	314.3	2.47
22	380.3	2.98
25	491.1	3.85
28	616.0	4.83
32	804.6	6.31
36	1018.3	7.99
40	1257.2	9.85
45	1591.1	12.50
50	1964.3	15.42

4. Tolerances on Dimensions and Nominal Mass.

4.1 Specified Lengths

On specified length	+75mm -25
On minimum length	+50 mm -0

4.2 Nominal Mass

4.2.1 For the purpose of checking the nominal mass, the density of steel shall be taken as 0.007 85 kg/mm² of the cross-sectional area per metre run.

4.2.2 The tolerances on nominal mass shall be as follows

Nominal Size mm	Tolerance on the nominal Mass, percent		
	Batch	Individual Sample*	Individual Sample for Coils only†
1) Up to and including 10	(2) ±7	(3) - 8	(4) ±8
Over 10 upto and including 16	±5	- 6	±6
Over 16	±3	- 4	±4

5. Physical Properties

5.1 Proof stress, percentage elongation and tensile strength for all sizes of deformed bars/wires determined on effective cross-sectional area shall be as specified in Table .1

5.2 The bars / wires shall withstand the bend test and the rebend test.

* For individual sample plus tolerance is not specified.

† For coils batch tolerance is not applicable.

TABLE 1 MECHANICAL PROPERTIES OF HIGH STRENGTH DEFORMED BARS AND WIRES

Sl. No	Property	Grade		
		Fe 415 (3)	Fe 500 (4)	Fe 550 (5)
(1)	(2)			
i)	0.2 percent proof stress/ yield stress, <i>Min</i> , N/mm ²	415.0	500.0	550.0
ii)	Elongation, percent, <i>Min</i> , on gauge length $5.65 \sqrt{A}$, where A is the cross sectional area of the test piece	14.5	12.0	8.0
iii)	Tensile strength, <i>Min</i>	10 percent more than the actual 0.2 percent proof stress but not less than 485.0 N/mm ²	8 percent more than the actual 0.2 percent proof stress but not less than 545.0 N/mm ²	6 percent more than the actual 0.2 percent proof stress but not less than 585.0 N/mm ²
0.2				

Note — For test procedures, refer to 8 of the standard, IS : 1608 : 1995 Mechanical testing of metals – Tensile testing (*second revision*) and IS 1599 : 1985 Method for bend test (*second revision*).

For detailed information, refer to IS 1786 : 1985 Specification for high strength deformed steel bars and wires for concrete reinforcement (third revision).

SUMMARY OF
IS 2090 : 1983 HIGH TENSILE STEEL BARS USED IN
PRESTRESSED CONCRETE
(First Revision)

1. Scope – Requirements for high tensile steel bars used in prestressed concrete.

2. Chemical Composition – The ladle analysis of steel shall show that steel contains no more than 0.050 percent of sulphur and not more than 0.050 percent of phosphorus.

3. Nominal Sizes —10, 12, 16, 20, 22, 25, 28 and 32 mm.

4. Tolerances

- a) Nominal Size : ± 0.5 mm for bars upto 25mm
 ± 0.6 mm for bars above 25mm
- b) Mass : ± 5 percent for bars upto 16mm
 ± 3 percent for bars above 16mm

5. Physical Requirements

<i>Characteristic</i>	<i>Requirement</i>
Tensile strength, <i>Min</i>	980 N/mm ²
Proof stress	Not less than 80 percent of minimum specified tensile strength
Elongation at rupture on a gauge length	10 percent
$5.65 \sqrt{A}$, <i>Min</i>	

(Where A is the area of cross-section)

The relaxation of stress in the bar, shall not exceed 49 N/mm² at the end of 1000.

Note—For test procedures, refer to 7 of the standard and IS 1608 : 1995 Mechanical testing of metals – Tensile testing (*second revision*).

For detailed information, refer to IS 2090 : 1983 Specification for high tensile steel bars used in prestressed concrete (first revision).

SUMMARY OF
IS 6003 : 1983 INDENTED WIRE FOR PRESTRESSED CONCRETE
(First Revision)

1. Scope – Requirements for manufacture, supply and testing of intended hard-drawn and stress-relieved wire for use in prestressed concrete.

2. Chemical Composition – The ladle analysis shall show that the steel contains not more than 0.04 percent of sulphur and not more than 0.04 percent of phosphorus.

3. Nominal Sizes – 3.00, 4.00 and 5.00 mm.diameter.

4. Geometrical Characteristics

4.1 The shape and pattern of indentation shall be as mutually agreed provided the indentations are placed in two lines, diametrically opposite and are staggered.

5. Tolerances

5.1 The tolerance on the nominal diameter shall be ± 0.05 mm.

5.2 Where ovality is more than half of the total diameter tolerance, check on section by weighing shall be made. Nominal mass and tolerance on nominal mass of finished wire shall be as given below:

<i>Nominal Diameter</i>	<i>Nominal Mass</i>	<i>Tolerance</i>
mm	g/m	g/m
5.00	154	± 3.1
4.00	98.9	± 2.0
3.00	55.5	± 1.5

6. Physical Requirements

6.1 Tensile Strength

<i>Nominal Diameter</i>	<i>Tensile Strength</i>
mm	Min, N/mm ²
5.00	1 570
4.00	1 715
3.00	1 865

6.2 Proof Stress – Not less than 85 percent of minimum tensile strength.

6.3 Ductility – Wire shall withstand the reverse bend test.

6.4 Elongation after Fracture – (Over a gauge length of 200 mm)

<i>Nominal Diameter</i>	<i>Elongation Percent</i>
mm	Min
5.00	4.00
4.00	3.00
3.00	2.50

6.5 Relaxation – Relaxation stress shall not exceed 5 percent of initial stress at the end of 1000 h.

Note – For test procedures, refer to 7 of the standard and IS 1608 : 1995 Mechanical testing of metals-Tensile testing (second revision)

For detailed information, refer to IS 6003 : 1983 Specification for intended wire for prestressed concrete (first revision).

SUMMARY OF
IS 6006 : 1983 UNCOATED STRESS RELIEVED STRAND FOR
PRESTRESSED CONCRETE
(First Revision)

1. Scope : Requirements for manufacture, supply and testing of uncoated, stress relieved, high tensile steel strands for use in prestressed concrete. The following types of strands are covered:

- a) Two wire strand
- b) Three wire strand
- c) Seven wire strand—Class 1 and Class 2 (For classification, *see* Table 2 and 3)

2. Manufacture

2.1 Wire

2.1.1 The elements wire to be used for strand shall be cold-drawn from plain carbon steel and shall contain not more than 0.040 percent of sulphur and not more than 0.040 percent of phosphorus.

2.1.2 The wire used shall be sound and free from splits, surface flaws, piping, and any other defects.

2.2 Strand—Seven wire strand shall have a centre wire at least 1.5 percent greater in diameter than the surrounding wires enclosed tightly by six helically placed outer wires with a uniform length of lay of at least 12 times but more than 16 times of nominal diameter of the

strand. The length of lay for the two and three wire strands shall be uniform throughout and shall be 24 to 36 times the diameter of element wire. The wires in the strand shall not unravel when the strand is cut and they shall not fly out of position when the strand is cut without seizing.

3. Size and Designation

3.1 Two Wire Strand and Three Wire Strand—They shall be designated by the number of element wires (plies) and the diameter of the element wire making the strand, for example, 2-ply 2 mm strand will mean a strand consisting of two element wires of diameter 2.0 mm each. (*see* Table 1)

3.2 Seven Wire Strand—The seven wire strand shall be designated by the approximate overall diameter of the strand and number of element wires (plies) making the strand, for example, 6.3 mm 7-ply strand will mean a strand of approximate diameter 6.3 mm and made out of seven (six outer and one central) wires. (*See* Table 2)

4. Dimensions and Tolerances : *See* Tables 1 and 2

TABLE 1 DIMENSIONS, TOLERANCES AND MASS OF TWO AND THREE WIRE STRANDS

<i>Designation</i>	<i>Nominal Diameter of Element Wire</i>	<i>Tolerance on Diameter of Element Wire</i>	<i>Nominal Cross Sectional Area of Strand</i>	<i>Nominal Mass of Strand</i>
(1)	(2) mm	(3) mm	(4) mm ²	(5) kg/m
2-ply 2 mm	2.0	±0.03	6.28	0.0493
2-ply 3 mm	3.0	±0.03	14.14	0.111
3-ply 3 mm	3.0	±0.03	21.21	0.166

TABLE 2 DIMENSIONS, TOLERANCES AND MASS OF SEVEN WIRE STRANDS

<i>Class</i>	<i>Designation</i>	<i>Nominal Diameter of Strand</i>	<i>Tolerances on the Nominal Diameter of Strand</i>	<i>Nominal Cross-Sectional Area of Strand</i>	<i>Nominal Mass of Strand</i>
(1)	(2)	(3) mm	(4) mm	(5) mm ²	(6) kg/m
1	6.3 mm 7-ply	6.3	± 0.4	23.2	0.182
	7.9 mm 7-ply	7.9	± 0.4	37.4	0.294
	9.5 mm 7-ply	9.5	± 0.4	51.6	0.405
	11.1 mm 7-ply	11.1	± 0.4	69.7	0.548
	12.7 mm 7-ply	12.7	± 0.4	92.9	0.730
	15.2 mm 7-ply	15.2	± 0.4	139.4	1.094
2	9.5 mm 7-ply	9.5	+ 0.66 -0.15	54.8	0.432
	11.1 mm 7-ply	11.1	+ 0.66 -0.15	74.2	0.582
	12.7 mm 7-ply	12.7	+ 0.66 -0.15	98.7	0.775
	15.2 mm 7-ply	15.2	+ 0.66 -0.15	140.0	1.102

5. Physical Requirements**5.1 Breaking Strength** : See Table 3.**5.2 Proof Load** : See Table 3.**5.3 Elongation** : Elongation of the strand shall not be

less than 3.5 percent and shall be measured on a gauge length of not less than 200 mm for 2 ply and 3 ply strand and not less than 600 mm for 7ply strands.

5.4 Relaxation – The relaxation stress in the wire, shall not exceed 5 percent of the initial stress at the end of 1000 h.**TABLE 3 MINIMUM BREAKING LOAD**

<i>Class</i>	<i>Designation</i>	<i>Breaking Load Min</i>	<i>0.2 percent Proof load Min</i>
(1)	(2)	(3) N	(4) N
-	2-ply 2 mm	12 750	10 840
	2-ply 3 mm	25 500	21 670
	3-ply 3 mm	38 250	42 460
1	6.3 mm 7-ply	40 000	34 000
	7.9 mm 7-ply	64 500	54 700
	9.5 mm 7-ply	89 000	75 600
	11.1 mm 7-ply	120 100	102 300
	12.7 mm 7-ply	160 100	136 200
	15.2 mm 7-ply	240 200	204 200
2	9.5 mm 7-ply	102 300	87 200
	11.1 mm 7-ply	137 900	117 200
	12.7 mm 7-ply	183 700	156 100
	15.2 mm 7-ply	260 700	221 500

Note—The modulus of elasticity is to be taken as 195 ± 10 kN/mm², unless otherwise indicated by the manufacturer.**Note** – For test procedures, refer to 7 of the standard and IS 1608 : 1995 Mechanical testing of metals-tensile testin (second revision).*For detailed information, refer to IS 6006:1983 Uncoated stress relieved strand for prestressed concrete (first revision).*

SUMMARY OF
IS 7887 : 1992 MILD STEEL WIRE ROD FOR GENERAL
ENGINEERING PURPOSES
(First Revision)

1. Scope – Requirements of hot-rolled mild steel wire rods in coils or straightened and cut lengths.

2. Chemical Composition

2.1 *The ladle analysis :* See Table

TABLE 1 CHEMICAL COMPOSITION

Grade	Constituent, Percent			
(1)	(2)	(3)	(4)	(5)
	Carbon	Manganese	Sulphur, <i>Max</i>	Phosphorus, <i>Max</i>
1	0.06 <i>Max</i>	0.35 <i>Max</i>	0.050	0.050
2	0.08 <i>Max</i>	0.25 to 0.400	0.050	0.050
3	0.10 <i>Max</i>	0.70 <i>Max</i>	0.050	0.050
4	0.08 to 0.13	0.30 to 0.60	0.050	0.050
4M	0.08 to 0.13	0.60 to 0.90	0.050	0.050
5	0.10 to 0.15	0.30 to 0.60	0.050	0.050
6	0.13 to 0.18	0.30 to 0.60	0.050	0.050
6M	0.13 to 0.18	0.60 to 0.90	0.050	0.050
7	0.15 to 0.20	0.30 to 0.60	0.050	0.050
7M	0.15 to 0.20	0.60 to 0.90	0.050	0.050
8	0.18 to 0.23	0.30 to 0.60	0.050	0.050
8M	0.18 to 0.23	0.60 to 0.90	0.050	0.050
9	0.20 to 0.25	0.30 to 0.60	0.050	0.050
10	0.22 to 0.28	0.30 to 0.60	0.050	0.050
10M	0.22 to 0.28	0.60 to 0.90	0.050	0.050

2.2 *Product of Analysis –* See Table 2.

**TABLE 2 PERMISSIBLE VARIATION FOR
PRODUCT ANALYSIS OF CARBON STEEL**

Constituent	Limit, or Maximum Specified Range, Percent	Variation Over Specified Maximum or Under the Minimum limits, percent
(1)	(2)	(3)
Carbon	0.25 upto Over 0.25	0.02 0.03
Manganese		0.03
Phosphorus		0.005
Sulphur		0.005
Silicon		0.03 0.05

3. Condition of Material on Delivery – The hot-rolled wire rod shall be supplied in the form of coils or straightened and cut lengths. The size and weight of coils shall be as agreed.

4. Freedom from Defects – The finished material shall be free from such surface defects and internal flaws as would be detrimental to the end use of the material. These defects, however, will be ignored in the one metre length of coil from both ends

5. Sizes and Tolerances

5.1 Size — the nominal dia shall be 5mm on wards with an increment of 0.5 mm.

5.2 Tolerance and out of shape as given in Table 3.

6. Physical Properties — As mutually agreed.

TABLE 3 TOLERANCE OF WIRE ROD

Nominal Diameter		Tolerance on Diameter	Out of shape mm
Over	Up to and including		
(1)	(2)	(3)	(4)
-	15	± 0.4	0.60
15	25	± 0.5	0.75
25	30	± 0.6	0.90
30	—	—	—

* Tolerance should be agreed at the time of ordering.

For detailed information, refer to IS 7887 : 1992. Specification for mild steel wire rod for general engineering purposes (first revision).

SUMMARY OF
IS 13620 : 1993 FUSION BONDED EPOXY COATED
REINFORCING BARS
(First Revision)

1. Scope – Covers deformed steel reinforcing bars with protective epoxy coating applied by electrostatic spray method.

2. Coating Materials

2.1 The coating material shall meet the requirements specified in Annex A of the standard.

2.2 The patching or repairing material or both, shall be compatible with the coating, inert in concrete and feasible for repairs at the coating plant or in the field.

3. Reinforcing Steel

Steel reinforcing bars to be coated shall conform to IS 1786 : 1985*

4. Surface Preparation

4.1 The surface of the steel reinforcing bars to be coated shall be cleaned by abrasive blast cleaning to near white metal. The surface profile shall be free from mill scale, rust and foreign matter when viewed under well-lit conditions.

4.2 The coating shall be applied to the cleaned surface as soon as possible after cleaning. Any formation of rust blooms on the cleaned bars are to be removed by blast cleaning before application of the coating. However, in no case shall the coating be delayed more than eight hours after cleaning.

* Plain high strength deformed steel bars, and wires for concrete reinforcement (*third revision*).

5. Application of Coating—The coating shall be applied as an electrostatically charged dry powder sprayed onto the grounded steel bar using an electrostatic spray gun. The powder may be applied to either a hot or cold bar. The coated bar shall be given a thermal treatment specified by the manufacturer of the epoxy resin which will provide a fully cured finish coating. Temperature shall be controlled to ensure a workman like job without blistering or other defects.

6. Requirements of Coated Bars

6.1 Coating Thickness – For acceptance purposes at least 90 percent of all coating thickness measurement shall be 0.1 mm to 0.3 mm after curing. The coating thickness limits do not apply to patch areas.

6.2 Continuity of Coating – The coating shall be visually inspected after curing for continuity of the coating and shall be free from holes, voids, contamination, cracks and damaged areas discernible to the unaided eye. In addition, there shall be not more than an average of two holidays per 300 mm

Note – Holiday means a pin hole not discernible to the unaided eye.

6.3 Adhesion – No visible cracks or disbonding in the coating on the outside radius shall be allowed.

For detailed information, refer to IS 13620 : 1993 Fusion bonded epoxy coated reinforcing bars (first revision).

SUMMARY OF

IS 14268 : 1995 UNCOATED STRESS RELIEVED LOW RELAXATION SEVEN-PLY STRAND FOR PRESTRESSED CONCRETE

1. Scope – Requirements for manufacture, supply and testing of un-coated, stress relieved ‘low relaxation’ seven -ply steel strand for prestressed concrete.

2. Class – Class I or class II depending upon breaking strength of strand given in Table 1

TABLE 1 PHYSICAL PROPERTIES

Class	Nominal Dia of Strand	Breaking Strength of Strand		0.2% Proof Load (90% of Breaking Strength)	
		kN	kgs	kN	kgs
(1)	mm (2)	(3)	(4)	(5)	(6)
I	9.5	89.0	9078	80.1	8170
	11.1	120.1	12250	108.1	11026
	12.7	160.1	16330	144.1	14698
	15.2	240.2	24500	216.2	22052
II	9.5	102.3	10434	92.1	9394
	11.1	137.9	14065	124.1	12658
	12.7	183.7	18737	165.3	16860
	15.2	260.7	26592	234.6	23929

Note — The Modulus of Elasticity is to be taken as 195 ± 10 kN/mm²

3. Dimension, Tolerances and Mass – See Table 2.

TABLE 2 DIMENSION, TOLERANCES AND MASS OF WIRE STRANDS

Class	Nominal Dia of Strand	Tolerance	Nominal Area of Strand	Nominal Mass of Strand
(1)	(2)	(3)	(4)	(5)
mm		mm	mm ²	kg/km
I	9.5	±0.40	51.6	405
	11.1	±0.40	69.7	548
	12.7	±0.40	92.9	730
	15.2	±0.40	139.4	1094
II	9.5	+0.66	54.8	432
		–0.15		
	11.1	+0.66	74.2	582
		–0.15		
	12.7	+0.66	98.7	775
		–0.15		
	15.2	+0.66	140.0	1102
		–0.15		

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4. Mechanical Properties

4.1 Breaking Strength and 0.2 Percent Proof Load— It shall be not less than the values specified in Table 1.

4.2 Elongation — The total elongation under load shall not be less than 3.5 percent on a minimum gauge length of 600mm.

4.3 Relaxation Properties — Low relaxation strand, when initially loaded to 70 percent of specified minimum breaking strength of the strand shall have relaxation losses of not more than 1.8 percent after 100 h and not more than 2.5 percent after 1000 h.

Note — For test procedures, refer to 6.2, 6.3, and 6.4 of the standard and IS 1608 :1995 Mechanical testing of metals- Tensile testing (*second revision*).

For detailed information, refer to IS 14268 : 1995 Specification for uncoated stress relieved low relaxation seven-ply strand for prestressed concrete.

SECTION 15

STRUCTURAL STEELS

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Note1 – See also Section 17 Structural Shapes

Note2 – IS 280 : 1978 Mild steel wire for general engineering purposes and IS 7887 : 1992. Mild steel wire rods for general engineering purposes (*first revision*) have been covered in Section 14 Concrete reinforcement.

SUMMARY OF
IS 1977 : 1996 LOW TENSILE STRUCTURAL STEEL
(Third Revision)

1. Scope – Requirements of low carbon steel plates, sections, flats, bars, etc. for general structural purposes in the tensile range of 290 to 470 MPa.

1.1 The steels are equally suitable for bolted and riveted structures and for general engineering purposes.

1.2 When welding is employed for fabrication and guaranteed weldability is required, welding procedure should be as specified in IS 9595 : 1996. Metal-arc welding of carbon and carbon manganese steels (*first revision*)^{*}.

2. Grades – These shall be three Grades – Fe 290, Fe 330, and Fe 370.

3. Freedom from Defects – The finished material shall be reasonably free from surface flaws; laminations; rough/jagged and imperfect edges; and all other harmful defects.

3.1 Minor surface defects may be removed by grinding provided the thickness is not reduced locally by more than 4 percent below the minimum specified thickness.

4. Chemical Analysis : See Table – 1

TABLE 1 CHEMICAL COMPOSITION

Grade Designation	Ladle Analysis, Percent, Max			
	C	Mn	S	P
(1)	(2)	(3)	(4)	(5)
Fe 290	0.25	1.25	0.055	0.055
Fe 330	0.25	1.25	0.055	0.055
Fe 370	0.25	1.25	0.055	0.055

5. Tensile Properties: See Table 2

TABLE 2 TENSILE PROPERTIES

Grade Designation	Tensile Strength MPa	Yield Stress Min MPa	Percent Elongation at Gauge Length $5.65 \sqrt{S_0}$ Min	Internal Diameter of Bend
(1)	(2)	(3)	(4)	(5)
Fe 290	290-390	165	23	2t
Fe 330	330-430	170	23	3t
Fe 370	370-470	215	23	3t

Where *t* is the thickness of test piece.

6. Bend Test – For bend test, the test piece at room temperature shall withstand bending through 180° to an internal diameter not greater than that given in Table 2 without cracking.

7. Dimensions – Nominal dimensions of rolled products conforming to this specification shall be in accordance with the relevant Indian Standard. Currently available Indian Standards are listed in Table 4 of the standard.

8. Tolerances – Rolling and cutting tolerances for steel products conforming to this standard shall be those specified in IS 1852 : 1985⁺⁺.

⁺⁺ Rolling and cutting tolerances for hot rolled steel products (*fourth revision*).

Note — For test procedures, refer to IS 1599 : 1985 Method of bend test (*second revision*) and IS 1608 : 1995 Mechanical testing of metals-tensile testing (*second revision*)

For detailed information, refer to IS 1977: 1996 low tensile structural steels. (third revision).

SUMMARY OF

IS 2062 : 1999 STEEL FOR GENERAL STRUCTURAL PURPOSES

(Fifth Revision)

1. Scope — Requirements of steel plates, strips, sections, flats, bars, etc, for use in structural work.

1.1 The steels are suitable for welded, bolted and riveted structures, and for general engineering purposes.

1.2 Where welding is employed for fabrication and guaranteed-weldability is required, welding procedure should be as specified in IS 9595 : 1996 'Metal arc welding of carbon and carbon manganese steels - Recommendations (first Revision)':.

2. Grades — There shall be three grades:

<i>Grade</i>	<i>Designation</i>
A	Fe 410W A
B	Fe 410W B
C	Fe 410W C

3. Freedom from Defects — The finished material shall be reasonably free from surface flaws; laminations; rough/jagged and imperfect edges; and all other harmful defects.

Minor surface defects may be removed by grinding provided the thickness is not reduced locally by more than 4 percent below the minimum specified thickness.

4. Mechanical Properties :

4.1. Tensile Test — As a rule, test pieces with a proportional gauge length complying with the requirements $L_0 = 5.65 \sqrt{S_0}$ should be used for the tensile test, where L_0 is the gauge length and S is the cross sectional area of the test.

4.2. Bend Test — For bend test, the test piece at room temperature shall withstand bending through 180° to an internal diameter not greater than that given in Table 1 without cracking.

4.3. Impact Test — It shall meet the requirements given in Table 1 provided no individual value shall be less than 70 percent of the specified value.

TABLE 1 MECHANICAL PROPERTIES

<i>Grade</i>	<i>Designation</i>	<i>Tensile Strength</i>	<i>Yield Stress, Min, MPa at Gauge length</i>			<i>Percent Elongation Diameter</i>	<i>Internal</i>	<i>Charpy V-Notch Impact Energy</i>
		Min, MPa	<20	20-40	>40	$5.65 \sqrt{S_0}$	of bend	J, Min
(1)	(2)	(3)	mm	mm	mm	min	min	(9)
A	Fe410WA	410	250	240	230	23	3t —	
B	Fe410WB	410	250	240	230	23	2 t for less than or equal to 25 mm thick products 3t for more than 25 mm thick products	27
C	Fe410WC	410	250	240	230	23	2t	27

4.4 Groove Crackability Test – Y-Groove crackability test may be carried out in accordance with IS 10842 for products of only Grade C material having thickness above 12 mm and above if specially agreed to between the purchaser and the manufacturer.

5. Dimensions – The nominal dimensions of rolled products conforming to this standard shall be in

⁺ Testing and evaluation procedure for Y groove crackability test.

accordance with the relevant Indian Standard. Currently available Indian Standard are listed in Table 4 of the standard

6. Tolerance – The rolling and cutting tolerances for steel products conforming to this standard shall be those specified in S 1852 : 1985⁺⁺

⁺⁺ Rolling and cutting tolerances for hot rolled- steel products
(fourth revision)

Note 1 – For test procedures, refer IS 599 : 1985. Method of end test (second revision) and IS 1608 : 1995 Mechanical testing of metals. Tensile testing (*second revision*).

Note 2 – For chemical composition, *see 8 of the standard.*

For detailed information, refer to IS 2062 : 1999 Specification for steel for general structural purposes (fifth revision).

SUMMARY OF

IS 8500 : 1991 STRUCTURAL STEEL- MICRO ALLOYED
(MEDIUM AND HIGH STRENGTH QUALITIES)

(First Revision)

1. Scope – Requirements of microalloyed steels of different strength levels for use in structural work. The steels may be suitable for other application also.

2. Grades – It shall be in 10 grades given in Table 1.

3. Freedom from Defects— The finished material shall be free from surface defects, such as pits, rolled in scales, deep scratches, grooves, laminations, cracks, rough jagged and imperfect edges, and any other harmful defects.

4. Mechanical Properties — See Table 1.

TABLE 1 MECHANICAL PROPERTIES

Grade	Tensile Strength Min	Yield Strength Min				Elongation Percent Min	Bend Internal Diameter		Charpy V-notch Impact Toughness, Joules, Min, (Average of 3 Values) Room Temp * -20°C	
		<16	16-40	41-63	>63					
		mm	mm	mm	mm					
		MPa	MPa	MPa	MPa		MPa	5.65 √S ₀		
							<12 mm 2t	12-25 mm 3t		
Fe 440	440	300	290	280	By agreement	22			—	—
Fe 440B	440	300	290	280	—	22	2 t	3 t	50	30
Fe 490	490	350	330	320	—	22	2 t	3 t	—	—
Fe 490B	490	350	330	320	—	22	2 t	3 t	50	25
Fe 540	540	410	390	380	—	20	2 t	3 t	—	—
Fe 540B	540	410	390	380	—	20	2 t	3 t	50	25
Fe 570	570	450	430	420	—	20	2 t	3 t	—	—
Fe 570B	570	450	430	420	—	20	2 t	3 t	45	20
Fe 590	590	450	430	420	—	20	2 t	3 t	—	—
Fe 590B	590	450	430	420	—	20	2 t	3 t	45	20

* Room Temperature = 25 ± 2°C;

** + is the thickness of the test piece.

Note 1— For test procedures, refer to IS 1599: 1985 Method of bend test (second revision), IS 1608:1995 Mechanical testing of metals – Tensile testing (second revision) and the standard.

Note 2 – For chemical composition see 7 of the standard.

For detailed information, refer to IS 8500 : 1991. Specification for structural steel – Microalloyed (medium and high strength qualities) (third revision).

SUMMARY OF

IS 11587 : 1986 STRUCTURAL WEATHER RESISTANCE STEELS

1. Scope – Requirements for high strength low alloy weather resistant structural steels in the form of plates, strips, sections and bars for welded, riveted or bolted construction requiring atmospheric corrosion resistance.

2. Grade – There shall be following three grades of structural weather resistant steel:

- a) WR-Fe 480A,
- b) WR-Fe 480B, and
- c) WR-Fe 500

3. Weldability – All steel grades specified in this standard are of weldable quality.

3.1 If the weather resistant steels are to be used unpainted, it is advisable to select the welding electrodes with matching weathering characteristics.

4. Freedom from Defects – The finished material shall be free from cracks, surface flaws, laminations, rough jagged and imperfect edges, and all other harmful defects.

5. Mechanical Properties

5.1 Tensile Test — See Table 1

TABLE 1 MECHANICAL PROPERTIES

Grade	Tensile Strength MPa	Yield Strength, Min, Mpa				Percentage Elongation on Gauge Length $5.65 \sqrt{S_0}$ min
		Up to and Including 12 mm	Over 12 mm Up to and Including 25 mm	Over 25 mm Up to and Including 40 mm	Over 40 mm Up to and Including 50 mm	
WR-Fe 480A	480	345	325	325	-	21
WR-Fe 480B	480	345	345	345	340	21
WR-Fe 500	500	355	-	-	-	20

5.2 Bend Test – The test piece when cold shall withstand the test without cracking as prescribed in the standard.

5.3 Impact Test – The mean values after the test shall be as given in Table 2.

TABLE 2 CHARPY V-NOTCH IMPACT TEST VALUE

Grade	Temperature °C	Impact Energy, Joule (Min, Average)
WR-Fe 480A	0	27
WR-Fe 480B	0	27
WR-Fe 500	-15	27

5.4 Flattering Test – Flattering test shall be carried out for circular hollow section. If agreed, this test may also be carried out on rectangular hollow sections. The ring shall be flattened cold between the parallel plates with the weld, if any, at 45°. No opening shall occur by fracture in the weld until the distance between the plates is less than 75 percent of the original outside diameter. The test shall continue until the weld, if any, opens and the weld shall show no sign of incomplete fusion. No crack or breakage in the metal elsewhere than the weld shall occur until the distance between the plate is 2/3 of the original outside diameter.

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6. Dimensions – Shall be in accordance with the relevant Indian Standards. Currently available Indian Standards are listed in Table 5 of the standard.

7. Tolerances – Rolling and cutting tolerances for

steel products conforming to this standard shall be those specified in IS 1852 :1985*.

*Rolling and cutting tolerances for hot rolled steel products
(fourth revision)

Note 1– For test procedures, refer to the standard, IS1599 : 1985 method of bend test (*second revision*),

IS 1608 :1995 Mechanical testing of metals-tensile testing (*second revision*) and

IS 1757:1988 Method of charpy impact test (v notch) for mettalic materials (*second revision*)

Note 2– For chemical composition refer to the standard

For detailed information, refer to IS 11587 : 1986 Structural weather resistant steels.

SUMMARY OF
IS 277 : 2003 GALVANIZED STEEL SHEETS
(PLAIN AND CORRUGATED)
(Sixth Revision)

1. Scope – Requirements of plain galvanized steel sheets and strips coils, and corrugated galvanized sheets.

2. Classification — See Table 1

TABLE 1 CLASSIFICATION OF GRADES OF GP/GC COILS AND SHEETS

Type	Designation	GradeReference of Base Metal IS1079/IS 513
(1)	(2)	(3)
(i) Deep drawing	GPD	Grade 'DD'
(ii) Extra deep drawing	GPED	Grade 'EDD'
(iii) Interstitial free	GPIF	Grade 'IF'
(iv) Corrugated ordinary	GC	Grade 'O'

Note – Spangles should not be allowed to form on the surface of strips / sheets during galvanizing

3. Zinc Coating – The zinc coating shall conform to the requirement of any one of the grades prescribed in Table 2. The mass of coating referred to in this standard shall represent the total mass of zinc, both sides inclusive.

3.1 The following are recommended grades of zinc coating for the various thickness of sheets –

Thickness mm	Grade of Zinc Coating
0.18 to 0.28 (both inclusive)	200
0.30 to 0.55 (both inclusive)	220
0.63 to 1.0 (both inclusive)	275
above 1.00 mm	350

Note 1 – The recommended thickness for roofing applications is 0.63 mm and corresponding recommended grade of coating shall be minimum 275 gm/m².

Note 2 – If agreed to between the manufacture and the purchaser for thickness 0.18 mm to 0.28 mm (both inclusive), other coating grades 180 and 120 may be used.

TABLE 2 MASS OF COATING

Grade of Coating	Minimum Average Coating Triple Spot Test g/m ² (2)	Minimum Coating Single Spot Test g/m ² (3)
(1)	(2)	(3)
600	600	510
450	450	380
350	350	300
275	275	235
220	220	190
200	200	170
180	180	155
120	120	100

4. Bend Test – Samples of galvanized steel sheets shall withstand bending through 180° around a mandrel having diameter specified in Table 3 of the Standard without peeling or flaking of zinc coating. Crack or fracture of base metal, shall not be permitted.

However, Cracks of the base metal developing at the edge of the specimen or coarse grain developing at the line of the bend shall be disregarded.

5. Coating Test

5.1 Determination of Mass of Zinc Coating – The average masses of zinc coating shall conform to both the values specified in Table 2.

6. Freedom from Defects – Galvanized plain sheets, corrugated sheets and coils shall be reasonably flat and free from bare spots, holes, tears and other harmful defects.

6.1 Coils, however, may contain some abnormal imperfections which render a portion of the coil unusable since the imperfections in the coil cannot be removed as in the case with cut length.

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7. Mass – See Table 4 of the Standard.

8. Dimensions and Tolerances of Plain Sheets/Coils.

8.1 Sizes of Plain Sheets

a) Length	- 1 800, 2 200, 2 500, 2 800 and 3 000 mm
b) Width	- 750, 900, 1 000 and 1 200 mm
c) Thickness (uncoated sheets)	- 0.18, 0.22, 0.25, 0.28, 0.32, 0.40, 0.45, 0.50, 0.55, 0.63, 0.70, 0.80, 0.90, 1.00, and 1.60 mm.

Note : Sheets for other sizes (length, width and thickness) may also be supplied subject to the mutual agreement between the purchaser and the manufacturer.

8.2 Unless other wire agreed, the internal diameter of sheet supplied coil shall be 450, 510 or 610 mm.

8.3 Tolerances

8.3.1 No sheet shall be smaller in length than that specified. Tolerances on length on plus side shall be 15 mm or 0.5 percent of length whichever is greater.

8.3.2 The diagonal distance between opposite corners of any sheet shall not differ by more than 20 mm.

8.3.3 No plain sheet shall be smaller in width than that specified. The positive tolerances on width shall be 10 mm.

8.3.4 Thickness : The tolerance on thickness of sheet and coil shall be according to IS 1079⁺ or IS 513⁺⁺.

8.3.5 Tolerance on Mass — The tolerance on mass of individual sheets calculated in accordance with Table 4 of the Standard shall be within ± 10 percent and tolerance on mass of each bundle of sheet shall be ± 5 percent.

9. Dimensions and Tolerances of Corrugated Sheets.

9.1 Sizes of Corrugated Sheets

⁺ Cold rolled low carbon steel sheets and strips (fourth revision)

⁺⁺ Hot-rolled carbon steel sheets and strip (fifth revision)

Note : For test procedures, see 8, 9 and 10 of the standard

9.1.1 Length – The length of the corrugated sheets shall be as follows – 1 800, 2 200, 2 500, 2 800, 3 000 and 3 050 mm

9.1.2 Depth and pitch of the corrugations: The depth and pitch of corrugation shall be as follows (see Fig. 1 of the standard)

Grade	Depth of Corrugation mm	Pitch of Corrugation mm
A	17.5	75
B	12.5	75

9.1.3 Number of corrugations – The number of corrugations shall be 8, 10, 11 and 13 depending on the width of the sheet. The overall width of the corrugated sheet before and after corrugation shall as shown in Table 3.

9.1.3.1 Sheets of sizes other than those specified above may be supplied, if agreed to between the contracting parties.

TABLE 3 OVERALL WIDTHS AND CORRUGATIONS OF SHEETS

Number of Corrugations	Grade	Overall Widths of Sheet	
		Before Corrugation mm	After Corrugation mm
(1)	(2)	(3)	(4)
8	A	750	660
10	A	900	810
11	A	1 000	910
13	A	1 200	1 110
8	B	750	680
10	B	900	830
11	B	1 000	930
13	B	1 200	1 130

9.2 Tolerances – See Table 4.

TABLE 4 TOLERANCE ON DIMENSION OF CORRUGATED SHEETS

Dimensions (1)	Tolerance ¹ (2)
Depth of corrugation	± 2.5 mm
Pitch of corrugation	± 5 mm
Overall width after corrugation	± 25 mm

¹⁾ Average of 4 measurements

For detailed information, refer to IS 277 : 2003 Specification for galvanized steel sheets (plain and corrugated) (fifth revision).

SUMMARY OF
IS 412 : 1975 EXPANDED METAL STEEL SHEETS FOR
GENERAL PURPOSES
(Second Revision)

1. Scope – Requirements for expanded metal steel used for general purposes.

2. Size of Mesh – Based on measurements of shortway of mesh (SWM) and longway of mesh (LWM) of diamond, and width and thickness of the strands.

3. Dimensions – See Table 1.

TABLE 1 SIZES OF SHORTWAY MESH AND LONGWAY MESH

Ref. No.	Size of Mesh (Nominal)		Largest Standard Size of Sheets		Size of Sheet Normally Stocked
	SWM mm	LWM mm	LWM mm	SWM mm	mm
1	100	250	3.75	10.97	2.50 × 3.75
2	100	250	3.75	14.63	
3	100	250	3.75	21.97	
4	75	200	3.75	7.30	
5	75	200	3.75	7.30	
6	75	200	3.75	14.60	
7	40	115	2.50	3.75	
8	40	115	2.50	4.85	
9	40	75	2.50	4.85	
10	40	75	2.50	7.30	
11	40	115	2.50	7.30	2.50 × 3.75
12	40	75	3.75	7.30	and
13	40	115	2.50	7.30	1.25 × 3.75
14	40	75	3.75	7.30	2.50 × 3.75
15	25	75	2.50	4.85	
16	25	75	2.50	4.85	
17	25	75	2.50	4.85	2.50 × 3.75
18	25	75	2.50	4.85	and
19	20	60	2.50	3.75	1.25 × 3.75
20	20	50	3.75	3.75	2.50 × 3.75
21	20	60	2.50	3.75	
22	20	50	3.75	3.75	
23	20	60	2.50	3.75	2.50 × 3.75
24	20	50	3.75	3.75	and
25	20	60	2.50	4.85	1.25 × 3.75
26	20	50	3.75	3.75	2.50 × 2.75
27	12.5	50	2.50	3.00	
28	12.5	40	3.75	3.00	
29	12.5	50	2.50	3.00	
30	12.5	50	2.50	3.00	
31	12.5	40	3.75	3.00	
32	12.5	50	2.50	3.00	
33	12.5	40	3.75	3.00	
34	10	40	2.50	2.00	
35	10	40	2.50	2.00	
36	10	40	2.50	2.00	2.50 × 1.75
37	9.5	28.5	2.50	2.00	and
38	9.5	28.5	2.50	2.00	1.25 × 1.75
39	9.5	28.5	2.50	2.00	2.50 × 1.75
40	9.5	25	2.50	2.00	
41	6	25	2.50	2.00	
42	6	25	2.50	2.00	2.50 × 1.75
43	5	20	2.50	1.50	1.25 × 1.75
44	3	15	2.50	1.50	

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4. Tolerances

On nominal specified : ± 10 mm
dimensions

On minimum specified : $+ 10$ mm
dimensions — 0 mm

On mass : ± 10 percent

4.1 Size of Mesh

On SWM : ± 1 mm up to 20 mm and
 ± 2 mm over 20 mm

On LWM : ± 2 mm up to 60 mm and
 ± 4 mm over 60 mm and

5.1 Tensile strength of blank steel sheets shall be between 280 and 380 MN/m².

Note —1 N/mm² = 1 MN/m² = 0.102 kgf/mm².

5.2 Bend Test — Test piece shall withstand without crack, being doubled over when cold, till the internal radius is not greater than 1.5 times its thickness and until the two sides of test piece are parallel.

6. Freedom from Defects — Finished expanded metal sheets shall be free from flaws, joints, welds, broken strands, laminations, etc.

7. Preservative Treatment — Shall be given a suitable protective coating to prevent corrosion.

5. Mechanical Properties

Note 1 — For test procedures, refer to IS 1608 :1995 Mechanical testing of metals tensile testing (*second revision*), and IS 1599:1985 Method for bend test (*second revision*),

Note 2 — For chemical composition see 3.1 and 3.2 of the standard.

For detailed information, refer to IS 412 : 1975 Expanded metal—Steel sheets for general purposes (*second revision*).

SUMMARY OF
IS 513 : 1994 COLD ROLLED LOW CARBON STEEL
SHEETS AND STRIPS
(Fourth Revision)

1. Scope – Requirements of cold rolled low carbon steel sheets and strips for bending and drawing purpose and where the surface is of prime importance. It covers sheets and strips up to 4 mm thick both in coil form and cut lengths.

2. Classification of Grades – Sheets and strips shall be classified in the following grades –

O	– Ordinary quality
D	– Drawing quality
DD	– Deep drawing quality, and
EDD	– Extra deep drawing quality

3. Chemical Composition

3.1 Ladle Analysis – The ladle analysis of steel, shall be as given in Table 1.

3.2 Product Analysis – Permissible variation in the case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

TABLE 1 CHEMICAL COMPOSITION

Grade	Constituent, percent, <i>Max</i>			
	Carbon	Manganese	Sulphur	Phosphorus
(1)	(2)	(3)	(4)	(5)
Ordinary (O)	0.15	0.60	0.055	0.055
Drawing (D)	0.12	0.50	0.040	0.040
Deep drawing (DD)	0.10	0.45	0.035	0.035
Extra deep drawing (EDD)	0.08	0.40	0.030	0.030

TABLE 2 PERMISSIBLE VARIATION FOR PRODUCT ANALYSIS

Constituent	Variation Over Specified Limit, Percent, Max
Carbon	0.02
Manganese	0.03
Sulphur	0.005
Phosphorus	0.005

Note — Product analysis shall not be applicable to rimming steel.

4.1 Tensile Test – Mechanical properties at room temperature in as delivered condition for annealed / skin passed sheets and strips (cut lengths and coils) shall be as follows –

Grade	Tensile strength MPa	Yield Stress Max, Max	Elongation Percent on Gauge Length 80 mm and Width 20 mm, Min	Hardness (Max) HRB HR (30T)	
O	--	--	--	See 4.3	
D	270-410	280	28	65	60
DD	270-370	250	32	57	55
EDD	270-350	220	36	50	50

4.2 Cupping Test – It shall be applicable only for sheets, strips and coils of D, DD and EDD grades having thickness from 0.5 mm upto 2.00 mm. See Fig. 1 of the standard.

4.3 Hardness Test – Hardness of different tempers at room temperature for ‘O’ grade shall be as follows—:

Temper	Hardness HRB.	
	Min.	Max.
Hard (H)	85	--
Half Hard (½H)	75	85
Quarter Hard (¼H)	60	75
Skin Passed (SP)	--	70
Annealed (A)	--	60

4.4 Bend Test – The angle of bend and internal diameter of bend for different grades of material shall be as follows :

4. Mechanical and Physical Properties

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4.4.1 For sheets / strips in cut lengths and coils in Annealed and Skin Pass condition :

<i>Steel Grade Bend</i>	<i>Angle of of Bend</i>	<i>Internal Diameter</i>
O	180°	<i>t</i>
D	180°	Close
DD	180°	Close
EDD	180°	Close

4.4.2 For Sheets / Strips of ‘O’ grade

<i>Temper</i>	<i>Angle of Bend</i>	<i>Internal Diameter of Bend</i>
H	--	--
½H	180°	3t
¼H	180°	2t
SP	180°	<i>t</i>
A	180°	<i>t</i>

Note – *t* is thickness of test piece.

4.4.3 The test pieces shall be deemed to have passed the test if the outer convex surface is free from cracks.

5. Freedom from Defects – The finished sheets and strips shall be free from harmful defects, such as scale rust, blisters lamination, pitting, porosity, cracked or torn edges any other defects which are harmful to the intended use.

6. Dimensions

6.1 Thickness – Dimensions of cold rolled sheets and strips shall be as given below –

<i>Thickness, mm</i>	0.18, 0.20, 0.22, 0.25, 0.28, 0.30, 0.32, 0.35, 0.40, 0.45, 0.50, 0.55, 0.63, 0.80, 0.90, 1.00, 1.20, 1.25, 1.40, 1.50, 1.60, 1.80, 2.00, mm
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6.1.1 The following are the preferred thickness for sheets above 2.00 mm, 2.50 mm, 2.65 mm, 3.00 mm, 3.25 mm, 3.50 mm and 4.00 mm

Note – For dimensional tolerances applicable to cold rolled sheets and strips See Tables 6 to 16 of the standard.

Note 1 — For supply conditions including surface finish refer to the standard.

Note 2 – For test procedures, refer to IS 1501 (Part) – 1984 Method for Vickers Hardness test for metallic materials : Part 1 HV 5 to HV 100 (*second revision*), IS 1586 : 2000 Method of Rockwell Hardness test for metallic materials (A-B-C-D-E-G-H-K 15 N, 30 N, 45N. 15 T, 30 T, 45 T) (*third revision*).

IS 1599 : 1985 Method of bend test (*second revision*),

IS 1608 : 1995 Mechanical testing of metals – Tensile testing (*second revision*) ; and

IS 10175 (Part 1) : 1993 Mechanical testing of metals – Modified erichsen cupping test – Sheet and strip : Part 1 Thickness upto 2 mm (*first revision*).

For detailed information, refer to IS 513 :1994 Specification for cold rolled low carbon steel sheets and strips (fourth revision).

SUMMARY OF

IS 1079 : 1994 HOT ROLLED CARBON STEEL SHEETS AND STRIPS

(Fifth Revision)

1. Scope— Requirements of Hot rolled carbon steel sheets including pack rolled sheets and strips intended for cold forming, drawing and general engineering purposes.

2. Grades— There shall be 4 grades of hot rolled carbon steel sheet and strip designated as follows.

- a) O— Ordinary quality : intended for general fabrication purposes where sheets or strips are used in the flat or for bending, moderate forming and welding operation
- b) D — Drawing quality
- c) DD — Deep drawing quality
- c) EDD — Extra deep drawing quality

Note — D, DD and EDD are intended for applications where drawing, severe forming and welding are involved.

3. Tensile Properties — Shall be as follows:

Grade	Tensile strength MPa	Yield Stress, MPa	Percent Elongation at Gauge length $5.65\sqrt{S_0}$ Min
O	—	—	—
D	240-400	—	25
DD	260-390	—	28
EDD	260-380	—	32

4. Bend Test — The test piece shall be bent cold through 180°. The test piece shall be deemed to have passed the test if the outer convex surface is free from cracks after complete bending. The internal diameter of bend for different grades shall be as follows

Steel Grade	Internal Diameter of Bend
O	2 t
D	t
DD	Close
EDD	Close

Note— Where t is the thickness of test piece.

Note1 — For test procedures, refer to IS 1599 : 1985 Method of bend test (second revision).

IS 1608 : 1995. Mechanical testing of metals Tensile testing (second revision) and

IS 10175 (Part 1) : 1993. Mechanical testing of metals modified erichsen cupping test-Sheet and strip, Part 1— Thickness upto 2 mm (first revision).

Note2— For chemical composition, refer to the standard.

For detail information, refer to IS 1079 : 1994 Hot rolled carbon steel sheets and strips (fifth revision).

5. Cupping Test — Cupping Test may be carried out only for sheets strips of D, DD and EDD grades having thickness from 0.5mm upto 2.00mm. The test and test values shall be as agreed mutually.

6. Strain Ageing Test — The test is to be carried out on grades where steel is supplied with non-ageing properties / guarantee and shall be as agreed. The test piece shall not develop crack near the bend, after prescribed test.

7. Freedom from Defects — The finished material in cut lengths shall be free from harmful defects which will affect the end use. When the material is supplied in the form of coils, the degree or amount of surface defects are expected to be more than in cut length sheets.

8. Dimensions and Tolerances

8.1 Dimensions of steel sheet and strip shall conform to the dimension specified in IS 1730 : 1989.*

8.2 Tolerance on length, width, thickness, and mass of the steel sheet and strip shall conform to the limits specified in IS 1852:1985.*

8.3 For Camber tolerances, flatness tolerances and out of square tolerances refer 13 of the standard.

9. Weight — The mass of the material shall be calculated on the basis that steel weighs 7.85 g/cm³:

* Dimensions for steel plates sheets, strips and flats for general engineering purposes (second revision)

+ Rolling and cutting tolerances for hot rolled steel products (fourth revision).

SUMMARY OF
IS 3502 : 1994 STEEL CHEQUERED PLATES
(Second Revision)

1. Scope – Requirements for steel chequered plates, having raised figures at regular intervals on one surface of the plate.

2. Material – Steel for the chequered plates shall conform to the requirements of Grade A of IS 2062 : 1992⁺ or IS 1977 : 1996⁺⁺.

3. Freedom From Defects – Plates shall be cleanly rolled to the dimensions specified. Finished material shall be free from harmful surface defects, such as cracks, surface flaws, imperfect edges, etc.

4. Patterns – See Fig.1 of the standard.

5. Tensile Test – Properties shall conform to Grade A of IS 2062 : 1992⁺ or IS 1977 : 1996⁺⁺.

6. Bend Test — In accordance with IS 1599 : 1985.*

7. Dimensions and Rolling Tolerances— Chequered plates shall normally be supplied in sheared edges.

7.1 Nominal dimensions of chequered plates (excluding raised portion) shall be in accordance with IS 1730 : 1989[†].

7.2. The rolling and cutting tolerances on width, length and thickness (excluding raised portion) shall be as given in IS 1852 : 1985[‡].

7.3. The minimum bead height of chequered plates shall be 0.8 mm.

* Method of bend test for steel products other than sheet, strip wire and tube (*second revision*).

[†] Dimensions for steel plates, sheets, strips and flats for general engineering purposes (*second revision*).

[‡] Rolling and cutting tolerances for hot rolled steel products (*second revision*).

⁺ Steel for general structural purposes (*fourth revision*).

⁺⁺ Structural steel (ordinary quality) (*second revision*).

Note – For test procedures, refer to IS 1599 : 1985 Methods of bend test (*second revision*) and IS 1608 : 1995 Mechanical testing of metals tensile testing (*second revision*).

For detailed information, refer to IS 3502 : 1994 Specification for steel chequered plates (second revision).

SUMMARY OF

IS 7226 : 1974 COLD-ROLLED MEDIUM, HIGH CARBON AND LOW ALLOY STEEL STRIP FOR GENERAL ENGINEERING PURPOSES

1. Scope – Requirements for cold-rolled medium, and high carbon and low alloy steel strips of thickness up to 3 mm and width up to 330 mm intended for general engineering purposes.

2. Chemical Analysis — Carbon content (percent) on ladle analysis shall be as follows :

3. Hardness Test – When subjected to Rockwell hardness test in accordance with IS 1586 : 1988* or IS 5072 : 1988⁺ shall conform to the requirements given below :

4. Freedom From Defects – Shall be free from scales, rust, blisters, laminations, pitting and cracked edges.

5. Edge Condition – Shall be supplied with mill, trimmed or slit edges.

<i>Medium Carbon</i>		<i>High Carbon</i>				<i>High Carbon Low Alloy</i>	
C40	C55	C70	C80	C85	C98	120Cr35	110Cr35W2
0.35-0.45	0.50-0.60	0.65-0.75	0.75-0.85	0.80-0.90	0.90 - 1.05	1.10- 1.30	1.0 -1.20

Note — For manganese, silicon, sulphur, phosphorus, chromium and tungsten contents, refer to 4 of the standard.

6. Surface Finish – Bright Finish.

Note – For rolling tolerances see 9 of the standard.

* Methods for rockwell hardness test for metallic material
(second revision).

+ Method for rockwell superficial hardness test (first revision)

<i>DESIGNATION ANNEALED HARDNESS, MAX ANNEALED AND RE-ROLLED HARDNESS, MAX</i>				
	<i>HRB</i> <i>Equivalent HV</i>		<i>HRC</i> <i>Equivalent HV</i>	
C40	83.4	160	28	290
C55	85.0	165	35	350
C70	87.9	175	35	350
C80	91.6	190	35	350
C85	91.6	190	35	350
C98	94.8	205	35	350
120 Cr 35	97.5	220	35	350
110 Cr 35W2	97.5	220	35	350

For detailed information, refer to IS 7226 : 1974 Specification for cold-rolled medium, high carbon and low alloy steel strip for general engineering purposes.

SUMMARY OF

IS 12313 : 1988 HOT-DIP TERNE COATED CARBON STEEL SHEETS

1. Scope – Requirements of terne coated carbon steel sheets for use in automobile industry, as a roofing and other similar application the thickness of the sheet shall be between 0.3 to 2.0 mm. The thickness other than this may be as agreed to between the purchaser and the manufacturer.

2. Terminology

2.1 Terne (Lead Alloy)— In the context of this standard, any lead-based alloy in commercial use for the hot-dip coating of steel sheet. Tin is the most common alloying element, but antimony is also commercially used, or combinations of both elements. If a specific alloy composition is required, it shall be by agreement between the manufacturer and the purchaser.

2.2 Designation System

Terne coating and qualities – The produced hot-tip terne coating is designated T0 (the '0' is inserted to fill a computer space and has no significance in the designation). The coating mass designation follows the T0 and three spaces are allocated for coating mass designation. If only two spaces are required, such as for designation '75', then the '75' is preceded by a '0' to fill computer space and is shown as '075'. If the product is skin passed, designation 'S' is used to indicate the coating condition. If the product has not been skin passed, the designation 'N' for normal coating (as produced) is shown. The numbers 01, 02, 03 and 04 are

common to other standards indicating the qualities of commercial, drawing, deep drawing, and deep drawing special killed. An example of a complete condition designation including coating, coating mass, coating condition and quality is T0 120N01. This is composed by combining the following :

T0 = terne coating
120 = coating designation
N = normal coating
01 = ordinary quality

3. Conditions of Manufacture

3.1 Ladle Analysis — See Table 1.

3.2 Product Analysis – Permissible variation in the case of product analysis from the limits specified in Table 1 shall be given as below:

Constituent	Permissible Variation Over Specified Limit, Percent
Carbon	0.02
Manganese	0.03
Sulphur	0.005
Phosphorus	0.005

3.3 Terne (Lead Alloy) Coating Mass – The mass of coating shall conform to the requirements in Table 2 for the specific coating designation. The mass of coating is the total amount on both surfaces of the sheet, expressed in grams per square metre (g/m²) of sheet.

TABLE 1 CHEMICAL COMPOSITION (LADLE ANALYSIS)

Quality		C	Mn	P	S
		Max	Max	Max	Max
Designation	Name				
T0 01	Ordinary	0.15	0.60	0.055	0.055
T0 02	Drawing	0.12	0.50	0.04	0.04
T0 03	Deep drawing	0.10	0.45	0.03	0.03
T0 04	Deep drawing special killed	0.08	0.45	0.03	0.03

**TABLE 2 COATING DESIGNATIONS
AND LIMITS**

Coating Designation	Minimum Coating Mass Limits, g/m ² (Total Both Sides)	
	Triple Spot Test Check Limits	Single Spot Test Check Limits
1	2	3
001	no minimum	no minimum
050	50	40
075	75	60
100	100	75
120	120	90

Note – ‘no minimum’ means that there are no established minimum check limits for triple spot and single spot tests.

3.4 Mechanical Properties – See Table 3.

4. Dimensional Tolerances – Refer to Tables 5 to 13 of the standard.

5. Workmanship – The terne sheet in cut lengths shall be free from amounts of laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing.

TABLE 3 MECHANICAL PROPERTIES

Quality		Tensile Strength <i>R_m Max*</i> MPa (N/mm ²)	Percentage Elongation		180°, Bend Mandrel Diameter, for All Thickness
Designation	Name		<i>A min+</i>		
			Gauge length <i>l</i> ₀ =60 mm	Gauge length <i>l</i> ₀ =80 mm	
T0 01	Ordinary	—	—	—	1a
T0 02	Drawing	430	24	23	—
T0 03	Deep drawing	410	28	25	—
T0 04	Deep drawing special killed	410	29	28	—

a = thickness of bend test piece.

* Minimum tensile strength for qualities T0 02, T0 03 and T0 04 would normally be expected to be 260 MPa. All tensile strength values are determined to the nearest 10 MPa.

+ For material up to and including 0.6 mm in thickness, the elongation values in the table shall be reduced by 2. For thickness up to 2 mm, use either *l*₀ = 50 mm or *l*₀ = 80 mm.

Note – For test procedures, refer to IS 1599 : 1985 Method of bend test (*second revision*); IS 1608 : 1995 Mechanical testing of metals – Tensile testing (*second revision*) and the standard.

For detailed information, refer to IS 12313: 1988 Specification for hot-dip terne coated carbon steel sheets.

SUMMARY OF
IS 1148 : 1982 HOT ROLLED STEEL RIVETS BARS
(UPTO 40 MM DIAMETER) FOR STRUCTURAL PURPOSES
(Third Revision)

1. Scope – Requirement for hot-rolled steel rivet bars in size up to 40 mm diameter used for the manufacture of hot forged rivets for structural purposes.

2. Chemical Composition

2.1 Ladle Analysis – Ladle analysis of the steel, shall be as given below:

<i>Constituent</i>	<i>Per cent, Max</i>
Carbon	0.23
Sulphur	0.050
Phosphorus	0.050

2.2 Product Analysis – Permissible variation in the case of product analysis, from the limits specified under 2.1 shall be as follows:

<i>Constituent</i>	<i>Variation Over the Specified Limit Percent, Max.</i>
Carbon	0.02
Sulphur	0.005
phosphorus	0.005

2.3 When steel is required in copper bearing quality, copper content shall be between 0.20 to 0.35 percent. In case of product analysis, permissible variation shall not exceed ± 0.3 percent.

2.4 When steel is silicon – killed, silicon content on the product analysis, shall not be less than 0.1 percent. When the steel is silicon- aluminium -killed or aluminium-killed, the requirement regarding minimum silicon content shall not apply.

3. Freedom from Defects – The finished material shall be free from such surface and internal flaws as would be determined to the end use of the material.

4. Lengths – In multiples of 250 mm.

5. Dimensional Tolerances – The bar shall comply with the following dimensional tolerances:

<i>Diameter of Bar</i> mm	<i>Total Tolerance</i> mm
Below 20	0.40
20	0.45
22 and 24	0.50
Over 24	2 percent of diameter

All the tolerances specified shall be minus tolerances. When special plus and minus tolerances are required by the purchaser, the sum of such tolerances shall not be specified as less than the above total tolerances.

6. Tests

6.1 Tensile Test

<i>Characteristic</i>	<i>Requirement</i>
Tensile strength, MPa	410- 530
Min Yield stress, min, MPa	
a) 6mm upto and including 12mm	260
b) Over 12 mm upto and including 20 mm	250
c) Over 20 mm upto and including 40mm	240
Elongation percent, Min,	
gauge length $5.65 \sqrt{S_0}$ Min	22

6.1.1 No tensile test shall be carried out on bars below 6mm

6.2 Dump Test – Minor surface flaws which do not tend to open out wider than 0.4 mm + 0.04 times the diameter of the rivet bar shall not be the cause for rejection. Dump test shall not be applicable to bars below 6 mm.

6.3 Bend Test – In the case of bars over 25mm in diameter the test piece when cold shall withstand, without fracture, being doubled over, either by pressure or by slow and steady blows from a hammer, till the internal diameter is not greater than three times the diameter of the test piece, and sides are parallel. For bars 25mm in diameter and under, the internal diameter of the bend shall be not greater than twice the diameter of the bar.

6.4 Shear Test – The ultimate shear strength of the bars as rolled shall be not less than 260 MPa.

Note – For test procedures, refer to IS 1599 : 1985 Method of bend test (*second revision*), and IS 1608 : 1995 Mechanical testing of metals-Tensile testing (*second revision*).

For detailed information, refer to IS 1148 : 1982 Hot rolled rivet bars upto 40mm diameter) for structural purposes (third revision).

SUMMARY OF
IS 1149 : 1982 HIGH TENSILE STEEL RIVETS BARS
FOR STRUCTURAL PURPOSES
(Third Revision)

1. Scope – Requirement for high tensile steel rivet bars in size up to 40 mm diameter for structural purposes.

2. Chemical Composition

2.1 Ladle Analysis – Ladle analysis of the steel, shall be as given below –

<i>Constituent</i>	<i>Per cent, Max</i>
Carbon	0.23
Sulphur	0.050
Phosphorus	0.050

2.2 Product Analysis : Permissible variation in the case of product analysis, from the limits specified under 2.1 shall be as follows:

<i>Constituent</i>	<i>Variation Over the Specified Limit Percent, Maximum</i>
Carbon	0.02
Sulphur	0.005
Phosphorus	0.005

2.3 When steel is required in copper bearing quality, copper content shall be between 0.20 to 0.35 percent. In case of product analysis, permissible variation shall not exceed ± 0.3 percent.

2.4 When steel is silicon-killed, silicon content on the product analysis, shall not be less than 0.1 percent. When the steel is silicon-aluminium-killed or aluminium-killed, the requirement regarding minimum silicon content shall not apply.

3. Freedom from Defects – The finished material shall be free from such surface and internal flaws as would be determined to the end use of the material.

4. Lengths – In multiples of 250 mm.

5. Dimensional Tolerances : Shall be similar as specified for IS 1148 : 1982*.

6. Tests

6.1 Tensile Test

<i>Characteristic</i>	<i>Requirement</i>
Tensile strength, <i>min</i> MPa	460
Min Yield stress, <i>min</i> , MPa	
a) 6mm upto and including 12 mm	310
b) Over 12 mm upto and including 20 mm	300
c) Over 20 mm upto and including 40 mm	280
Elongation percent, <i>Min</i>	
guage length $5.65 \sqrt{S_0}$ Min	22

6.1.1 No tensile test shall be carried out on bars below 6mm.

6.2 Bend Test – In the case of bars over 25 mm in diameter the test piece when cold shall withstand, without fracture, being doubled over, either by pressure or by slow and steady blows from a hammer, till the internal diameter is not greater than three times the diameter of the test piece, and sides are parallel. For bars 25 mm in diameter and under, the internal diameter of the bend shall be not greater than twice the diameter of the bar.

6.3 Shear Test – The ultimate shear strength of the bars as rolled shall be not less than 370 MPa.

6.4 Hot Compression Test – A test piece having a length equal to twice its diameter, shall be cut from a bar and shall, without cracking or showing signs of fracture withstand being heated to a forging temperature and hammered or compressed on the end till its length has been reduced to its original diameter.

* Hot rolled river bars (upto 40 mm dia) for structural purposes (*third revision*).

Note – For test procedures, refer to IS 1599 : 1985 Method of bend test (*second revision*), IS 1608 : 1995 Mechanical testing of metals-Tensile testing (*second revision*) and IS 5242 : 1979 Method of test for determining shear strength of metals (*first revision*).

For detailed information, refer to IS 1149 : 1982 Specification for high tensile steel rivet bars for structural purposes (third revision).

SUMMARY OF

IS 1161 : 1998 STEEL TUBES FOR STRUCTURAL PURPOSES. (Fourth Revision)

1. Scope – Requirements for hot finished welded (HFW), hot finished seamless (HFS), and electric resistance welded (ERW) or high frequency induction welded (HRIW) plain carbon steel tubes for structural purposes.

2. Designation – Shall be designated by their nominal bore and shall be classified as 'Light', 'Medium' and 'Heavy' depending on the wall thickness (*see* Table 1). They shall be further graded as YSt 210, YSt 240 and YSt 310 depending on the yield stress of the material (*see* Table 2). The designation of the steel tubes shall, therefore, include the nominal bore of the tube, classification on wall thickness and grade of the material.

3. Material — The tubes shall be manufactured from steel conforming to IS 107 48 : 1995*

4. Dimensions and Weight

4.1 Sizes in weights and some geometrical properties of tubes shall be as given in Table 1.

4.2 Tolerances – The following tolerances shall apply:

a) Outside Diameter

1) Up to and including 48.3 mm	+ 0.4 mm –0.8 mm
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2) Over 48.3 mm	±1.0 percent
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b) Thickness (for all sizes)

1) Welded tubes	+Not limited –10 percent
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2) Seamless tubes	+Not limited 12.5 percent
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c) Weight	+10 percent
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1) Single tube light	–8 percent
Medium Heavy	} ± 10 percent
2) 10 tonne lots light	
Medium Heavy	} ± 5 percent
	} ±7.5 percent

* Hot rolled steel strip for welded tubes and pipes (*first revision*)

5. Workmanship – The tubes shall be cleanly finished and reasonably free from scale. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall be cut cleanly and square with the axis of tube, unless otherwise specified.

6. Galvanizing – If the tubes are required in galvanized condition the zinc coating on the tubes shall be conforming to the requirements.

7. Straightness – Tubes shall not deviate from straightness by more than 1 mm in any 600 mm length.

8. Lengths – The tubes shall normally be supplied in random lengths at 4 to 7 m.

9. Tests

9.1 Tensile Test – *See* Table 2.

9.2 Ductility Test – The tubes of 50 mm NB and under shall withstand cold bend test and tubes above 50 mm NB shall withstand flattening test as prescribed in the standard.

TABLE 1 SIZES AND PROPERTIES OF STEEL TUBES FOR STRUCTURAL PURPOSES

<i>Nominal Bore</i>	<i>Outside Diameter</i>	<i>Class</i>	<i>Thickness</i>	<i>Weight</i>	<i>Area of Cross Section</i>	<i>Internal Volume</i>
mm (1)	mm (2)	(3)	mm (4)	kg/m (5)	cm ² (6)	cm ³ /m (7)
15	21.3	Light	2.0	0.947	1.21	235
		Medium	2.6	1.21	1.53	203
		Heavy	3.2	0.44	1.82	174
20	26.9	Light	2.3	1.38	1.78	390
		Medium	2.6	1.56	1.98	370
		Heavy	3.2	1.87	2.38	330
25	33.7	Light	2.6	1.98	2.54	638
		Medium	3.2	2.41	3.06	585
		Heavy	4.0	2.93	3.73	518
32	42.4	Light	2.6	2.54	3.25	1 086
		Medium	3.2	3.10	3.94	1 017
		Heavy	4.0	3.79	4.82	929
40	48.3	Light	2.9	3.23	4.13	1 418
		Medium	3.2	3.56	4.53	1 378
		Heavy	4.0	4.37	5.56	1 275
50	60.3	Light	2.9	4.08	5.23	2 332
		Medium	3.6	5.03	6.41	2 213
		Heavy	4.5	6.19	7.88	2 066
65	76.1	Light	3.2	5.71	7.32	3 814
		Medium	3.6	6.42	8.20	3 727
		Heavy	4.5	7.93	10.1	3 534
80	88.9	Light	3.2	6.72	8.61	5 343
		Medium	4.0	8.36	10.7	5 138
		Heavy	4.8	9.90	12.7	4 936
90	101.6	Light	3.6	8.70	11.1	6 995
		Medium	4.0	9.63	12.3	6 877
		Heavy	4.8	11.5	14.6	6 644
100	114.3	Light	3.6	9.75	12.5	9 004
		Medium	4.5	12.2	15.5	8 704
		Heavy	5.4	14.5	18.5	8 409
110	127.0	Light	4.5	13.6	17.3	10 930
		Medium	4.8	14.5	18.4	10 819
		Heavy	5.4	16.2	20.6	10 599
125	139.7	Light	4.5	15.0	19.1	13 410
		Medium	4.8	15.9	20.3	13 287
		Heavy	5.4	17.9	22.8	13 043
135	152.4	Light	4.5	16.4	20.9	16 142
		Medium	4.8	17.5	22.2	16 008
		Heavy	5.4	19.6	25.0	15 740
150	165.1	Light	4.5	17.8	22.7	19 128
		Medium	4.8	18.9	24.2	18 981
		Heavy	5.4	21.3	27.1	18 690

Table 1 SIZES AND PROPERTIES OF STEEL TUBES FOR STRUCTURAL PURPOSES (concluded)

<i>Nominal Bore</i>	<i>Outside Diameter</i>	<i>Class</i>	<i>Thickness</i>	<i>Weight</i>	<i>Area of Cross Section</i>	<i>Internal Volume</i>
mm (1)	mm (2)	(3)	mm (4)	kg/m (5)	cm ² (6)	cm ³ /m (7)
150	168.3	Light	4.5	18.2	23.1	19 921
		Medium	4.8	19.4	24.7	19 771
		Heavy 1	5.4	21.7	27.6	19 473
		Heavy 2	6.3	25.2	32.0	19 030
175	193.7	Light	4.8	22.4	28.5	26 606
		Medium	5.4	25.1	32.0	26 260
		Heavy	5.9	27.3	34.8	25 974
200	219.1	Light	4.8	25.4	32.3	34 454
		Medium	5.6	29.5	37.5	33 930
		Heavy	5.9	31.0	39.5	33 734
225	244.5	Heavy	5.9	34.7	44.2	42 507
250	273.0	Heavy	5.9	38.9	49.5	53 557
300	323.9	Heavy	6.3	49.3	62.8	76 073
350	355.6	Heavy	8.0	68.6	87.3	90 533

TABLE 2 - TENSILE PROPERTIES OF STEEL TUBES FOR STRUCTURAL PURPOSES

Grade	Tensile Strength <i>Min</i>	Yield Stress <i>Min</i>	Elongation on Gauge Length $5.65 \sqrt{S_0}$ <i>Min</i> Percent
	MPa	MPa	
YSt210	330	210	20
YSt240	410	240	17
YSt310	450	310	14

Note 1 – For test procedures, refer to IS 1608 : 1995 Mechanical testing of metals-Tensile testing (*second revision*), IS 2328 : 1983 Method of flattening test on metallic tubes (*first revision*), IS 2329 : 1985 Method for bend test on metallic tubes (*first revision*), IS 4736 : 1986. Hot-dip zinc coating on mild steel tubes (*first revision*) and *the standard*.

Note 2 – For other geometrical properties, refer to *the standard*.

For detailed information, refer to IS 1161 : 1998 Specification for steel tubes for structural purposes (fourth revision).

SUMMARY OF
IS 4923 : 1997 HOLLOW STEEL SECTIONS FOR STRUCTURAL
USE
(Second Revision)

1. Scope – Requirements for hot and cold formed square and rectangular hollow steel sections for structural use.

Section 1 General Requirements

2. Designation – A hollow section shall be designated by its outside dimensions and its thickness in millimetres and shall be further classified into CF or HF depending upon whether it is cold formed or hot formed.

a) A cold formed square hollow section with outside dimensions of 50 mm square and 2.90 mm thickness is designated as 50 × 50 × 2.90 CF SHS.

b) A hot formed rectangular hollow section with outside dimensions of 40 mm depth, 25 mm breadth and 2.65 mm thickness is designated as 40 × 25 × 2.65 HF RHS.

3. Dimensions and Weights — See Tables 1 and 2.

**TABLE 1 DIMENSIONS AND PROPERTIES
OF SQUARE HOLLOW SECTIONS**

Designation	Depth or Width (D)	Thick- ness	Weight	Area of Section
mm	mm	mm	kg/m	cm ²
(1)	(2)	(3)	(4)	(5)
25.0×25.0×2.6	25.0	2.6	1.69	2.16
25.0×25.0×3.2	25.0	3.2	1.98	2.53
30.0×30.0×2.6	30.0	2.6	2.10	2.68
30.0×30.0×3.2	30.0	3.2	2.49	3.17
30.0×30.0×4.0	30.0	4.0	2.94	3.75
32.0×32.0×2.6	32.0	2.6	2.26	2.88
32.0×32.0×3.2	32.0	3.2	2.69	3.42
32.0×32.0×4.0	32.0	4.0	3.19	4.07
35.0×35.0×2.6	35.0	2.6	2.51	3.20
35.0×35.0×3.2	35.0	3.2	2.99	3.81
35.0×35.0×4.0	35.0	4.0	3.57	4.55
38.0×38.0×2.6	38.0	2.6	2.75	3.51
38.0×38.0×2.9	38.0	2.9	3.03	3.86
38.0×38.0×3.2	38.0	3.2	3.29	4.19
38.0×38.0×3.6	38.0	3.6	3.63	4.62
38.0×38.0×4.0	38.0	4.0	3.95	5.03
40.0×40.0×2.6	40.0	2.6	2.92	3.72
40.0×40.0×3.2	40.0	3.2	3.49	4.45
40.0×40.0×3.6	40.0	3.6	3.85	4.91
40.0×40.0×4.0	40.0	4.0	4.20	5.35
45.0×45.0×2.6	45.0	2.6	3.32	4.24
45.0×45.0×2.9	45.0	2.9	3.66	4.67
45.0×45.0×3.2	45.0	3.2	3.99	5.09
45.0×45.0×3.6	45.0	3.6	4.42	5.63
45.0×45.0×4.5	45.0	4.5	5.31	6.77
49.5×49.5×2.9	49.5	2.9	4.07	5.19
49.5×49.5×3.6	49.5	3.6	4.93	6.28
49.5×49.5×4.5	49.5	4.5	5.95	7.58

Continued—				
Designation	Depth or Width (D)	Thick- ness	Weight	Area of Section
mm	mm	mm	kg/m	cm ²
(1)	(2)	(3)	(4)	(5)
63.5×63.5×3.2	63.5	3.2	5.85	7.45
63.5×63.5×3.6	63.5	3.6	6.51	8.29
63.5×63.5×4.5	63.5	4.5	7.93	10.10
72.0×72.0×3.2	72.0	3.2	6.71	8.54
72.0×72.0×4.0	72.0	4.0	8.22	10.47
72.0×72.0×4.8	72.0	4.8	9.66	12.31
75.0×75.0×3.2	75.0	3.2	7.01	8.93
75.0×75.0×4.0	75.0	4.0	8.59	10.95
75.0×75.0×4.9	75.0	4.9	10.30	13.12
88.9×88.9×3.6	88.9	3.6	9.38	11.95
88.9×88.9×4.5	88.9	4.5	11.52	14.67
88.9×88.9×4.9	88.9	4.9	12.44	15.85
91.5×91.5×3.6	91.5	3.6	9.67	12.32
91.5×91.5×4.5	91.5	4.5	11.88	15.14
91.5×91.5×5.4	91.5	5.4	14.01	17.85
100.0×100.0×4.0	100.0	4.0	11.73	14.95
100.0×100.0×5.0	100.0	5.0	14.41	18.36
100.0×100.0×6.0	100.0	6.0	16.98	21.63
113.5×113.5×4.5	113.5	4.5	14.99	19.10
113.5×113.5×4.8	113.5	4.8	15.92	20.28
113.5×113.5×5.4	113.5	5.4	17.74	22.60
113.5×113.5×6.0	113.5	6.0	19.53	24.87
125.0×125.0×4.5	125.0	4.5	16.62	21.17
125.0×125.0×5.0	125.0	5.0	18.33	23.36
125.0×125.0×6.0	125.0	6.0	21.69	27.63
132.0×132.0×4.8	132.0	4.8	18.71	23.88
132.0×132.0×5.4	132.0	5.4	20.88	26.59
132.0×132.0×6.0	132.0	6.0	23.01	29.31
150.0×150.0×5.0	150.0	5.0	22.26	28.36
150.0×150.0×6.0	150.0	6.0	26.40	33.63

TABLE 2 DIMENSIONS AND PROPERTIES OF RECTANGULAR HOLLOW SECTIONS

<i>Designation</i>	<i>Depth of Section (D)</i>	<i>Width of Section (B)</i>	<i>Thickness</i>	<i>Weight</i>	<i>Area of Section</i>
(1)	(2)	(3)	(4)	(5)	(6)
mm	mm	mm	mm	kg/m	cm ²
50.0×25.0×2.9	50.0	25.0	2.9	2.98	3.80
50.0×25.0×3.2	50.0	25.0	3.2	3.24	4.13
60.0×40.0×2.9	60.0	40.0	2.9	4.12	5.25
66.0×33.0×2.9	66.0	33.0	2.9	4.07	5.19
66.0×33.0×3.6	66.0	33.0	3.6	4.93	6.28
66.0×33.0×4.5	66.0	33.0	4.5	5.95	7.58
70.0×30.0×2.9	70.0	30.0	2.9	4.12	5.25
70.0×30.0×3.2	70.0	30.0	3.2	4.50	5.73
70.0×30.0×4.0	70.0	30.0	4.0	5.45	6.95
80.0×40.0×2.9	80.0	40.0	2.9	5.03	6.41
80.0×40.0×3.2	80.0	40.0	3.2	5.50	7.01
80.0×40.0×4.0	80.0	40.0	4.0	6.71	8.55
96.0×48.0×3.2	96.0	48.0	3.2	6.71	8.54
96.0×48.0×4.0	96.0	48.0	4.0	8.22	10.47
96.0×48.0×4.8	96.0	48.0	4.8	9.66	12.31
100.0×50.0×3.2	100.0	50.0	3.2	7.01	8.93
100.0×50.0×4.0	100.0	50.0	4.0	8.59	10.95
122.0×61.0×3.6	122.0	61.0	3.6	9.67	12.32
122.0×61.0×4.5	122.0	61.0	4.5	11.88	15.14
122.0×61.0×5.4	122.0	61.0	5.4	14.01	17.85
127.0×50.0×3.6	127.0	50.0	3.6	9.34	11.89
127.0×50.0×4.6	127.0	50.0	4.6	11.69	14.89
145.0×82.0×4.8	145.0	82.0	4.8	15.92	20.28
145.0×82.0×5.4	145.0	82.0	5.4	17.74	22.60
172.0×92.0×4.8	172.0	92.0	4.8	18.71	23.83
172.0×92.0×5.4	172.0	92.0	5.4	20.88	26.59

4. Straightness and Twist—Maximum deviation from straightness for tubes in finish straightened condition shall be 1/600th of length at the centre of the length. For tubes in mill straightened condition 1/200th of any length at the centre of the length. Twist shall be measured for square and rectangular sections as given in the

standard. the tolerances on twist shall be 2 mm plus 0.5 mm/m.

5. Oiling and Painting—Hollow sections may be varnished painted or oiled externally.

Section 2 Hot Formed Sections

6. Tolerances—The following tolerances shall be permitted on hot formed hollow sections:

- | | |
|--------------------------------|---|
| a) Thickness for all sizes | |
| 1) Welded tubes | ± 10 percent |
| 2) Seamless tubes | + 17.5 percent |
| | - 12.5 percent |
| b) Outside dimensions of sides | ± 1 percent of length of the side to be measured with a minimum of ± 0.5 mm |
| c) Weight | |
| 1) On individual length | +10 percent |
| | - 8 percent |
| 2) On lots of 10 tonnes | ± 7.5 percent |
| d) Squareness of corner | 90° ± 2° |
| e) Radii of corners-Outside | 3t, Max where t is the thickness of section |
| f) Length | |
| 1) Exact length | ± 6 mm |
| 2) Random length | This may be obtained by arrangement between the purchaser and manufacturer |

7. Tensile Properties—See Table 3.

TABLE 3 TENSILE PROPERTIES OF HOT FORMED SECTIONS

<i>Grade</i>	<i>Tensile Strength, Min, MPa</i>	<i>Yield Stress, Min, MPa</i>	<i>elongation, percent, Min</i>
YSt210	330	210	20
YSt240	410	240	15
YSt310	450	310	10

Note—For welded tubes, the strip tensile test specimen shall not include the weld.

SECTION 3 COLD FORMED SECTIONS

8. Tolerances

8.1 The following tolerances shall be permitted on cold formed hollow sections:

- a) Thickness for all sizes ±10 percent

Notes 1—The measurement of thickness should exclude the weld zone.

Note 2 — The height of the internal weld fin shall not exceed 60 per cent of the wall thickness.

8.2 The Tolerances on outside dimensions of sides, weight, squareness of corners radii of corners and length shall be same as applicable for hot formed sections as given in 6 above.

9. Tensile Properties – See Table 4.

TABLE 4 TENSILE PROPERTIES OF COLD FORMED SECTION.

Grade	Tensile Strength,	Yield stress,	Elongation, percent, Min	
	Min, MPa	Min, MPa	25.4 and under*	Over 25.4*
YSt210	330	210	12	20
YSt240	410	240	10	15
YSt310	450	310	8	10

*The value shall be applicable for the smaller side of the rectangular section.

Note 1 – For test procedures, refer to IS 1608 : 1995 Mechanical testing of metals- Tensile testing (*second revision*)

Note 2 – For other geometrical properties, refer to *the standard*.

For detailed information, refer to IS 4923 : 1997 Specification for Hollow steel sections for structural use (second revision).

SECTION 16

LIGHT METALS AND THEIR ALLOYS

CONTENTS

	<i>Title</i>	<i>Page</i>
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IS 736 : 1986	Wrought aluminium and aluminium alloys- plates for general engineering purposes (<i>third revision</i>)	16.4
IS 737 : 1986	Wrought aluminium and aluminium alloys sheet and strip, for general engineering purposes (<i>third revision</i>)	16.5
IS 738 : 1994	Wrought aluminium and its alloys-drawn tubes for general engineering purposes (<i>third revision</i>)	16.7
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SUMMARY OF
IS 733 : 1983 WROUGHT ALUMINIUM AND ALUMINIUM
ALLOY BARS, RODS AND SECTIONS FOR GENERAL
ENGINEERING PURPOSES
(Third Revision)

1. Scope – Requirements for wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes.

2. Freedom from Defects – The material shall be sound and free from harmful defects.

3. Dimensions and Tolerances – Shall be as laid in IS 3965 : 1981.

4. Designation and Typical Uses of Alloys

<i>Designation</i>	<i>Typical uses</i>	<i>Designation</i>	<i>Typical uses</i>
19000	Panelling and moulding, refrigeration tubing, equipment for chemical, food and brewing industrial packaging, cooking utensils, sheet metal work, architectural and builder's hardware, spun / pressed hollow ware, deep drawn parts, cladding, welding wire, electrical appliances.	45000	Filler wire for brazing.
19500	Corrosion resistant cladding on stronger alloys impact extruded containers; food, chemical brewing and processing equipments; tanks and pipes; marine fittings; reflectors; pressed and anodized utility items, jewellery, and cable sheathing.	52000	Panelling and structures, shear metal work and domestic appliances, marine applications like sheathing lining of boat bottom, etc.
19600	Similar to 19500.	53000	Shipbuilding; rivets; pressure vessels and other processing tanks, cryogenics, and welded structures.
24345	Heavy duty forgings, structures where high mechanical properties are of utmost importance, aircraft application of clad sheets, extrusions and armaments.	54300	Welded structures, cryogenic applications, structural marine applications, rail and road tank cars, rivets and missile components.
24534	Stressed parts in aircrafts and other structures where high strength is of primary consideration.	63400	Architectural uses, such as, windows, door frames, wall facings, partitions, hand rails etc. and other similar applications where surface finish is important and medium strength would suffice.
43000	Filler wire of welding.	63401	Bus bar application
* Dimensions for wrought aluminium and aluminium alloy-bars, rods and sections (<i>first revision</i>)		64401	Conductor application
		64423	Applications requiring good strength and machinability, such as, missile machinery components.
		64430	Structural applications of all kinds, such as, road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc. Cargo containers, milk containers, deep-drawn containers, and flooring.
		65032	Similar to 64430
		74530	Stressed structural applications requiring welding, such as bridges, chequered plates, dump-truck bodies, pressure vessels and rail coaches, etc.
		76528	Stressed structural applications capable of being used at low temperature.

Note — For chemical composition and mechanical properties see 5 (Tables 1 and 2) of the standard.

For detailed information, refer to IS 733 : 1983 Specifications for wrought aluminium and aluminium alloy bars, rods and sections for General engineering purposes (third revision).

SUMMARY OF
IS 736 : 1986 WROUGHT ALUMINIUM AND ALUMINIUM ALLOY
PLATE FOR GENERAL ENGINEERING PURPOSES
(Third Revision)

1. Scope —Requirements for wrought aluminium and aluminium alloy plates for general engineering purpose.		<i>Designation</i>	<i>Typical uses</i>
2. Freedom from Defects – The material shall be sound and free from harmful defects.			vessels, irrigation tubing, heat exchangers, utensils and pressure cookers, roofing sheets, airconditioning ducting, fan blades and vehicle panelling.
3. Dimensions and Tolerances – Shall be as specified in IS 2677 : 1979.*		51000-A	Appliances and utensils, architectural trims, consumers durable with attractive anodized finishes.
4. Designation and Typical Uses of Alloys		51000-B	Architectural applications; high anodizing quality kitchen ware and cooking utensils, consumer durables; bathroom fittings, auto-trim, airconditioner and TV housing; chemical equipment, marine applications and refrigerator trim.
<i>Designation</i>	<i>Typical uses</i>		
19800	Jewellery, decorative and novelty anodized items, auto trim, reflectors, breweries and some chemical plants.		
19700	Similar to 19800		
19600	Corrosion resistant cladding on stronger alloys, impact extruded containters; food, chemical brewing and processing equipment, tanks and pipes, marine fitting, reflectors, pressed and anodized utility items, jewellery and cable sheathing	52000	Panelling and structures, sheet metal work, domestic appliances.
19500	Similar to 19600	53000	Welded structures, cryogenic applications, structural marine applications, rail and road tank cars, rivets and missile components.
19000	Panelling and moulding; refrigeration tubing equipment for chemical, food and brewing industries; packaging; cooking utensils. Sheet metal work, architectural and builder's hardware spun/pressed holloware, deep drawn parts, cladding, welding wire, electrical appliances.	54300	Similar to 53000
		55000	Shipbuilding and other applications demanding moderately high strength with good corrosion resistance; rivets, zippers, welding wire, etc.
24345	Heavy duty forgings, structures where high mechanical properties are of utmost importance, aircraft application of clad sheets, extrusions and armaments.	64430	Structural applications of all kinds, such as, road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc., cargo containers, milk containers, deep drawn containers and flooring.
31000	General purpose alloy for moderate strength applications, pressure	65032	Similar to 64430
		74530	Stressed structural applications requiring welding such as bridges, chequered plates, dump-truck bodies, pressure vessels, rail coaches, etc.

* Dimensions for wrought aluminium and aluminium alloys, plates and hot rolled sheets (*first revision*).

Note – For chemical composition and mechanical properties, see 5 (Table 1) and 6 (Table 2) of the standard.

For detailed information, refer to IS 736 : 1989 Specifications for wrought aluminium and aluminium alloys, plate for general engineering purposes (third revision).

SUMMARY OF
IS 737 : 1986 WROUGHT ALUMINIUM AND ALUMINIUM ALLOY
SHEET AND STRIP FOR GENERAL ENGINEERING PURPOSES
(Third Revision)

1. Scope – Requirements for wrought aluminium and aluminium alloy sheet and strip for general engineering purposes.		<i>Designation</i>	<i>Typical uses</i>
2. Freedom from Defects — The material shall be sound and free from harmful defects.		24345	Heavy duty forgings, structures where high mechanical properties are of utmost importance, aircraft application of clad sheets, extrusions and armaments.
3. Dimensions and Tolerances – See IS 2676 : 1981* and IS 2677 : 1979.**		31000	General purpose alloy for moderate strength applications, pressure vessels, irrigation tubing, heat exchangers, utensils and pressure cookers, roofing sheets, pilferproof and detonator caps, airconditioning ducting, fan blades and vehicle panelling.
4. Designation and Typical uses of Alloys			
<i>Designation</i>	<i>Typical uses</i>		
19000	Electrolytic capacitors, decorative hollowares, trims and other applications requiring high degree of finish.	31500	General purpose sheet, roofing and siding, utensils, sheet metal work, vehicle panelling, pressure vessels and lamp caps.
19800	Jewellery, decorative and novelty and anodized items, auto rim, reflectors,		
19700	breweries and some chemical plants and metallizing.	40800	Vehicle panelling, fan blades and other applications same as of alloys 19000 and 31000 except those for bright anodizing purposes, detonators, utensils/holloware containers and closures.
19600	Corrosion resistant cladding on and stronger alloys, impact extruded containters; food, chemical brewing and processing equipment, tanks and pipes, marine fitting, reflectors, pressed and anodized utility items, jewellery and cable sheathing.	51000-A	Appliances and utensils, architectural rims, consumers durable with attractive anodized finishes.
19500	Similar to 19600	51000-B	Architectural applications; high anodizing quality kitchen ware and cooking utensils, consumer durables; bathroom fittings, auto trim, airconditioner and TV housing; chemical equipment, marine applications and refrigerator trim.
19000	Panelling and moulding; refrigeration tubing equipment for chemical, food and brewing industries; packaging; cooking utensils. Sheet metal work, architectural and builder's hardware spun/pressed holloware, deep drawn parts, cladding, welding wire, electrical appliances.	51300	General purpose alloy which can be used for most of the applications of alloys 31000 and 19000.

* Dimensions for wrought aluminium and aluminium alloy sheet and strip (*first revision*).

** Dimensions for wrought aluminium and aluminium alloys, plates and hot rolled sheets (*first revision*).

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<i>Designation</i>	<i>Typical uses</i>	<i>Designation</i>	<i>Typical uses</i>
52000	Panelling and structures, sheet metal work, domestic appliances.	64430	Structural applications of all kinds, such as road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc. Cargo containers, milk containers, deep drawn containers and flooring.
53000	Shipbuilding; rivets; pressure vessels and other processing tanks; cryogenics and welded structures.	65032	Similar to 64430
54300	Welded structures, cryogenic applications, structural marine applications, rail and road tank cars, rivets and missile components.	74530	Stressed structural applications requiring welding such as bridges, chequered plates, dump-truck bodies, pressure vessels, rail coaches, etc.
55000	Shipbuilding and other applications demanding moderately high strength with good corrosion resistance; rivets, zippers, welding wire etc.		

Note – For chemical composition and mechanical properties *see* **5** (Table 1) and **6** (Table 2) of the standard.

For detailed information, refer to IS 737 : 1986 Specifications for wrought aluminium and aluminium alloy sheet and strip for general engineering purposes (third revision).

SUMMARY OF

IS 738 : 1994 WROUGHT ALUMINIUM AND ITS ALLOYS-DRAWN
TUBES FOR GENERAL ENGINEERING PURPOSES*(Third Revision)*

1. Scope – Requirements of wrought aluminium and aluminium alloy drawn tubes of round cross-section for general engineering purposes.

2. Freedom from Defects – The drawn tubes shall be sound and free from harmful defects.

3. Dimensions and Tolerances – As given in IS 2678 : 1987.*

4. Designation and Typical uses of Alloys

<i>Designation</i>	<i>Typical uses</i>
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19000	Panelling and moulding; equipments for food, chemical and brewing industries; architectural and builder's hardwares, fasteners, welding wire, electrical appliances, refrigeration tubes and wave guide tubes.
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19500	Food, chemical, brewing and processing equipments, marine fittings, pressed and anodized utility items, heat exchanger tubes, condenser tubes, gas and oil transmission pipeline.
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24345	Stressed parts in aircraft and other structures where high strength is of primary consideration, hydraulic tubes.
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* Dimension and tolerances for wrought aluminium and aluminium alloy round tubes (*second revision*)

<i>Designation</i>	<i>Typical uses</i>
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31000	General purpose alloy for moderate strength applications, pressure vessels, irrigation tubing, heat exchangers, utensils and pressure cookers, roofing sheets, pilferproof and detonator caps, airconditioning ducting, fan blades and vehicle panelling.
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52000	Panelling and structures, hydraulic tube, appliances, refrigeration tubing, condenser and heat exchanger tubes, gas and oil transmission pipelines.
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63400	Architectural uses and other similar applications where surface finish is important and medium strength would suffice. Electrical conduits, tubes for wave guides, gas and oil transmission pipelines.
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64430	Structural applications of all kinds, such as, road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc. Cargo containers, milk containers, deep drawn containers and flooring.
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65028	Structural applications of all kinds such road and rail transport vehicles, bridges, cranes, roof trusses, furniture, gas and oil transmission pipelines, condenser and heat exchanger tubes, hydraulic tubes.
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65032	Similar to 65028
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Note — For chemical composition and mechanical properties see 8 (Table 1) and 9 (Table 2) of the standard.

For detailed information, refer to IS 738 : 1994 Specifications for wrought aluminium and its alloys-drawn tubes for general engineering purpose (third revision).

SUMMARY OF

IS 739 : 1992 WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS-WIRE FOR GENERAL ENGINEERING PURPOSES

(Third Revision)

1. Scope – Requirements of wrought aluminium and aluminium alloy wire for general engineering purposes.

2. Freedom from Defects – Wire shall be sound and free from harmful defects.

3. Dimensions and Tolerances – Shall given in IS 2525 : 1982.*

4. Designation and Typical uses of Alloys

Designation Typical Uses

19000 Panelling and moulding; equipments for food, chemical and brewing industries; architectural and builder's hardwares, fasteners, welding wire, electrical appliances, rivet wires, spray gun wires.

19500 Food, chemical, brewing and processing equipments, marine fittings, pressed and anodized utility items, jewellery, rivet for aircraft purpose, filler rods for inert gas arc welding.

24345 Structures where high mechanical properties are of utmost importance, screw machine products, fasteners and rivets for aircraft purposes.

31000 General purpose alloy for moderate strength applications, pressure vessels, builders hardware, vehicle panelling, rivet wires, fasteners, filler rods for inert gas arc welding.

Designation

Typical Uses

43000 Filler wires for brazing and soldering, welding rods, spray gun wires.

46000 Filler wires for brazing, welding rods, spray gun wires.

52000 Panelling and structures, rivet wires, zippers, grills, fasteners, filler rods for inert gas arc welding.

53000 Shipbuilding, rivets, pressure vessels, welding rods, zippers, screen wires, grills fasteners.

55000 Shipbuilding and other applications demanding moderately high strength with good corrosion resistance; rivets, zippers, welding wire, screen wires, grills, fasteners.

55380 Filler wires for welding rivets, screen wires.

63400 Architectural uses and other similar applications where surface finish is important and medium strength would suffice, builders hardware.

64430 Structural applications of all kinds, such as, road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc. Cargo containers, milk containers, deep drawn containers and flooring.

65032 Structural applications of all kinds rivets, builders hardwares and fastener rods

* Dimension of wrought aluminium and aluminium alloys, wire (first revision)

Note – For chemical composition and mechanical properties see 8 (Table 1) and 9 (Table 2) of the standard.

For detailed information, refer to IS 739 : 1992 Specifications for wrought aluminium and aluminium alloys-wire for general engineering purpose (third revision).

SUMMARY OF
IS 740 : 1977 WROUGHT ALUMINIUM ALLOY RIVET STOCK FOR
GENERAL ENGINEERING PURPOSES
(Second Revision)

1. Scope – Requirements for wrought aluminium and aluminium alloys rivet stock for general engineering purposes.		<i>Designation</i>	<i>Typical use</i>
		<i>New Old</i>	
2. Freedom from Defects – The material shall be sound and free from harmful defects.		53000 NR 5	Rivets used in ship building, pressure vessels and other processing tanks and in aircraft manufacture.
3. Dimensions and Tolerances – As given in IS 3577 : 1992.*		55000 NR 6	Rivets used in ship building, aircraft manufacture and other applications demanding moderately high strength with good corrosion resistance.
4. Designation and Typical Uses of Alloys		64430 HR 30	Rivets used in structures of all kinds, such as, road and rail transport vehicles, bridges, cranes, roof trusses, cargo containers, flooring.
<i>Designation</i>	<i>Typical use</i>		
<i>New Old</i>			
19000 RIC	Rivets used in equipment for food, chemical, brewing and processing, cooking, utensils, architectural and builders hardware and in aircraft manufacture.	65032 HR 20	Structural applications of all kinds such as, road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc, cargo containers, milk containers, deep drawn containers and flooring.
24345 HR 15	Rivets used in structures where high mechanical properties are of utmost importance, aircraft structures.		

* Wrought aluminium and its alloys – Rivet, bolt and screw stock – Dimensions and tolerances (*first revision*)

Note – For chemical composition and mechanical properties, see 4 (Table 1 and 2) of the standard.

For detailed information, refer to IS 740 : 1977 Specifications for wrought aluminium and aluminium alloy rivet stock for general engineering purposes (second revision).

SUMMARY OF
IS 1254 : 1991 CORRUGATED ALUMINIUM SHEET
(First Revision)

1. Scope – Material, profile, dimensions and finish for corrugated aluminium sheets meant for following uses:

- a) General purpose,
- b) Industrial, and
- c) Building.

2. Freedom from Defects – Corrugated sheet shall be clean and reasonably free from harmful defcets.

3. Profiles

<i>Uses</i>	<i>Pitch</i>	<i>Depth</i>
	mm	mm
a) General purpose	75	19
b) Industrial	125	38
c) Building	190	38

3.1 The corrugations shall be uniform and parallel with the sides of the sheet.

4. Dimensions

4.1 Thickness – The thickness of the corrugated sheet shall be as agreed. Tolerance on the thickness of the

sheets shall be subject to the general thickness tolerance specifield in IS 2676 : 1981.*

4.2 Width

General purpose : 650 to 800 mm overall
 Industrial : 795 mm overall
 Building : 830 mm overall

4.2.1 A tolerance of ± 10 mm for sheets of 0.45 mm and above in thickness. The tolerance on width for sheets less than 0.45 mm thick, shall be subject to agreement.

4.3 Length – Preferred lengths are 1800, 2400, 3000 and 3600 mm subject to a tolerance of ± 6 mm.

4.4 Squareness – The diagonal distance between corners of any finished sheet shall not differ by more than 20 mm for sheets of 0.45 mm and above in thickness. The tolerance on squareness for sheets less than 0.45 mm in thickness, shall be subject to mutual agreement.

5. Finish – The finish shall be ‘as-rolled’.

* Dimensions for wrought aluminium and aluminium alloys sheet and strip (first revision)

Note — For types of profile, see 5 of the standard.

For detailed information, refer to IS 1254 : 1991 Specifications for Corrugated aluminium sheet (third revision).

SUMMARY OF

IS 1285 : 2002 WROUGHT ALUMINIUM AND ALUMINIUM ALLOY EXTRUDED ROUND TUBE AND HOLLOW SECTIONS FOR GENERAL ENGINEERING PURPOSES

(Third Revision)

1. Scope – Requirements of extruded round tube and hollow sections made from wrought aluminium and aluminium alloys for general engineering purposes.		<i>Designation</i>	<i>Typical use</i>
2. Freedom from Defects – The extruded round tube and hollow sections shall be sound and free from harmful defects.		52000	conditioning, utensils, detonator caps, pressure vessels, fan blades and vehicle panelling.
3. Dimensions and Tolerances – The dimensions of extruded round tube and hollow sections and the tolerance shall be as laid down in IS 2673 : 2002* and IS 6477 : 1983 ** respectively.		53000	Panelling and structures, hydraulic tube appliances, refrigeration tubing condenser and heat exchanger tubes, gas and oil transmission pipelines.
4. Designation and Typical uses of Alloys –		54300	Ship building; rivets; pressure vessels and other processing tanks; cryogenics, and welded structures.
<i>Designation</i>	<i>Typical use</i>		
19000	Panelling and moulding, equipment for food, chemical and brewing industries, architectural and builders hardwares, fasteners, welding wires and electrical guide tubes.	62400	Welded structures, cryogenic applications, structural marine applications, rail and road tank cars, rivets and missile components.
19500	Food, chemical, brewing and processing equipment, marine fittings, pressed and anodized utility items, heat exchanger tubes, condenser tubes, gas and oil transmission pipeline.	63400	Further where appearance and bending characteristics are important, such as furniture applications.
24345	Stressed parts in aircrafts and other structures where high strength is of primary consideration, hydraulic tubes air-conditioning ducting fan blades and vehicle panelling.	64423	Architectural uses and other similar applications where surface finish is important and medium strength would suffice. Electrical conduits, tubes for wave guides, gas and oil transmission pipelines.
31000	General purpose alloy for moderate strength applications for chemical equipment, irrigation tubing, heat exchangers furniture, condenser, air-	64430	Applications requiring good strength and machinability such as textile machinery components.
		65032	Structural applications of all kinds, such as road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc. Cargo containers, milk containers, deep drawn containers and flooring.
		74530	Similar to 64430
			Stressed structural applications requiring welding, such as bridges, chequered plates, dump-truck bodies, pressure vessels and rail coaches.

* Dimension for wrought aluminium and aluminium alloys, extruded round tube (*first revision*)

** Dimensions for wrought aluminium and aluminium alloys, extruded hollow sections (*first revision*)

Note— For chemical composition and mechanical properties, see 5 (Table 1 and 2) of the standard.

For detailed information, refer to IS 1285 : 2002 Specifications for wrought aluminium and aluminium alloy extruded round tube and hollow sections for general engineering purposes (third revision).

SUMMARY OF

IS 2525 : 1982 DIMENSION FOR WROUGHT ALUMINIUM AND
ALUMINIUM ALLOYS, WIRE*(First Revision)*

1. Scope – Lays down dimensions and tolerances for wrought aluminium alloys in the form of wire.

2. Dimensions – The diameters of round wires and the width/width across flats of shaped wires shall be as follows:

mm	mm	mm
0.32	1.00	3.15
0.36	1.12	3.55
0.40	1.25	4.00
0.45	1.40	4.50
0.50	1.60	5.00
0.56	1.80	5.60
0.63	2.00	6.30
0.71	2.24	7.10
0.80	2.50	8.00
0.90	2.80	9.00

3. Tolerances**3.1 Round Wires**

<i>Diameter, mm</i>	<i>Tolerance, mm</i>
Up to 0.63	± 0.015
From 0.71 to 1.12	± 0.025
From 1.25 to 9.0	± 0.05 or 1 per cent of diameter which ever is higher.

3.2 Hexagonal and Octagonal Wires

<i>Width Across Flats, mm</i>	<i>Tolerance mm</i>
Up to 1.12	± 0.04
Over 1.12 to 9.00	± 0.07 or 1.5 percent of width across flats which ever is higher.

3.3 Square and Rectangular Wires

<i>Width or Thickness mm</i>	<i>Tolerance mm</i>
up to 2.50	± 0.05
From 0.71 to 1.12	± 0.08
From 1.25 to 9.0	± 0.10 or 2 percent of width / thickness which ever is higher.

For detailed information, refer to IS 2525 : 1982 Specifications for wrought aluminium and aluminium alloy, wire (first revision).

SUMMARY OF
IS 2676 : 1981 DIMENSIONS FOR WROUGHT ALUMINIUM AND
ALUMINIUM ALLOYS, SHEET AND STRIP
(Second Revision)

1. Scope – Lays down dimensions and tolerances for wrought aluminium alloys, sheet and strip.

2. Dimensions

2.1. Lengths and Widths

<i>Length</i> mm	<i>Width</i> mm	<i>Length</i> mm	<i>Width</i> mm
1 800	× 600	3 600	× 900
1 800	× 900	3 600	× 1 000
1 800	× 1 000	3 600	× 1 200
1 800	× 1 200	3 600	× 1 500
2 000	× 600	4 000	× 900
2 000	× 900	4 000	× 1 000
2 000	× 1 000	4 000	× 1 200
2 000	× 1 200	4 000	× 1 500
2 000	× 1 500		
2 400	× 600		
2 400	× 900		
2 400	× 1 000		
2 400	× 1 200		
2 400	× 1 500		

2.2 Thickness

0.15	1.25
0.19	1.40
0.23	1.60
0.28	1.80
0.32	2.00
0.36	2.24
0.40	2.50
0.45	2.80
0.50	3.15
0.56	3.55
0.63	4.00
0.71	4.50
0.80	5.00
0.90	5.60
1.0	6.00
1.12	

3. Tolerances

3.1 For shearing tolerances, general and fine for sheets and strips and the tolerances, general and fine on thicknesses of sheets and strips, refer to tables 1 to 6 of the standard.

3.2 Squareness Tolerances for Sheets – The difference of the two diagonal distances between opposite corners of any sheet shall not exceed the total tolerance of the sheet, that is, sum of positive and negative tolerance.

For detailed information, refer to IS 2676 : 1981 Specifications for dimensions for wrought aluminium and aluminium alloys, sheet and strip (first revision).

SUMMARY OF
IS 2677 : 1979 DIMENSIONS FOR WROUGHT ALUMINIUM AND
ALLOYS PLATES AND HOT-ROLLED SHEETS
(First Revision)

1. Scope – Lays down the dimensions and tolerances for wrought aluminium and aluminium alloys, plate and hot-rolled sheets.

2. Dimensions

2.1 Lengths and Widths

mm	mm	mm	mm	mm	mm
1 800 × 300	2 400 × 300	3 600 × 300			
1 800 × 600	2 400 × 600	3 600 × 600			
1 800 × 900	2 400 × 900	3 600 × 900			
1 800 × 1 200	2 400 × 1 200	3 600 × 1 200			

2.2 Thickness and Tolerances – See Table 1.

2.3 Shearing Tolerance on Length and Width – See Table 2.

TABLE 1 TOLERANCES ON THICKNESS OF PLATE AND HOT-ROLLED SHEETS

All dimensions in millimeters		
STANDARD THICKNESS	FOR WIDTHS UP TO AND INCLUDING 1200	FOR WIDTH 1201 TO 2000
(1)	(2)	(3)
4.0	±0.43	±0.46
4.5	±0.43	±0.46
5.0	±0.43	±0.46
5.5	±0.38	±0.46
6.0	±0.38	±0.46
6.5	±0.38	±0.46
7.0	±0.38	±0.46
7.5	±0.38	±0.46
8.0	±0.38	±0.46
9.0	±0.42	±0.46
10.0	±0.46	±0.48
11.0	±0.49	±0.51
12.0	±0.52	±0.53
14.0	±0.54	±0.56
16.0	±0.58	±0.58
18.0	±0.64	±0.64
20.0	±0.69	±0.69
22.5	±0.73	±0.73
25.0	±0.76	±0.76
30.0	±1.0	±1.0
35.0	±1.15	±1.15
40.0	±1.20	±1.20
45.0	±1.30	±1.30
50.0	±1.45	±1.50
65.0	±1.50	±1.55

TABLE 2 SHEARING TOLERANCE ON LENGTH AND WIDTH OF PLATE

All dimensions in millimetres.								
THICKNESS								
FOR LENGTHS AND WIDTHS								
(1)	For Lengths Up to and Including 2 400		For Lengths Over 2 400, Up to and Including 6 300		For Lengths Over 6 300, Up to and Including 8 000		For Lengths Over 8 000, Up to and Including 10 000	
	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Up to and including 12.50	7	3	8	3	10	3	13	3
Over 12.50 and up to and including 25.0	10	3	11	3	13	3	13	3
Over 25.0	13	3	13	3	13	3	13	3

Note— The shearing tolerance on width of hot-rolled coil having thickness between and including 4.0 mm to 6.00 mm shall be ± 5mm for widths up to and including 1200 mm and ± 6.5 mm for width over 1200 mm.

For detailed information, refer to IS 2677 : 1979 Specifications for dimensions for wrought aluminium and aluminum alloys, plates and hot-rolled sheets (first revision).

SUMMARY OF

**IS 2678 : 1987 DIMENSIONS AND TOLERANCE FOR WROUGHT
ALUMINIUM AND ALUMINIUM ALLOYS DRAWN ROUND TUBES**
(Second Revision)

1. Scope – Lays down the dimensions and tolerances for wrought aluminium and aluminium alloy drawn round tube with parallel bore.

2. Dimensions – See Table 1

3. Tolerances — See Tables 2, 3 and 4.

TABLE 1 DIMENSIONS OF DRAWN ROUND TUBE WITH PARALLEL BORE

All dimensions in millimetres
Nominal Wall Thickness

Nominal Outside Diameter										
4.0 } 5.0 } 6.3 }	0.50,	0.63,	0.80 ,	1.00,						
8.0 } 10.0 } 12.5 }	0.50,	0.63,	0.80,	1.00,	1.25,	1.60,	2.00,			
16.0 } 20.0 } 25.0 }	0.50,	0.63,	0.80,	1.00,	1.25,	1.60,	2.00,	2.50,		
31.5 } 40.0 } 50.0 }	0.80,	1.00,	1.25,	1.60,	2.00,	2.50,	3.15,			
63.0 } 80.0 }	0.80,	1.00,	1.25,	1.60,	2.00,	2.50	3.15,	4.0 ,	5.0,	
100 } 125 }	0.80,	1.00,	1.25,	1.60,	2.00,	2.50	3.15,	4.0 ,	5.0,	6.3
160 } 200 }	1.60,	2.00	2.50,	3.15,	4.0,	5.0,	6.3,	8.0,	10.0,	12.5
250 }	2.00,	2.50,	3.15,	4.0,	5.0,	6.3,	8.0,	10.0,	12.5	
160 } 200 }	3.15,	4.0,	5.0,	6.3	8.0,	10.0,	12.5,			
250 }	6.3,	8.0,	10.0,	12.5						
	8.0,	10.0,	12.5,	16.0						

Note1: Nominal dimension means specified dimensions

Note2: Sizes other than standard shall be as agreed to between the manufacturer and the purchaser

**TABLE 2 TOLERANCES ON WALL THICKNESS OF
DRAWN ROUND TUBE WITH PARALLEL BORE**

Nominal Wall Thickness	Tolerance on Mean Thickness	Tolerances on Thickness at Any Point
mm	± mm	± mm
0.50	0.05	0.09
0.63	0.05	0.11
0.80	0.05	0.14
1.00	0.05	0.16
1.25	0.05	0.18
1.60	0.08	0.22
2.00	0.09	0.28
2.50	0.10	0.36
3.15	0.13	0.46
4.0	0.20	0.61
5.0	0.26	0.74
6.3	0.33	0.99
8.0	0.40	1.21
10.0	0.51	1.50
12.5	0.63	1.89
16.0	0.80	2.40

**TABLE 3 TOLERANCES ON OUTSIDE OR INSIDE DIAMETERS
OF DRAWN ROUND TUBE WITH PARALLEL BORE**

All dimensions in millimeters.

<i>Nominal Outside</i>	<i>Nominal Wall Thickness of Tube</i>															
Diameter	0.50	0.63	0.80	1.00	1.25	1.60	2.00	2.50	3.15	4.0	5.0	6.3	8.0	10.0	12.5	16.0
	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
4.0	0.13	0.13	0.13	0.13												
5.0	0.13	0.13	0.13	0.13												
6.3	0.13	0.13	0.13	0.13												
8.0	0.13	0.13	0.13	0.13	0.13	0.13	0.13									
10.0	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13								
12.5	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13								
16.0	—	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13							
20.0	—	0.15	0.15	0.13	0.13	0.13	0.13	0.13	0.13	0.13						
25.0	—	0.18	0.15	0.15	0.15	0.13	0.13	0.13	0.13							
31.5	—	0.20	0.18	0.18	0.15	0.13	0.13	0.13	0.13	0.13	0.13					
40.0	—	0.23	0.23	0.20	0.18	0.15	0.15	0.15	0.15	0.15	0.15	0.15				
50.0	—	—	0.28	0.25	0.20	0.18	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15		
63.0	—	—	—	—	0.35	0.28	0.25	0.23	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
80.0	—	—	—	—	—	0.43	0.35	0.30	0.25	0.23	0.23	0.23	0.23	0.23	0.23	0.23
100	—	—	—	—	—	0.61	0.51	0.46	0.41	0.36	0.33	0.33	0.30	0.30	0.30	0.28
125	—	—	—	—	—	—	0.64	0.56	0.48	0.40	0.38	0.38	0.36	0.36	0.36	0.33
160	—	—	—	—	—	—	—	—	0.64	0.58	0.58	0.58	0.56	0.56	0.56	0.51
200	—	—	—	—	—	—	—	—	—	—	0.94	0.94	0.92	0.92	0.86	0.84
250	—	—	—	—	—	—	—	—	—	—	—	—	1.37	1.37	1.32	1.30

**TABLE 4 TOLERANCES ON STRAIGHTNESS OF
DRAWN ROUND TUBES WITH PARALLEL BORE**

All dimensions in millimetres.

<i>Nominal outside Diameter</i>	<i>Tolerance on straightness</i>
From 10 up to and including 150	1.25 mm/m
Over 150	2.00 mm/m

For detailed information, refer to IS 2678 : 1987 Specification for dimensions and tolerances for wrought aluminium and aluminium alloy drawn round tubes (second revision).

SECTION 17

STRUCTURAL SHAPES

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* This covers both aluminium and steel.

Note – See also Section 15 Structural steel and Section 16 Light metal and their alloys.

SUMMARY OF
IS 3908 : 1986 ALUMINIUM EQUAL LEG ANGLES
(First Revision)

1. Scope – Cover the material, dimensions and sectional properties of aluminium equal leg angles for structural use and other applications.

For example ALE 80 × 80 × 6

2. Designation – Aluminium equal leg angles sections shall be designated as ALE followed by lengths of legs and thickness of the section in mm.

3. Dimensions –

3.1 Designation and Size in mm

ALE 10×10×1.5	ALE 30×30×3.0	ALE 50×50×3.0	ALE 100×100× 6.0
ALE 10×10×2.0	ALE 30×30×4.0	ALE 50×50×4.0	ALE 100×100× 8.0
	ALE 30×30×5.0	ALE 50×50×5.0	ALE 100×100× 10.0
		ALE 50×50×6.0	ALE 100×100×12.0
ALE 15×15×1.5	ALE 35×35×3.0	ALE 60×60×4.0	ALE 120×120× 10.0
ALE 15×15×2.0	ALE 35×35×4.0	ALE 60×60×5.0	ALE 120×120× 12.0
ALE 15×15×3.0	ALE 30×30×5.0	ALE 60×60×6.0	ALE 120×120× 16.0
ALE 20×20×2.0	ALE 40×40×3.0	ALE 70×70×5.0	ALE 150×150×10.0
ALE 20×20×3.0	ALE 40×40×4.0	ALE 70×70×6.0	ALE 150×150×12.0
	ALE 40×40×5.0	ALE 70×70×7.0	ALE 150×150×16.0
ALE 25×25×2.0	ALE 45×45×3.0	ALE 80×80×6.0	ALE 200×200×12.0
ALE 25×25×3.0	ALE 45×45×4.0	ALE 80×80×8.0	ALE 200×200×16.0
ALE 25×25×4.0	ALE 45×45×5.0	ALE 80×80×10.0	ALE 200×200×20.0

4. Materials –

4.1 Aluminium sections covered in this standard shall be manufactured from the following alloys in appropriate temper:

19000, 24345, 24534, 52000, 53000,
54300, 63400, 64423, 64430, 65032 and
74530.

4.2 Aluminium alloys and temper selected shall conform to the provisions of IS 733 : 1983*

*Wrought aluminium and aluminium alloy bars, rods, and sections for general engineering purposes (third revision).

Note – For sectional properties refer to Table 1 of the standard. Dimensional tolerances for the sections shall be as specified in IS 3965 : 1981*

* Dimensions for wrought aluminium and aluminium alloy bar, rod and section (first revision)

For detailed information, refer to IS 3908 : 1986. Specifications for aluminium equal leg angles (first revision)

SUMMARY OF
IS 3909 : 1986 ALUMINIUM UNEQUAL LEG ANGLES
(First Revision)

1. Scope – Covers the material, dimensions and sectional properties of aluminium unequal leg angles for structural use and other applications.

of longer and shorter legs and thickness of the section in mm.

For example Alu 80 × 60 × 6

2. Designation – Aluminium unequal leg angles sections shall be designated as ALU followed by lengths

3. Dimensions –

3.1 Designation and Size in mm			
ALU 20×10×1.5	ALU 50×25×3.0	ALU 80×40×4.0	ALU 125×80× 8.0
ALU 20×10×2.0	ALU 50×25×4.0	ALU 80×40×6.0	ALU 125×80× 10.0
ALU 20×15×1.5	ALU50×30×5.0	ALE 80×40×8.0	ALU 125×80×12.0
ALU 20×15×2.0			
ALU 20×15×3.0	ALU 50×30×3.0	ALU 80×60×4.0	ALU150×80× 8.0
	ALU 50×30×4.0	ALU 80×60×6.0	ALU150×80×10.0
ALU 30×15×2.0	ALU 50×30×5.0	ALU 80×60×8.0	ALU150×80× 12.0
ALU 30×15×3.0		ALU 90×60×6.0	
ALU 30×20×2.0	ALU 60×30×3.0		ALU 200×100× 10.0
ALU 30×20×3.0	ALU 60×30×4.0	ALU100×50×6.0	ALU 200×100× 12.0
ALU 30×20×4.0	ALU 60×30×5.0	ALU100×50×8.0	ALU 200×100× 16.0
		ALU100×50×10.0	
ALU 40×20×2.0	ALU 60×40×4.0		ALU 200×150×12.0
ALU 40×20×3.0	ALU 60×40×5.0	ALU100×80×6.0	ALU 200×150×16.0
ALU 40×20×4.0	ALU 60×40×6.0	ALU 100×80×8.0	ALU 200×150×20.0
		ALU100×80×10.0	
ALU 40×25×2.0	ALU 65×45×4.0		
ALU 40×25×3.0	ALU 65×45×5.0	ALU120×80×8.0	
ALU 40×25×4.0		ALU120×80×10.0	
	ALU 75×50×5.0	ALU120×80×12.0	
ALU 45×30×3.0	ALU 75×50×6.0		
ALU 45×30×4.0			
ALU 45×30×5.0			

Note— For sectional properties, refer to Table 1 of the standard. dimensional tolerances for the sections shall be as specified in IS 3965 :1981*

appropriate temper : 19000, 24345, 24534, 52000, 53000, 54300, 63400, 64423, 64430, 65032 and 74530.

4. Material—

4.2 Aluminium alloys and temper selected shall conform to the provisions of IS 733 : 1983.⁺

4.1 Aluminium sections covered in this standard shall be manufactured from the following alloys in

⁺ Wrought aluminium and aluminium alloy bar rods and sections for general engineering purposes (*third revision*)

* Dimensions for wrought aluminium and aluminium alloy bar, rod and section (*first revision*).

For detailed information, refer to IS 3909 : 1986 Specifications for aluminium unequal leg angles (first revision)

SUMMARY OF
IS 3921 : 1985 ALUMINIUM CHANNELS
(First Revision)

1. Scope – Cover the material, dimensions and sectional properties of aluminium channels for structural use and other applications.

2. Designation – Aluminium channels shall be designated as ALC followed by the depth of channel in mm, flange width in mm and mass of the section in kg/m,

Example : ALC 80 × 40 - 3.21

3. Material

3.1 Aluminium sections covered in this standard shall be manufactured from the following alloys in appropriate temper :

19000, 24345, 24534, 52000, 53000, 63400, 64423, 64430, 65032 and 74530.

3.2 Aluminium alloys and temper selected shall conform to the provisions of IS 733 : 1983*

* Wrought aluminium and aluminium alloy bars rods and sections for general engineering purposes (*third revision*)

4. Dimensions

4.1 Designation and size

ALC 40 × 20 - 0.63	ALC 100 × 50 - 4.09
ALC 40 × 20 - 0.44	ALC 120 × 50 - 4.43
ALC 50 × 30 - 1.55	ALC 120 × 50 - 3.68
ALC 50 × 30 - 0.88	ALC 120 × 60 - 4.98
ALC 50 × 30 - 1.14	ALC 120 × 60 - 6.08
ALC 60 × 30 - 1.13	ALC 150 × 60 - 5.51
ALC 60 × 30 - 1.55	ALC 150 × 60 - 6.77
ALC 60 × 30 - 1.95	
ALC 60 × 40 - 1.87	ALC 150 × 80 - 6.59
ALC 60 × 40 - 2.38	ALC 150 × 80 - 6.59
ALC 80 × 40 - 2.10	ALC 150 × 80 - 8.07
ALC 80 × 40 - 2.67	ALC 150 × 80 - 0.26
ALC 80 × 40 - 3.21	
ALC 100 × 40 - 2.95	ALC 200 × 80 - 9.28
ALC 100 × 40 - 3.55	ALC 200 × 80 - 11.74
ALC 100 × 50 - 4.98	ALC 200 × 100 - 15.33
ALC 100 × 50 - 3.39	ALC 200 × 100 - 3.47

Note — For sectional properties, refer to Table of the standard, Dimensional tolerances for the sections shall be as specified in IS 3965 :1981*

* Dimensions for wrought aluminium and aluminium alloy bars rods and section (*first revision*).

For detailed information, refer to IS 3921 : 1985 Specifications for aluminium channels (first revision).

SUMMARY OF
IS 5384 : 1985 ALUMINIUM I-BEAM
(First Revision)

1. Scope – Covers the material, dimensions and sectional properties of aluminium I- beam sections for structural use and other applications.

2. Designation – Aluminium I- beam sections shall be designated as ALB followed by the depth of section, width of flange in mm and mass in kilograms per metre of the section.

Example : ALB 120 x 60 - 4.7

3. Materials –

3.1 Aluminium sections covered in this standard shall be manufactured from the following alloys in appropriate temper :

19000, 24345, 24534, 52000, 53000, 54300, 63400, 64423, 64430, 65032 and 74530.

3.2 Aluminium alloys and temper selected shall conform to the provisions of IS 733 : 1983⁺

⁺ Wrought aluminium and aluminium alloy, bars, rods and sections for general engineering purposes (*third revision*)

4. Dimensions —

4.1 Designation

ALB 40 × 20 - 0.4	ALB 100 × 60 - 4.7
ALB 40 × 20 - 0.6	
ALB 50 × 30 - 0.9	ALB 120 × 60 - 4.7
ALB 50 × 30 - 1.2	ALB 120 × 60 - 5.0
ALB 60 × 30 - 1.1	ALB 120 × 70 - 5.6
ALB 60 × 30 - 1.5	ALB 120 × 80 - 6.1
ALB 60 × 30 - 1.9	ALB 120 × 80 - 7.4
ALB 60 × 40 - 1.9	ALB 150 × 80 - 6.6
ALB 60 × 40 - 2.4	ALB 150 × 80 - 8.1
ALB 80 × 40 - 2.1	ALB 150 × 100 - 7.7
ALB 80 × 40 - 2.7	ALB 150 × 100 - 9.4
ALB 80 × 40 - 3.2	ALB 150 × 100 - 12.1
ALB 100 x 50 - 3.4	ALB 200 × 100 - 10.5
ALB 100 x 50 - 3.9	ALB 200 × 100 - 13.4
ALB 100 x 60 - 3.9	ALB 200 × 100 - 12.9
ALB 100 x 60 - 4.1	ALB 200 × 120 - 16.1

Note— For sectional properties, refer to the standard dimensional tolerances for the sections shall be as specified in IS 3965:1981*

* Dimensions for wrought aluminium and aluminium alloy bar, rod and sections (*first revision*)

For detailed information, refer to IS 5384 : 1985 Specifications for aluminium I-beam (first revision).

SUMMARY OF
IS 6445 : 1985 ALUMINIUM TEE - SECTIONS
(First Revision)

1. Scope – Covers the material, dimensions and sectional properties of aluminium tee – sections for structural use and other applications.

2. Designation – Aluminium tee-sections shall be designated as ALT followed by the depth of section, in mm width of flange in mm and mass in kilograms per metre of the section.

Example : ALT 125 × 100 – 7.0

3. Materials

3.1 Aluminium sections covered in this standard shall be manufactured from the following alloys in appropriate temper –

19000, 24345, 24534, 52000, 53000, 54300, 63400, 64423, 64430, 65032 and 74530.

3.2 Aluminium alloys and temper selected shall conform to the provisions of IS 733 : 1983⁺

⁺ Wrought aluminium and aluminium alloy, bars, rods and sections for general engineering purposes (*third revision*)

4. Dimensions

4.1 Designation

ALT 25 × 25 - 0.4	ALT 100 × 75 - 5.4
ALT 30 × 30 - 0.5	ALT 100 × 100 - 4.2
ALT 30 × 30 - 0.7	ALT 100 × 100 - 5.2
ALT 40 × 50 - 0.8	ALT 100 × 100 - 6.2
ALT 50 × 50 - 1.2	ALT 125 × 75 - 5.2
ALT 50 × 50 - 1.6	ALT 125 × 75 - 6.2
ALT 65 × 65 - 1.6	ALT 125 × 100 - 5.9
ALT 65 × 65 - 2.1	ALT 100 × 100 - 7.0
ALT 65 × 65 - 2.7	ALT 150 × 75 - 5.9
ALT 65 × 65 - 3.3	ALT 150 × 75 - 7.0
ALT 75 × 75 - 2.4	ALT 150 × 100 - 7.9
ALT 75 × 75 - 3.1	ALT 150 × 100 - 10.2
ALT 75 × 100 - 2.8	ALT 150 × 150 - 9.5
ALT 75 × 100 - 3.7	ALT 150 × 150 - 12.4
ALT 100 × 75 - 2.0	ALT 175 × 175 - 11.2
ALT 100 × 75 - 3.1	ALT 175 × 175 - 14.7
ALT 100 × 75 - 4.5	ALT 200 × 200 - 12.8
	ALT 200 × 200 - 16.8

Note – For sectional properties, refer to the standard dimensional tolerances for the sections shall be as specified in IS 3965 : 1981*

* Dimensions for wrought aluminium and aluminium alloy bar, rod and sections (*first revision*).

For detailed information, refer to IS 6445 : 1985 Aluminium tee-section (first revision).

SUMMARY OF

IS 808 : 1989 DIMENSIONS FOR HOT ROLLED STEEL BEAM,
COLUMN, CHANNEL AND ANGLE SECTIONS

(Third Revision)

1. **Scope** – Covers the nominal dimensions, and sectional properties of hot rolled sloping flange beam and column sections, sloping and parallel flange channel sections and equal and unequal leg angle sections.

2. **Classification**2.1 *Beams*

- a) Indian Standard junior beams (ISJB),
- b) Indian Standard light beams (ISLB),
- c) Indian Standard medium weight beams (ISMB) and
- d) Indian Standard wide flange beams (ISWB)

2.2 *Columns / Heavy Weight Beams*

- a) Indian Standard column sections (ISSC) and
- b) Indian Standard heavy weight beam (ISHB)

2.3 *Channels*

- a) Indian Standard junior channels (ISJC)
- b) Indian Standard light weight channels (ISLC)
- c) Indian Standard medium weight channels (ISMC) and
- d) Indian Standard medium weight parallel flange channels (ISMCP)

2.4 *Angles*

- a) Indian Standard equal angles (ISA)
- b) Indian Standard unequal angles (ISA)

3. **Designation** – Beam, columns and channel sections shall be designated by the respective abbreviated reference symbols followed by the depth of the section, for example:

- a) MB 200 – for a medium weight beam of depth 200 mm
- b) SC 200 – for a column section of depth 200 mm
- c) MC 200 – for a medium weight channel of depth 200 mm and

- d) MCP 200 – for a medium weight parallel flange channel of depth 200 mm

4. **Dimensions**4.1 *Beams*4.1.1 *Medium flange beams –*

MB100	MB225	MB450
MB125	MB250	MB500
MB150	MB300	MB550
MB175	MB350	MB600
MB200	MB400	

4.1.2 *Junior beams*

JB 150	JB200
JB175	JB225

4.1.3 *Light weight beams –*

LB 75	LB275
LB100	LB300
LB(P)100	LB(P)300
LB125	LB325
LB150	LB350
LB175	LB400
LB(P)175	LB450
LB200	LB500
LB(P)200	LB550
LB225	LB600
LB250	

Note – (P) stands for Provisional Section.

4.1.4 *Wide flange beams*

WB150	WB350
WB175	WB400
WB200	WB450
WB200*	WB500
WB225	WB550
WB250	WB600
WB300	WB600

Note – WB200* (RSJ sections) is mainly used for railway electrification.

4.1.5 Column heavy weight beams –**4.1.5.1 Column Sections**

SC100	SC180
SC120	SC200
SC140	SC220
SC150*	SC250
SC160	

Note — SC150* (BFB sections) is mainly used for railway electrification.

4.1.5.1.2 Heavy weight beams columns

HB150	HB300
HB150*	HB300*
HB150*	HB350
HB200	HB350*
HB200*	HB400
HB225	HB400*
HB225*	HB450
HB250	HB450*
HB250*	

Note: Heavy section.

4.2 Channels**4.2.1 Medium weight channels**

MC 75	MC225
MC100	MC225*
MC125	MC250
MC125*	MC250*
MC150	MC250*
MC150*	MC300
MC175	MC300*
MC175*	MC300*
MC200	MC350
MC200*	MC400

Note: * Heavy sections.

4.2.2 Junior channels

JC100	JC175
JC125	JC200
JC150	

4.2.3 Light weight channels

LC 75	LC(P)200
LC100	LC225
LC125	LC250
LC(P)125	LC300
LC150	LC(P)300
LC(P)150	LC350
LC175	LC400
LC200	

Note – (P) stands for provisional section.

4.2.4 Parallel Flange –

MCP 75	MCP225
MCP100	MCP225*
MCP125	MCP250
MCP125*	MCP250*
MCP150	MCP300
MCP150*	MCP300*
MCP175	MCP300*
MCP175*	MCP350
MCP200`	MCP400
MCP200*	

Note. – *Heavier section

4.3 Equal leg angles

∠ 20 20 × 3	∠ 45 45 × 3
× 4	× 4
∠ 25 25 × 3	× 5
× 4	× 6
× 5	∠ 50 50 × 3
∠ 30 30 × 3	× 4
× 4	× 5
× 5	× 6
∠ 35 35 × 3	∠ 55 55 × 4
× 4	× 5
× 5	× 6
× 6	× 8
∠ 40 40 × 3	∠ 60 60 × 4
× 4	× 5
× 5	× 6
× 6	× 8
∠ 65 65 × 4	∠ 100 100 × 6
× 5	× 8
× 6	× 10
× 8	× 12
∠ 70 70 × 5	∠ 110 110 × 8
× 6	× 10
× 8	× 12
× 10	× 16
∠ 75 75 × 5	∠ 130 130 × 8
× 6	10
× 8	× 12
× 10	× 16
∠ 80 80 × 6	∠ 150 150 × 10
× 8	× 12
× 10	× 16
× 12	× 20
∠ 90 90 × 6	∠ 200 200 × 12
× 8	× 16
× 10	× 20
× 12	× 25

4.3.1 Supplementary list of equal leg angles –

∠ 50 50 × 7	∠ 130 130 × 9
× 8	∠ 150 150 × 15
∠ 55 55 × 10	× 18
∠ 60 60 × 4	∠ 180 180 × 15
× 10	× 18
∠ 65 65 × 10	× 20
∠ 100 100 × 7	∠ 200 200 × 24
× 15	

$\angle 120$ 120 \times 8
 \times 10
 \times 12
 \times 15

4.4 Unequal Leg Angles

$\angle 30$ 20 \times 3	$\angle 70$ 45 \times 5
\times 4	\times 6
\times 5	\times 8
$\angle 40$ 25 \times 3	\times 10
\times 4	$\angle 75$ 50 \times 5
\times 5	\times 6
\times 6	\times 8
$\angle 45$ 30 \times 3	\times 10
\times 4	$\angle 80$ 50 \times 5
\times 5	\times 6
\times 6	\times 8
$\angle 50$ 30 \times 3	\times 10
\times 4	$\angle 90$ 60 \times 6
\times 5	\times 8
\times 6	\times 10
$\angle 60$ 40 \times 5	\times 12
\times 6	$\angle 100$ 65 \times 6
\times 8	\times 8
$\angle 100$ 75 \times 6	\times 10
\times 8	$\angle 150$ 115 \times 8
\times 10	\times 10
\times 12	\times 12
$\angle 125$ 75 \times 6	\times 16
\times 8	$\angle 200$ 100 \times 10
\times 10	\times 12
$\angle 125$ 95 \times 6	\times 16
\times 8	
\times 10	
\times 12	

4.4.1 Supplementary list of unequal leg angles

$\angle 150$ 75 \times 8	$\angle 200$ 150 \times 10
\times 10	\times 12
\times 12	\times 16
$\angle 40$ 20 \times 3	\times 20
\times 4	$\angle 90$ 65 \times 6
\times 5	\times 7
$\angle 60$ 30 \times 5	\times 8
\times 6	\times 10
$\angle 60$ 40 \times 7	$\angle 100$ 50 \times 6
$\angle 65$ 50 \times 5	\times 7
\times 6	\times 8
\times 7	\times 10
\times 8	$\angle 100$ 65 \times 7
$\angle 70$ 50 \times 5	$\angle 120$ 80 \times 8
\times 6	\times 10
\times 7	\times 12
\times 8	$\angle 125$ 75 \times 12
$\angle 75$ 50 \times 7	$\angle 135$ 65 \times 8
$\angle 80$ 40 \times 5	\times 10
\times 6	\times 12
\times 7	$\angle 150$ 75 \times 9
\times 8	\times 15
$\angle 80$ 60 \times 6	$\angle 150$ 90 \times 10
\times 7	\times 12
\times 8	\times 15
	$\angle 200$ 100 \times 15
	\times 18

For detailed information, refer to IS 808 :1989 Dimensions for hot rolled steel beam, columns, channel and angle sections (third revision).

SUMMARY OF
IS 811 : 1987 COLD FORMED LIGHT GAUGE STRUCTURAL STEEL
SECTIONS
(Second Revision)

1. Scope – Lays down dimensions mass, sectional properties and requirements for corrosion protection for cold formed light gauge open wall steel sections for structural and other general applications, having minimum thickness of 1.25mm.

2. Designation – Cold formed light gauge sections shall be designated by figures denoting depth (mm) × width (mm) × thickness (mm) of the section.

3. Materials – Sheet and strip used for making the cold-formed sections shall conform to IS 1079 : 1994* Sheet and strip conforming to IS 513: 1994+ may also be used for sections where load bearing is not a design criteria, for example, false ceiling, sections for frames of doors and windows.

4. Dimensions and Properties –

4.1 Equal Angles –

4.1.1 Designations

h × h × t in mm	h × h × t in mm
20 × 20 × 1.25	60 × 60 × 2.00
20 × 20 × 1.60	60 × 60 × 2.55
20 × 20 × 2.00	60 × 60 × 3.15
30 × 30 × 1.60	60 × 60 × 4.00
30 × 30 × 2.00	70 × 70 × 3.15
30 × 30 × 3.15	70 × 70 × 4.00
40 × 40 × 1.60	70 × 70 × 5.00
40 × 40 × 2.00	80 × 80 × 3.15
40 × 40 × 2.55	80 × 80 × 4.00
40 × 40 × 3.15	80 × 80 × 5.00
50 × 50 × 2.00	80 × 80 × 6.00
50 × 50 × 2.55	100 × 100 × 3.15
50 × 50 × 3.15	100 × 100 × 4.00
50 × 50 × 4.00	100 × 100 × 5.00
	100 × 100 × 6.00

* Hot rolled carbon steel sheet and strips (*fifth revision*).

+ Cold rolled low carbon steel sheets and strips (*fourth revision*)

4.2 Unequal Angles –

4.2.1 Designations

h × b × t in mm	h × b × t in mm
20 × 15 × 1.25	60 × 30 × 2.00
20 × 15 × 1.60	60 × 30 × 3.15
20 × 15 × 2.00	80 × 30 × 2.00
30 × 15 × 1.25	80 × 30 × 2.55
30 × 15 × 1.60	80 × 30 × 3.15
30 × 15 × 2.00	80 × 50 × 3.15
30 × 20 × 1.60	80 × 50 × 4.00
30 × 20 × 2.00	80 × 50 × 5.00
40 × 20 × 1.60	80 × 50 × 6.00
40 × 20 × 2.00	100 × 30 × 3.15
40 × 20 × 2.55	100 × 30 × 4.00
40 × 25 × 2.00	100 × 30 × 5.00
40 × 25 × 2.55	100 × 50 × 3.15
50 × 25 × 1.60	100 × 50 × 4.00
50 × 25 × 2.00	100 × 50 × 5.00
50 × 25 × 2.55	100 × 50 × 6.00

4.3 Designation Channels without Lips-square –

h × h × t in mm	h × h × t in mm
20 × 20 × 1.25	50 × 50 × 3.15
20 × 20 × 1.60	50 × 50 × 4.00
20 × 20 × 2.00	60 × 60 × 2.00
25 × 25 × 1.25	60 × 60 × 3.15
25 × 25 × 1.60	60 × 60 × 4.00
25 × 25 × 2.00	80 × 80 × 2.00
25 × 25 × 2.55	80 × 80 × 3.15
30 × 30 × 1.60	80 × 80 × 5.00
30 × 30 × 2.00	80 × 80 × 6.00
30 × 30 × 3.15	100 × 100 × 2.00
40 × 40 × 1.60	100 × 100 × 3.15
40 × 40 × 2.00	100 × 100 × 5.00
40 × 40 × 2.55	100 × 100 × 6.00
40 × 40 × 3.15	
50 × 50 × 2.00	
50 × 50 × 2.55	

SP 21 : 2005

4.4 Channels without Lips — Rectangular

4.4.1 Designations

$h \times b \times t$ in mm	$h \times b \times t$ in mm
30 × 15 × 1.25	80 × 50 × 5.00
30 × 15 × 1.60	80 × 60 × 2.00
30 × 20 × 1.25	80 × 60 × 3.15
30 × 20 × 2.00	80 × 60 × 4.00
40 × 15 × 1.25	90 × 40 × 1.60
40 × 15 × 2.00	90 × 40 × 2.00
40 × 20 × 2.00	90 × 40 × 3.15
40 × 20 × 3.15	90 × 50 × 1.60
40 × 25 × 1.60	90 × 50 × 2.00
40 × 25 × 2.00	90 × 50 × 3.15
40 × 25 × 2.55	100 × 40 × 1.60
50 × 25 × 1.60	100 × 40 × 2.00
50 × 25 × 2.00	100 × 40 × 3.15
50 × 25 × 2.55	100 × 40 × 4.00
50 × 25 × 3.15	100 × 50 × 2.00
50 × 40 × 1.60	100 × 50 × 3.15
50 × 40 × 2.00	100 × 50 × 4.00
50 × 40 × 2.55	100 × 50 × 5.00
50 × 40 × 3.15	100 × 60 × 2.00
60 × 30 × 1.60	100 × 60 × 3.15
60 × 30 × 2.00	100 × 60 × 4.00
60 × 30 × 3.15	100 × 60 × 5.00
60 × 30 × 4.00	120 × 50 × 3.15
60 × 40 × 2.00	120 × 50 × 4.00
60 × 40 × 3.15	120 × 50 × 5.00
60 × 40 × 4.00	120 × 60 × 4.00
60 × 50 × 2.00	120 × 60 × 5.00
60 × 50 × 3.15	120 × 60 × 6.00
70 × 30 × 1.60	140 × 60 × 4.00
70 × 30 × 2.00	140 × 60 × 6.00
70 × 30 × 3.15	150 × 50 × 3.15
70 × 40 × 2.00	150 × 50 × 4.00
70 × 40 × 3.15	150 × 50 × 5.00
70 × 40 × 4.00	180 × 50 × 3.15
80 × 25 × 1.60	180 × 50 × 5.00
80 × 25 × 2.00	200 × 50 × 4.00
80 × 25 × 3.15	200 × 50 × 5.00
80 × 25 × 4.00	200 × 50 × 6.00
80 × 40 × 1.60	200 × 80 × 4.00
80 × 40 × 2.00	200 × 80 × 5.00
80 × 40 × 3.15	200 × 80 × 6.00
80 × 40 × 4.00	250 × 50 × 4.00
80 × 50 × 2.00	250 × 50 × 5.00
80 × 50 × 3.15	250 × 50 × 6.00
80 × 50 × 4.00	250 × 80 × 4.00
	250 × 80 × 5.00

4.5 Designations Channels Without Lips— Square

$h \times h \times c \times t$ in mm, where 'c' is lip length	
25 × 25 × 8 × 1.25	60 × 60 × 15 × 2.00
25 × 25 × 8 × 1.60	60 × 60 × 15 × 2.55
30 × 30 × 10 × 1.25	60 × 60 × 20 × 3.15
30 × 30 × 10 × 1.60	80 × 80 × 15 × 2.00
35 × 35 × 10 × 1.25	80 × 80 × 20 × 3.15
35 × 35 × 10 × 1.60	80 × 80 × 25 × 4.00
40 × 40 × 10 × 1.25	80 × 80 × 25 × 5.00
40 × 40 × 1.0 × 1.6	100 × 100 × 15 × 2.00
40 × 40 × 15 × 2.00	100 × 100 × 20 × 3.15
50 × 50 × 15 × 2.00	100 × 100 × 25 × 4.00
50 × 50 × 10 × 1.60	100 × 100 × 25 × 5.00

4.6 Channels without Lips— Rectangular:

Designations	
$h \times b \times c \times t$ in mm, where 'c' is lip length	
30 × 15 × 10 × 1.15	90 × 50 × 15 × 2.00
30 × 15 × 10 × 1.60	90 × 50 × 20 × 3.15
40 × 20 × 10 × 1.25	100 × 40 × 10 × 1.60
40 × 20 × 10 × 1.60	100 × 40 × 15 × 2.00
50 × 25 × 10 × 1.25	100 × 40 × 25 × 3.15
50 × 25 × 10 × 1.60	100 × 50 × 15 × 2.00
50 × 25 × 15 × 2.00	100 × 50 × 20 × 3.15
50 × 40 × 10 × 1.25	100 × 50 × 25 × 4.00
50 × 40 × 10 × 1.60	100 × 25 × 25 × 4.00
50 × 40 × 15 × 2.00	100 × 60 × 15 × 2.00
50 × 40 × 15 × 3.15	100 × 60 × 20 × 3.15
60 × 30 × 10 × 1.60	100 × 60 × 25 × 4.00
60 × 30 × 15 × 2.00	100 × 60 × 25 × 5.00
60 × 30 × 20 × 3.15	120 × 50 × 15 × 2.00
60 × 30 × 20 × 4.00	120 × 50 × 20 × 3.15
60 × 40 × 15 × 2.00	120 × 50 × 25 × 4.00
60 × 40 × 20 × 3.15	120 × 50 × 25 × 5.00
60 × 40 × 20 × 4.00	120 × 60 × 20 × 3.15
70 × 25 × 10 × 1.60	120 × 60 × 25 × 4.0
70 × 25 × 15 × 2.00	120 × 60 × 25 × 5.0
70 × 25 × 20 × 3.15	140 × 60 × 20 × 3.15
70 × 30 × 15 × 2.00	140 × 60 × 25 × 4.00
70 × 30 × 20 × 3.15	140 × 60 × 25 × 5.00
70 × 40 × 15 × 2.00	150 × 50 × 20 × 3.15
70 × 40 × 20 × 3.15	150 × 50 × 25 × 4.00
70 × 40 × 25 × 4.00	150 × 50 × 25 × 5.00
80 × 40 × 10 × 1.60	180 × 50 × 20 × 3.15
80 × 40 × 20 × 3.15	180 × 50 × 25 × 4.00
80 × 40 × 15 × 4.00	180 × 50 × 25 × 5.00
80 × 50 × 10 × 1.60	180 × 80 × 20 × 3.15
80 × 50 × 15 × 2.00	180 × 80 × 25 × 4.00
80 × 50 × 20 × 3.15	180 × 80 × 25 × 5.00
80 × 50 × 25 × 4.00	200 × 50 × 20 × 3.15
90 × 40 × 10 × 1.60	200 × 50 × 25 × 4.00
90 × 40 × 15 × 2.00	200 × 50 × 25 × 5.00
90 × 40 × 20 × 3.15	200 × 80 × 20 × 3.15
90 × 50 × 10 × 1.6	200 × 80 × 25 × 4.00
	200 × 80 × 25 × 5.00
	250 × 50 × 20 × 3.15
	250 × 50 × 25 × 4.00
	250 × 50 × 25 × 5.00
	250 × 80 × 20 × 3.15
	250 × 80 × 25 × 4.00
	250 × 80 × 25 × 5.00

4.7 Hat Section—Square:**4.7.1 Designations**

h x h x d x t in mm	h x h x d x t in mm
30 × 30 × 10 × 1.25	60 x 60 x 10 x 1.60
30 × 30 × 10 × 1.60	60 x 60 x 15 x 2.00
35 × 35 × 10 × 1.25	60 x 60 x 20 x 3.15
35 × 35 × 10 × 1.60	60 x 60 x 25 x 4.00
40 × 40 × 10 × 1.25	80 x 80 x 15 x 2.00
40 × 40 × 10 × 1.60	80 x 80 x 20 x 3.15
40 × 40 × 15 × 2.00	80 x 80 x 25 x 4.00
40 × 40 × 20 × 3.15	80 x 80 x 30 x 5.00
50 × 50 × 10 × 1.60	100 x 100 x 15 x 2.00
50 × 50 × 15 × 2.00	100 x 100 x 20 x 3.15
50 × 50 × 20 × 3.15	100 x 100 x 25 x 4.00
60 × 60 × 10 × 1.60	100 x 100 x 30 x 5.00
	100 x 100 x 30 x 6.00

4.8 Hat Sections— Rectangular $h > b$:**4.8.1 Designation**

h x b x d x t in mm	h x b x d x t in mm
50 × 40 × 10 × 1.60	80 × 50 × 15 × 2.00
50 × 40 × 15 × 2.00	80 × 50 × 20 × 3.15
50 × 40 × 20 × 3.15	80 × 50 × 25 × 4.00
60 × 40 × 15 × 2.00	80 × 60 × 15 × 2.00
60 × 40 × 20 × 3.15	80 × 60 × 20 × 3.15
60 × 50 × 15 × 2.00	80 × 60 × 25 × 4.00
60 × 50 × 20 × 3.15	100 × 80 × 15 × 2.00
60 × 50 × 25 × 4.00	100 × 80 × 20 × 3.15
80 × 40 × 15 × 2.00	100 × 80 × 25 × 4.00
80 × 40 × 20 × 3.15	100 × 80 × 30 × 5.00

4.9 Hat Sections— Rectangular $b > h$:**4.9.1 Designation**

h x b x d x t in mm	h x b x d x t in mm
30 × 50 × 10 × 1.25	40 × 50 × 10 × 1.60
30 × 50 × 10 × 1.60	40 × 60 × 15 × 2.00
40 × 50 × 10 × 1.25	40 × 60 × 20 × 3.15

4.10 Lipped Zed Section—Equal Flanges:**4.10.1 Designation**

h x b x c x t in mm	h x b x c x t in mm
80 × 40 × 20 × 1.60	85 × 40 × 20 × 3.15
80 × 40 × 10 × 2.00	90 × 40 × 20 × 1.60
80 × 40 × 20 × 2.30	90 × 40 × 20 × 2.00
80 × 40 × 20 × 2.55	90 × 40 × 20 × 2.30
80 × 40 × 20 × 3.15	90 × 40 × 20 × 2.55
85 × 40 × 20 × 1.60	90 × 40 × 20 × 3.15
85 × 40 × 20 × 2.00	95 × 40 × 20 × 1.60
85 × 40 × 20 × 2.30	95 × 40 × 20 × 2.00
85 × 40 × 20 × 2.55	95 × 40 × 20 × 2.30
	95 × 40 × 20 × 2.55

95 × 40 × 20 × 3.15

100 × 40 × 20 × 1.60
100 × 40 × 20 × 2.00
100 × 40 × 20 × 2.30
100 × 40 × 20 × 2.55
100 × 40 × 20 × 3.15
105 × 45 × 20 × 1.60
105 × 45 × 20 × 2.00
105 × 45 × 20 × 2.30
105 × 45 × 20 × 2.55
105 × 45 × 20 × 3.15
110 × 45 × 20 × 1.60
110 × 45 × 20 × 2.00
110 × 45 × 20 × 2.30
110 × 45 × 20 × 2.55
110 × 45 × 20 × 3.15
115 × 45 × 20 × 1.60
115 × 45 × 20 × 2.30
115 × 45 × 20 × 2.55
115 × 45 × 20 × 3.15
120 × 45 × 20 × 1.60
120 × 45 × 20 × 2.00
120 × 45 × 20 × 2.30
120 × 45 × 20 × 2.55
120 × 45 × 20 × 3.15
125 × 45 × 20 × 1.60
125 × 45 × 20 × 2.00
125 × 45 × 20 × 2.30
125 × 45 × 20 × 2.55
125 × 45 × 20 × 3.15
130 × 45 × 20 × 1.60
130 × 45 × 20 × 2.00
130 × 45 × 20 × 2.30
130 × 45 × 20 × 2.55
130 × 45 × 20 × 3.15
140 × 60 × 20 × 1.60
140 × 60 × 20 × 2.00
140 × 60 × 20 × 2.30
140 × 60 × 20 × 2.55
140 × 60 × 20 × 3.15
150 × 60 × 20 × 1.60
150 × 60 × 20 × 2.00
150 × 60 × 20 × 2.30
150 × 60 × 20 × 2.55
150 × 60 × 20 × 3.15
160 × 60 × 20 × 1.60
160 × 60 × 20 × 2.00
160 × 60 × 20 × 2.30
160 × 60 × 20 × 2.55
160 × 60 × 20 × 3.15
170 × 60 × 20 × 1.60
170 × 60 × 20 × 2.00
170 × 60 × 20 × 2.30
170 × 60 × 20 × 2.55
170 × 60 × 20 × 3.15
180 × 60 × 20 × 1.60
180 × 60 × 20 × 2.00
180 × 60 × 20 × 2.30
180 × 60 × 20 × 2.55
180 × 60 × 20 × 3.15

190 × 60 × 20 × 1.60
190 × 60 × 20 × 2.00
190 × 60 × 20 × 2.30
190 × 60 × 20 × 2.55
190 × 60 × 20 × 3.15
200 × 60 × 20 × 1.60
200 × 60 × 20 × 2.00
200 × 60 × 20 × 2.30
200 × 60 × 20 × 2.55
200 × 60 × 20 × 3.15
210 × 60 × 20 × 1.60
210 × 60 × 20 × 2.00
210 × 60 × 20 × 2.30
210 × 60 × 20 × 2.55
210 × 60 × 20 × 3.15
220 × 60 × 20 × 1.60
220 × 60 × 20 × 2.00
220 × 60 × 20 × 2.30
220 × 60 × 20 × 2.55
220 × 60 × 20 × 3.15
230 × 75 × 20 × 1.60
230 × 75 × 20 × 2.00
230 × 75 × 20 × 2.30
230 × 75 × 20 × 2.55
230 × 75 × 20 × 3.15
240 × 75 × 20 × 1.60
240 × 75 × 20 × 2.00
240 × 75 × 20 × 2.30
240 × 75 × 20 × 2.55
240 × 75 × 20 × 3.15
250 × 75 × 20 × 1.60
250 × 75 × 20 × 2.00
250 × 75 × 20 × 2.30
250 × 75 × 20 × 2.55
250 × 75 × 20 × 3.15
260 × 75 × 20 × 1.60
260 × 75 × 20 × 2.00
260 × 75 × 20 × 2.30
260 × 75 × 20 × 2.55
260 × 75 × 20 × 3.15
270 × 75 × 20 × 1.60
270 × 75 × 20 × 2.00
270 × 75 × 20 × 2.30
270 × 75 × 20 × 2.55
270 × 75 × 20 × 3.15
280 × 75 × 20 × 1.60
280 × 75 × 20 × 2.00
280 × 75 × 20 × 2.30
280 × 75 × 20 × 2.55
280 × 75 × 20 × 3.15
290 × 75 × 20 × 1.60
290 × 75 × 20 × 2.00
290 × 75 × 20 × 2.30
290 × 75 × 20 × 2.55
290 × 75 × 20 × 3.15
300 × 75 × 20 × 1.60
300 × 75 × 20 × 2.00
300 × 75 × 20 × 2.30
300 × 75 × 20 × 2.55
300 × 75 × 20 × 3.15

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4.11 90° Corner – Refer to Table 11 of the standard.

5. Tolerances

5.1 Straightness – The straightness of any length shall be such that the offset does not exceed 1/600 of that length, when measured along both the X-X and Y-Y axis.

5.2 Profile – The deviation of the profile dimensions shall not exceed ± 0.5 mm. The deviation from the angle of 90° shall not exceed 1°

5.3 Twist – The section shall be reasonably free from twist.

6. Corrosion Protection – Corrosion protection of cold formed light gauge steel sections shall be carried out in accordance with IS 4180 : 1967. The performance tests for protective scheme in the protection of these sections against corrosion shall conform to IS 4777 : 1968. +

* Code of practice for corrosion protection of light gauge steel sections used in buildings.

+ Performance tests for protection schemes used in protection of light gauge steel against corrosion.

For detailed information refer to IS 811:1984 Specifications for cold formed light gauge structural steel sections (second revision).

SUMMARY OF
IS 1173 : 1978 HOT ROLLED AND SLIT STEEL TEE BARS
(Second Revision)

1. Scope – Lays down nominal dimensions, weight and basic geometrical properties.

2. Classification –

- a) Indian Standard Rolled Normal Tee Bars (ISNT)
- b) Indian Standard Rolled Deep Legged Tee Bars (ISDT),

c) Indian Standard Slit Light Weight Tee Bars (ISLT).

d) Indian Standard Slit Medium Weight Tee Bars (ISMT)

e) Indian Standard Slit Tee Bars from H- sections (ISHT).

3. Dimensions and Properties

Designation	Weight (kg/m)	Normal size (Depth × Width) mm × mm	Moments of Inertia	
			I _{xx} 10 ⁶ mm ⁴	I _{yy} 10 ⁶ mm ⁴
a) Indian Standard Normal Tee Bars				
ISNT 20	1.1	20 × 20	0.005	0.002
ISNT 30	1.8	30 × 30	0.018	0.008
ISNT 40	3.5	40 × 40	0.061	0.029
ISNT 50	4.4	50 × 50	0.123	0.057
ISNT 60	5.4	60 × 60	0.214	0.097
ISNT 75	10.0	75 × 75	0.620	0.292
ISNT 100	14.9	100 × 100	1.64	0.768
ISNT 150	22.7	150 × 150	5.41	2.50
b) Indian Standard Deep Legged Tee Bars				
ISDT 100	8.1	100 × 50	0.990	0.096
ISDT 150	15.7	150 × 75	4.50	0.370
c) Indian Standard Slit Light Weight Tee Bars				
ISLT 200	28.4	200 × 165	12.7	3.58
ISLT 250	37.5	250 × 180	27.7	5.32
d) Indian Standard Slit Medium Weight Tee Bars				
ISMT 50	5.8	50 × 70	0.108	0.177
ISMT 62.5	6.7	62.5 × 70	0.218	0.192
ISMT 75	7.5	75 × 75	0.412	0.234
ISMT 87.5	9.8	87.5 × 87.5	0.756	0.384
ISMT 100	12.7	100 × 100	1.16	0.750
e) Indian Standard Slit Tee Bars from H-Section				
ISHT 75	15.3	75 × 150	0.962	2.30
ISHT 100	20.0	100 × 200	1.94	4.97
ISHT 125	27.4	125 × 250	4.15	10.0
ISHT 150	29.4	150 × 250	5.74	11.0

Note — For detailed dimensions and properties, namely, sectional area, section moduli, etc. see Table 1 of the standard.

For detailed information, refer to IS 1173 : 1978 Specifications for hot rolled and slit steel Tee bars (second revision)

SUMMARY OF
IS 1730 : 1989 STEEL PLATES SHEETS STRIPS AND FLATS, FOR
STRUCTURAL AND GENERAL ENGINEERING PURPOSES
(Second Revision)

1. Scope – Specifies nominal dimensions, nominal mass and surface area (for sheets) of hot-rolled steel plates, sheets, strips and flats for structural and general engineering purposes.

2. Designation – Hot-rolled steel plates, sheets strips and flats conforming to this standard shall be designated as under :

- a) Plates shall be designated as ISPL followed by figures denoting length (mm) × width (mm) × thickness (mm) of the sheet.
- b) Sheets shall be designated as ISSH followed by figures denoting length (mm) × width (mm) × thickness (mm) of the sheet.

c) Strips shall be designated as ISST followed by figures denoting width (mm) x thickness x (mm) of the strip.

d) Flats shall be designated by the width (mm) followed by letters ISF and the thickness (mm).

3. Plates

3.1 Thickness – Standard nominal thickness of plates in (mm) shall be as follows:

5.0	10	18	28	45
6.0	12	20	32	50
7.0	14	22	36	56
8.0	16	25	40	63

3.2 Size – See Table 1.

TABLE 1 STANDARD NOMINAL SIZES OF PLATES

Width in mm →	900	950	1000	1100	1200	1250	1400	1500	1600	1800	2000	2200	2500
Length in mm ↓	Maximum Standard Nominal thickness in mm.												
2 200	63	63	63	63	63	63	63	63	63	63	63	63	63
2 500	63	63	63	63	63	63	63	63	63	63	63	63	63
2 800	63	63	63	63	63	63	63	63	63	63	63	63	63
3 200	63	63	63	63	63	63	63	63	63	63	63	63	63
3 600	63	63	63	63	63	63	63	63	63	63	63	63	63
4 000	63	63	63	63	63	63	63	63	63	63	63	63	63
4 500	63	63	63	63	63	63	63	63	63	63	63	63	63
5 000	63	63	63	63	63	63	63	63	63	63	63	63	63
5 600	63	63	63	63	63	63	63	63	63	63	63	63	56
6 300	63	63	63	63	63	63	63	63	63	63	63	56	50
7 100	63	63	63	63	63	63	63	63	63	63	56	50	45
8 000	63	63	63	63	63	63	63	63	63	56	50	45	40
9 000	63	63	63	63	63	63	63	56	56	50	45	40	36
10 000	63	63	63	63	63	63	56	50	50	45	40	36	32
11 000	63	63	63	63	56	56	50	50	45	40	36	32	28
12 500	63	63	63	56	50	50	45	40	40	36	32	28	25
13 500	63	63	56	50	50	45	40	40	36	32	28	25	25

4. Sheets –

4.1 Thickness – Standard nominal thickness in mm shall be as follows

0.40	0.80	1.12	1.60	2.00	2.80	4.00
0.50	0.90	1.25	1.80	2.24	3.15	4.30
0.63	1.00	1.40	1.90	2.50	3.55	4.65

4.2 Dimensions

Size mm × mm	
1800 × 600	2800 × 600
750	750
900	900
950	950
1000	1000
1100	1100
	1200
	1250
1200	1400
1250	1500
1400	
1500	3200 × 600
2000 × 600	750
750	900
900	950
950	1000
1000	1100
	1200
1100	1250
1200	1400
1250	1500
1400	
1500	3600 × 600
2200 × 600	750
750	900
900	950
950	1000
1000	1100
	1200
1100	1250
1200	1400
1250	1500
1400	
1500	4000 × 600
2500 × 600	750
750	900
900	950
950	1000
1000	1100
1100	1200
	1250
1200	1400
1250	1500
1400	
1500	

5. Strips –

5.1 Thickness – Standard nominal thickness in mm shall be as follows :

1.60	2.24	3.15	4.50	8.00
1.80	2.50	3.65	5.00	10.00
2.00	2.80	4.00	6.00	

5.2 Dimensions – Width in mm shall be as follows:

100	200	400	800	1050	1300
125	250	500	950	1150	1450
160	320	650	1000	1250	1550

6 Flats

6.1 Thickness – Standard nominal thickness in mm shall be as follows :

3.0	8.0	20.0
4.0	10.0	25.0
5.0	12.0	30.0
6.0	15.0	40.0
		50.0

6.2 Dimensions – Width in mm shall be as follows:

10	45	90	180
16	50	100	200
20	60	120	250
25	65	130	300
30	70	140	400
35	75	150	
40	80	160	

7. Tolerances – The rolling and cutting tolerances and mass tolerances for steel plates, sheet strips and , flats shall be as laid down in IS 1852 : 1985.

* Rolling and cutting tolerances for hot rolled steel products (fourth revision)

For detailed information, refer to IS 1730 : 1989 Steel plates, sheets, strips and flats structural and general engineering purposes – Dimensions (second revision).

SUMMARY OF

IS 1732 : 1989 STEEL BARS, ROUND AND SQUARE FOR
STRUCTURAL AND GENERAL ENGINEERING

PURPOSES-DIMENSIONS

(Second Revision)

1. Scope – Specifies dimensions, sectional areas and mass of hot-rolled round and square steel bars for structural and general engineering purposes. This standard does not cover bars for rivets and threaded components.

2. Designation – Hot rolled round and square steel bars conforming to this standard shall be designated by the letters ISRO and ISSQ respectively followed by the diameter in mm in the case of round bars and the side width in mm in the case of square bars (See Tables 1 and 2).

3. Dimensions and Mass – The dimensions of hot-rolled round and square steel bars shall be as given in Tables 1 and 2.

TABLE 1 DIMENSIONS OF HOT-ROLLED ROUND STEELBARS*Designation*

ISRO 5	ISRO 28	ISRO 70
ISRO 6	ISRO 30	ISRO 75
ISRO 8	ISRO 32	ISRO 80
ISRO 10	ISRO 35	ISRO 90
ISRO 12	ISRO 40	ISRO 100
ISRO 14	ISRO 45	ISRO 110
ISRO 16	ISRO 50	ISRO 120
ISRO 18	ISRO 55	ISRO 140
ISRO 20	ISRO 60	ISRO 160
ISRO 22	ISRO 65	ISRO 180
ISRO 25		ISRO 200

TABLE 2 DIMENSIONS OF HOT-ROLLED SQUARE STEEL BARS*Designation*

ISSQ 5	ISSQ 18	ISSQ 50
ISSQ 6	ISSQ 20	ISSQ 60
ISSQ 8	ISSQ 22	ISSQ 70
ISSQ 10	ISSQ 25	ISSQ 80
ISSQ 12	ISSQ 30	ISSQ 100
ISSQ 14	ISSQ 35	ISSQ 120
ISSQ 16	ISSQ 40	

Note – For sectional areas and mass of bars, refer to Tables 1 and 2 of the standard.

For detailed information, refer to IS 1732 : 1989 Specifications for steel bars, round and square for structural and general engineering purposes-Dimensions (second revision).

SUMMARY OF
IS 1863 : 1979 ROLLED STEEL BULB FLATS
(First Revision)

1. Scope – Specifies dimensions, sectional properties and dimensional tolerances of hot-rolled steel bulb flats

2. Material – The bulb flats may be manufactured from steel conforming to IS 2062 : 1992, IS 3039 : 1988 or IS 8500 : 1991[‡] as appropriate.

3. Designation – The bulb flats shall be designated by the width (b) and thickness (t)

Example: 200 × 10

4. Dimensions – See Table 1 and 1A

TABLE 1 BULB FLATS - DIMENSIONS

Designation		
80 × 6	200 × 9	300 × 11
7	10	12
100 × 7	11.5	13
8	220 × 10	320 × 12
120 × 7	11.5	13
8	240 × 10	340 × 12
140 × 7	11	14
8	12	370 × 13
160 × 7	260 × 10	15
		811
400 × 14		
9	12	× 16
180 × 8	280 × 11	430 × 15
9	12	17
10		

* Steel for general structural purposes (fourth revision)

† Structural steel for construction of hulls of ships
(second revision)

‡ Structural steel microalloyed - (medium & high strength qualities)
(first revision)

**TABLE 1A SUPPLEMENTARY LIST OF
BULB FLATS**

Designation	
120 × 6	320 × 14
140 × 10	340 × 13
160 × 10	15
180 × 11	370 × 16
220 × 9	400 × 15
280 × 10	430 × 14
13	20

Note – For sectional properties of bulb flats, refer to the standard.

5. Tolerances –

5.1 Straightness – The maximum permissible variation in straightness when measured over the entire length shall be 0.0035 × length.

5.2 Length – The cutting tolerance on length shall be 100 mm, –0 mm

Note – For tolerance on width thickness and weight, refer to the standard.

For detailed information, refer to IS 1863 : 1979 Specifications for rolled steel bulb flats (first revision)

SUMMARY OF

IS 2314 : 1986 STEEL SHEET PILING SECTIONS

(First Revision)

1. Scope – Stipulates dimensions and dimensional tolerances for Z-type, U-type and flat-type profile of hot rolled steel sheet piling sections. Sectional properties of these sections as calculated with the nominal dimensions are also included.

2. Material – Piling sections shall be made from steel of any one grade conforming to IS 2062 : 1992* or IS 8500 : 1991†. Where steel is required in copper bearing quality, the copper content shall be between 0.20 and 0.35 percent.

3. Type –

Z-Type – Roughly Z shape with joints of piles when driven located alternately at inner and outsides of the piling wall.

U-Type – Roughly U shape with joints of piles when driven located on the neutral axis of the piling wall.

Flat-Type – Having flat shape with high resistance to tensile forces.

4. Designation – Steel sheet piling sections conforming to this specification shall be designated with the letters ISPS followed by the section modulus per metre of wall in cm³ and letter symbols Z, U and F which denote Z-type, U-type and flat-type sections respectively. Designation for available piling sections shall be as follows:

a) Z Type Piling Sections

ISPS 1021 Z ISPS 1888 Z

ISPS 1481 Z ISPS 2322 Z

b) U Type Piling Sections

ISPS 1625 U ISPS 2222 U ISPS 2770 U

c) Flat - Type Piling Sections**Designation IS PS 100 F**

Note – For detailed dimensions, tolerances and geometrical properties refer to Figs 1 to 3 and Table 1 to 5 of the Standard.

4. Tolerances –

4.1 On Length – The sections shall be supplied in lengths between 9 m and 13.4 m subject to a tolerance of + 75 mm and -50 mm.

Note – For detailed tolerances, refer to 6 of the standard.

5. Surface Defects – Sheet piles shall not show defects under use steel sheet piles shall be straight and the cut and surface shall be flat.

6. Strength of Joint – Tensile strength of joints of flat-type sheet piles shall not be less than 400 t/m.

* Steel for general structural purposes (*fourth revision*)

† Structural steel - Micro alloyed medium and high strength qualities (*first revision*)

For detailed information, refer to IS 2314 : 1986 Steel sheet piling section (first revision).

SUMMARY OF

IS 3443 : 1980 CRANE RAIL SECTION

(First Revision)

1. Scope – Lays down dimensions, shape and other requirements of crane rail sections.

2. Designation – By letters ISCR followed by head width of the rail section in mm.

3. Tensile Properties – Steel shall have a minimum tensile strength of 710 MPa with a minimum elongation of 14 percent on a gauge length of 5.65 where S_o is the area of cross-section of specimen

4. Hardness – Not less than 200 HB.

5. Freedom from Defects — Shall be free from twist. Camber shall not exceed 0.2 percent of length. The asymmetry of rail cross section with respect to vertical axis shall not exceed 2 mm and 0.6 mm in rail flange and head respectively.

6. Dimensions and Properties

Designation	Cross-Sectional Area (cm ²)	Weight (kg/m)	Bottom Width/Height (mm)	Ixx (cm ⁴)	Iyy (cm ⁴)
ISCR 50	38.0	29.8	90	357.5	111.4
ISCR 60	51.0	40.8	105	654.6	195.9
ISCR 80	81.8	64.2	130	1524	468.6
ISCR 100	113.0	89.0	150	2806	920.0
ISCR 120	151.0	118.0	170	479	1672.0
ISCR 140	187.0	147.0	170	5528	2609.0

6.1 Tolerance

Head Width	+2 mm for other than ISCR 120 and 140 +2 mm, – 3 mm for ISCR 120 and 140
Height	± 1 mm for ISCR 50, 60 and 80 ± 1.5 mm for ISCR 100 ± 2 mm for ISCR 120 and 140.
Length of rail	+ 100 mm, – 0 mm
Weight	+ 3 Percent and – 2 Percent

Note 1 – For detailed dimensions, tolerance and sectional properties, See Tables 2 to 4 of the standard.

Note 2 – Dimensions of some of the rail sections commonly used in country (non-metric sections) alongwith relevant tolerances and sectional properties are covered in Appendix A of the standard.

Note 3 – For method of tests refer to IS 1500 : 1983 Method of Brinell hardness test (second revision), and IS 1608 : 1995 Mechanical testing of metals - Tensile testing (second revision).

For detailed information, refer to IS 3443 : 1980. Specifications for crane rail sections (first revision).

SUMMARY OF
IS 3954 : 1991 HOT ROLLED CHANNEL SECTIONS FOR GENERAL
ENGINEERING PURPOSES – DIMENSIONS
(First Revision)

1. Scope – Lays down the nominal dimensions, mass and sectional properties of hot- rolled steel channel sections for general engineering purpose.

2. Designation – Hot rolled steel channel sections conforming to this standard shall be designated by the letters CHG followed by a figure denoting the depth of the channel in mm.

3. Dimensions and Sectional Properties

<i>Designation</i>	<i>Mass</i>	<i>Sectional</i>	<i>Width</i>	<i>Moment of Inertia</i>	
	kg/m	Area cm ²	Flange mm	I _{xx}	I _{yy}
CHG 16	0.76	0.971	10	0.29	0.075
CHG 20	0.86	1.099	10	0.53	0.081
CHG 40	4.82	6.144	32	13.59	5.752

Note — For more sectional properties refer to Table 1 of the standard.

For detailed information, refer to IS 3954 : 1991. Specifications for hot rolled steel channel sections for general engineering purposes – Dimensions (first revision).

SUMMARY OF
IS 3964 : 1980 LIGHT RAILS
(First Revision)

1. Scope — Requirements of light rail sections.

2. Designation — By letters ISLR followed by a figure denoting weight in kg per metre of the rail section.

3. Tensile Properties — Steel shall have a minimum tensile strength of 710 MPa with a minimum elongation of 14 percent on a gauge length of $5.65\sqrt{S_0}$ Where S_0 is a area of cross section of specimen.

4. Dimensions and Sectional Properties —

<i>Designation</i>	<i>Head width mm</i>	<i>Bottom width mm</i>	<i>Height mm</i>	<i>Sectional Area cm²</i>
ISLR 10	34.93	63.50	63.50	12.74
ISLR 12	35.72	68.00	69.85	15.24
ISLR 15	41.28	76.20	79.38	18.98
ISLR 25	52.39	100.01	104.78	31.68

5. Tolerances —

Head width	± 2 mm
Web thickness	+1.0 −0.5 mm
Height	± 1 mm
Bottom flange width	± 2 mm
Length of rail	± 50 mm
Weight per metre	± 3 Percent

6. Freedom from Defects — Rail should be reasonably free from twist, camber, etc.

Note 1 — For detailed dimensions and sectional properties of rail sections, refer to Table-1 and 2 of the standard.

Note 2 — For method of test, refer to IS 1608 : 1995 Mechanical testing of metals—Tensile testing (*second revision*)

For detailed information, refer to IS 3964 : 1980 Specifications for light rails (first revision).

SUMMARY OF IS 8081 : 1976 SLOTTED SECTIONS

1. Scope

1.1 This standard covers the requirements, such as materials, workmanship, finish, strength tests, general design provisions, tolerances on dimensions and marking for slotted sections.

1.2 This standard does not apply to steel sections used for the fabrication of metal shelving cabinet (adjustable type) and metal shelving racks (adjustable type).

2. Materials – Steel and Aluminium shall conform to specified grades.

3. Workmanship – Sections shall be supplied free from all burrs.

4. Finishes – Before any paint finish is applied, all surfaces shall be free from scale, grease, rust or other surface imperfections. A coat of anti-rust treatment shall be applied before painting the steel surfaces.

4.1 Galvanizing or anodizing, if required, shall comply with prescribed standards.

5. Strength – Failure loads determined as in 6.1.3 of the standard shall be reduced in the following ratio :

5.1 Minimum yield stress of material (*min.* 0.2 percent proof stress in case of aluminium sections)

5.2 Yield stress of test piece (0.2 percent proof stress in case of aluminium sections)

5.3 In no case shall this ratio be greater than one.

Note — For the purpose of this standard the minimum yield stress of material (other than aluminium sections) shall be taken as given in Table 2 of the standard.

6. General Design Provisions

6.1 Permissible loads and factors of safety — Safe working loads shall be obtained by dividing failure load value by minimum factor of safety specified in the standard.

6.2 Limiting Beam Deflection – Should not exceed 1/180 of the span.

7. Tolerance of Dimensions –

7.1 Flange Sectional Dimensions – The tolerance on sum of the dimensions of all flanges shall not exceed the following:

Nominal Size		Tolerance
Over	Up to and Including	Percent
mm	mm	
–	40	± 5
40	50	± 4
50	75	± 3
75	–	± 2

7.2 Flange Thickness – The tolerances on the thickness of the section, for steel and for aluminium section shall conform to the respective specification as appropriate.

7.3 Internal Radius of Bend – The internal radius of bend shall have a tolerance of 1.00 mm on the nominal radius.

7.4 Angle of Bend – The angle of bend shall be $\pm 2^\circ$ throughout the width of the flange.

7.5 Size of Holes – The tolerance on size of holes shall be ± 0.1 mm.

7.6 Pitch of Holes – The deviation in the pitch of holes shall be ± 0.1 mm.

7.7 Overall Length

7.7.1 Standard Length – The tolerance on standard lengths shall be ± 1.6 mm.

7.7.2 Overall Centre-to-Centre of End Holes – The tolerance on overall centre-to-centre of end holes shall be ± 1.6 mm.

7.8 Straightness — The offset shall not be more than 1/600 of the length.

7.9 Twist of Section — The twist of section shall not be more than 40 minutes of angle per metre.

For detailed information, refer to IS 8081 : 1976 Specifications for slotted sections

SUMMARY OF
IS 12778 : 2004 HOT ROLLED PARALLEL FLANGE STEEL SECTION
FOR BEAMS, COLUMNS AND BEARING PILES DIMENSIONS AND
SECTION PROPERTIES
(First Revision)

1 Scope – Covers the nominal dimensions, mass and sectional properties of hot rolled parallel flange beams, columns and bearing piles.

2 Classification

2.1 Beams, column and pile sections are classified as follows.

- a) Indian Standard Narrow Parallel Flange Beams, NPB.
- b) Indian Standard Wide Parallel Flange Beams, WPB.
- c) Indian Standard Parallel Flange Bearing Piles, PBP.

2.3 The following abbreviated reference symbols have been used in designating the Indian Standard sections mentioned in **2.1**:

<i>Sl.No.</i>	<i>Section</i>	<i>Classification</i>	<i>Abbreviated Reference Symbol</i>
(1)	(2)	(3)	(4)
i)	Beams	ISNPB	NPB
ii)	Beams/Columns	ISWPB	WPB
iii)	Pile Sections	ISPBP	PBP

3 Dimensions, Mass and Tolerances

3.1 Nominal dimensions and mass of narrow and wide parallel flange beams and bearing piles shall conform to the values given in Tables 1 to 3, respectively of the standard.

3.2 Dimensional and mass tolerances of the various sections shall conform to the appropriate values stipulated in IS 12779*.

4 Sectional Properties

Sectional properties of the beam, column and pile sections are given in Tables 1 to 3 of the standard, for information.

* Rolling and cutting tolerances for hot rolled parallel flange beam and column sections – specification.

For detailed information, refer to IS 12778 : 2004 Specifications for hot rolled steel sections for parallel flange beams, columns – dimensions and section properties and bearing piles (first revision).

SECTION 18

WELDING ELECTRODES AND WIRES

CONTENTS

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SUMMARY OF

IS 814 : 2004 COVERED ELECTRODES FOR MANUAL METAL ARC
WELDING OF CARBON AND CARBON MANGANESE STEEL

(Sixth Revision)

1. Scope – Requirements for covered carbon and carbon manganese steel electrodes for carbon and carbon manganese steel, including hydrogen controlled electrodes for manual metal arc welding of mild and medium tensile steels including structural steels, depositing weld metal having a tensile strength not more than 610 MPa.

1.1 Electrodes designed specifically for repair welding, often marketed in India as ‘low heat input’ electrodes are not covered in this standard.

1.1.2 Ilmenite type electrodes are being used fairly widely in few other countries. There appears to be a trend to use ilmenite as an ingredient of the covering in our country also. Provision for a separate class for such electrodes may be considered at a later stage.

Notes – For weld metal with tensile strength higher than 610 MPa, a reference may be made to IS 1395*.

2. Classification –**2.1 Coding**

Classification of electrodes shall be indicated by the coding system of letters and numerals as given below to indicate the specified properties or characteristics of the electrodes.

2.1.1 Main Coding– Shall be followed in the order stated:

- a) A prefix letter ‘E’ shall indicate a covered electrode for manual metal arc welding, manufactured by extrusion process;
- b) A letter indicating the type of covering;
- c) First digit indicating ultimate tensile strength in combination with the yield stress of the weld metal deposited;
- d) Second digit indicating the percentage elongation in

combination with the impact values of the weld metal deposited;

- e) Third digit indicating welding position(s) in which the electrode may be used; and
- f) Fourth digit indicating the current condition in which the electrode is to be used.

2.1.2 The following letters indicating the additional properties of the electrodes may be used, if required:

- a) Letters H₁, H₂, H₃ indicating hydrogen controlled electrodes
- b) Letters J, K and L indicating increased metal recovery as effective electrode:
‘Efficiency (EE)’ as per IS 13043 in the following range
J = 110 - 129 percent;
K = 130 - 149 percent; and
L = 150 percent and above.
- c) Letter ‘X’ indicating the radiographic quality

2.2 Type of Covering – Type of covering shall be indicated by the following letters :

- | | |
|----|---------------------------------------|
| A | – Acid |
| B | – Basic |
| C | – Cellulosic |
| R | – Rutile |
| RR | – Rutile, heavy coated |
| S | – Any other type not mentioned above. |

2.3 Strength Characteristics – See Table 1

**TABLE 1 DESIGNATION OF STRENGTH
CHARACTERISTICS**

Designating Digit	Ultimate Tensile Strength N/mm ²	Yield Strength Min N/mm ²
(1)	(2)	(3)
4	410-510	330
5	510-610	360

2.4 Elongation and Impact Properties – See Table 2

*Low and medium alloy steel covered electrodes for manual metal arc welding (third revision).

TABLE 2 COMBINATION OF PERCENTAGE ELONGATION AND IMPACT STRENGTH

Designating Digit	Percentage Elongation on Gauge Length $5.65\sqrt{S_0}$, Min	Impact Strength J/°C, Min
(1)	(2)	(3)
For Tensile Range 410-510 N/ mm ²		
0	16	No impact requirements
1	20	47J/+27° C
2	22	47J/+0° C
3	24	47J/-20° C
4	24	27J/-30° C
For Tensile Range 510-610 N/ mm ²		
0	16	No impact requirements
1	18	47J/+27° C
2	18	47J/+0° C
3	20	47J/-20° C
4	20	27J/-30° C
5	20	27J/-40° C
6	20	27J/-46° C

NOTE- $\sqrt{S_0}$ is the cross-sectional area of test piece.

2.5 Welding Position – Shall be indicated by the appropriate designating digits as follows:

- 1 All positions.
- 2 All positions except vertical down.
- 3 Flat butt weld, flat fillet weld and horizontal/vertical fillet weld.
- 4 Flat butt weld and flat fillet weld.
- 5 Vertical down, flat butt, flat fillet and horizontal and vertical fillet weld.
- 6 Any other position or combination of positions not classified above.

2.6 Welding Current and Voltage Conditions– Shall be indicated by the appropriate designating digits as given in Table 3.

2.7 Hydrogen Controlled Electrodes – The letters H₁, H₂ and H₃ shall be included in the classification as a suffix for those electrodes which will give diffusible hydrogen ml/100 gm.

2.8 Increased Metal Recovery –The letters J, K and L shall be included in the classification as a suffix for those electrodes which have appreciable quantities of metal powder in their coating and give increased metal recovery with respect to that of core wire melted, where

TABLE 3 WELDING CURRENT AND VOLTAGE CONDITIONS

Digit	Direct Current Recommended Electrode Polarity ¹⁾	Alternating Current Open Circuit Voltage V, Min
(1)	(2)	(3)
0 ²⁾	+	Not recommended
1	+ or –	50
2	–	50
3	+	50
4	+ or –	70
5	–	70
6	+	70
7	+ or –	90
8	–	90
9	+	90

1) Positive polarity (+) Negative polarity (–)

2) Symbol 0 reserved for electrodes used exclusively on direct current,

J = 110–129 percent,

K = 130–149 percent, and

L = 150 percent and above

2.9 Radiographic Quality Electrodes – The letter 'X' shall be included in the classification as a suffix for those electrodes which deposit radiographic quality welds.

3. Core Wire – Shall conform to IS 2879*.

4. Dimensions and Tolerances –

4.1 Size and length – Shall be designated by the nominal diameter of the core wire expressed in mm. Shall be as given in Table 4.

Tolerance on specified diameter of the core wire shall be ± 0.05 mm. On specified length shall be ± 3 mm.

TABLE 4 SIZES AND LENGTHS OF ELECTRODES

Size, mm (1)	Length, mm (2)
1.6	150 or 200 or 250
2.0	200 or 250 or 300 or 350
2.5	250 or 300 or 350
3.15	350 or 450
4.0	350 or 450
5.0	350 or 450
6.3	350 or 450
8.0	350 or 450

* Mild steel for metal arc welding electrodes (third revision)

4.2 Bare Length (Contact End)

Electrode size, mm	Bare Length, mm	
	Minimum	Maximum
1.6 to 3.15	15	30
4.0 to 8.0	20	40

4.3 Bare Length (Arc Striking End) – The arc striking end of the electrode shall be bare and permit easy striking of arc. The distance from the arc end to the first point where the full cross section of the covering prevails shall not exceed the following limits:

- (i) For all classification $\frac{1}{2}$ core wire diameter
OR 2.0 mm
whichever is less

4.4 Concentricity of Flux covering with core wire – Tolerance shall be such that the maximum core plus one covering dimension shall not exceed the minimum Core plus one covering dimensions by more than –

- 5 percent of the mean of two dimensions for EBXXXX and ESBXXXX
- 4 percent of the mean of two dimensions for ERXXXX, ERRXXXX and EAXXXXX
- 3 percent of the mean of two dimensions for ECXXXX

5. Tests**5.1 Chemical Analysis**

The sample for analysis shall be taken from weld metal obtained with the electrode. The result of the analysis shall meet the requirement of Table 5 of the standard.

5.2 All Weld Metal Mechanical Tests for Tensile and Impact – Ultimate tensile strength, minimum yield strength, percentage elongation and impact values shall be as specified in Table 6.

5.3 Butt Weld test – No crack or defect at the outer surface of the test specimens is greater than 3 mm measured across the specimen and 1.5mm along the length.

5.4 Running Performance Test (for Sizes 2.5mm and Below) – Bead should be free from porosities, slag inclusion cracks etc.

5.5 Increased Metal Recovery Test – Shall conform to that specified in 2.8.

5.6 Diffusible Hydrogen Evaluation Test – As specified.

5.7 Radiographic Quality Test – For radiographic quality electrode the radiograph shall not show crack or incomplete fusion.

TABLE 5 CHEMICAL COMPOSITION - REQUIREMENTS FOR WELD METAL

Classification	Weight, Percent, Max									Combined Limit for Mn+Ni+Cr+Mo+V
	C	Mn	Si	P	S	Ni	Cr	Mo	V	
EAXXXXX										Not specified
ECXXXX										do
ERXXXX										do
ERRXXXX										do
EBXXXX	1.12	1.6	0.75	0.035	0.035	0.30	0.20	0.30	0.08	1.75
ESB XXXX										Same as EBXXXX

TABLE 6 MECHANICAL PROPERTIES OF WELD METAL

Classification	Ultimate Tensile Strength	Yield Strength,	Percentage E longation on Gauge	Temperature for Impact °C	Impact Strengths
	MPa	MPa	Length $5.65 \sqrt{S_o}$ <i>Min</i>		<i>J, Min</i>
EX40XX	410-540	330	16	No impact requirement	
EX41XX	410-540	330	20	+ 27	47
EX42XX	410-540	330	22	0	47
EX43XX	410-540	330	24	– 20	47
EX44XX	410-540	330	24	– 30	27
EX50XX	510-610	360	16	No impact requirement	
EX51XX	510-610	360	18	+27	47
EX52XX	510-610	360	18	0	47
EX53XX	510-610	360	20	– 20	47
EX54XX	510-610	360	20	– 30	27
EX55XX	510-610	360	20	– 40	27
EX56XX	510-610	360	20	– 46	27

Note – In view of the possible scatter in welding and testing, the upper limit of ultimate tensile strengths may be exceeded by 40MPa.

Note – For method of tests, refer to the standard.

For detailed information, refer to IS 814 : 2004 Specifications for covered electrodes for manual metal arc welding of carbon manganese steel (sixth revision).

SUMMARY OF
IS 1278 : 1972 FILLER RODS FOR GAS WELDING
(Second Revision)

1. Scope – Requirements of ferrous and non-ferrous filler rods for gas welding made of the following materials supplied in cut lengths.

- a) Structural steels,
- b) Austenitic stainless steels,
- c) Cast irons (excluding spheroidal graphite and malleable iron castings),
- d) Copper and copper alloys,
- e) Nickel and nickel alloys,
- f) Aluminium and aluminium alloys, and
- g) Magnesium and magnesium alloys.

2. Dimensions and Tolerances

2.1 Size

<i>Diameter</i>	<i>Tolerance on</i>	<i>Diameter</i>
mm	<i>Cast Iron Filler Rods</i>	<i>Other gas welding Filler Rods</i>
	mm	mm
1, 1.25, 1.6, 2, 2.5	± 0.08	± 0.05
3.15, 4, 5, 6.3		
8, 10, 12.5	± 0.08	+ 0.05 - 0.10

2.2 Length – It shall be 500 or 1000 mm for rods less than 2.5 mm dia and 1000 mm for rods 2.5 mm and above. The tolerance on length of cast iron filler rods shall be

$\begin{matrix} +6 \\ -50 \end{matrix}$ mm. For all other rods shall be ± 5 mm.

3. Requirements

3.1 Shall be free from surface imperfections, corrosion products, grease, excessive oxide, etc.

3.2 Structural steel filler rods shall have a protective copper coating; copper content not exceeding 0.4 percent by weight.

3.3 Aluminium, aluminium alloy and magnesium alloy filler rods shall be supplied in as manufactured condition.

3.4 In case of austenitic stainless steel filler rods, the inter – crystalline corrosion test may be conducted. The test piece shall show no sign of cracking.

Note 1 – For chemical composition requirements, refer to Tables 2 to 8 of the standard.

Note 2 – A guide for selection and use of gas welding rods is given in Appendix A of the standard.

For detailed information, refer to IS 1278 : 1972 Specifications for filler rods for gas welding (second revision).

SUMMARY OF

IS 1395 : 1982 LOW AND MEDIUM ALLOY STEEL COVERED
ELECTRODES FOR MANUAL METAL ARC WELDING

(Third Revision)

1. Scope – Covers the requirements for low and medium alloy steel covered electrodes for manual metal arc welding.

2. Classification

2.1 Part One – Prefix letter E indicates the suitability of the electrodes for manual metal arc welding.

2.2 Part Two – Minimum tensile properties of the weld metal are indicated by two digits as follows :

Digits	41	49	55	63	68	76	83
Tensile Strength Min, MPa	410	490	550	630	680	760	830

2.3 Part Three – Type of Flux Covering

Letter	Flux Covering of Types
C	Cellulosic
R	Rutile (medium coated)
O	Oxidizing
B	Basic

2.4 Part Four – Chemical composition – The electrodes are divided into six groups A, B, C, D, G and M followed by a digit and / or a digit and a letter L (in cases where low carbon deposits are required) to indicate the chemical composition group and sub-groups as shown in Table 1 of the standard.

2.5 Part Five – The fifth part of the classification system comprises of a one digit code indicating the different positions of welding in which the electrode can be used.

2.5.1. Symbol Position(s) of Welding

1.	All positions
2.	All position except vertical down
3.	Flat butt, flat fillet, horizontal/ vertical
4.	Flat butt, flat fillet.
5.	Similar to 3, and recommended for vertical downward.

2.6 Part Six – The sixth part is a symbol for the welding characteristics of the electrodes:

Symbol	Direct Current Recommended Polarity	Alternating Current Minimum Open- Circuit Voltage, V
0	+	(see Note-1)
1	+ or -	50
2	-	50
3	+	50
4	+ or -	70
5	-	70
6	+	70
7	+ or -	90
8	-	90
9	+	90

Note – Symbol is reversed for electrodes used exclusively on direct current.

2.7 Part Seven – The following suffixes shall be used to indicate the presence of iron powder and the metal recovery :

Fe	Iron powder covering giving metal recovery of minimum 110 percent
J	Iron powder covering giving a metal recovery of 110 to 130 percent
K	Iron powder covering giving a metal recovery of 130 to 150 percent
L	Iron powder covering giving a metal recovery of over 150 percent

3. Size and Tolerances

Designation of the Electrode Size	Diameter of the Electrode Core Wire
	mm
2	2.00
2.5	2.50
3.15	3.15
4	4.00
5	5.00
6.3	6.30
8	8.00

Tolerance on the specified diameter of the core wire of the electrode shall be ± 0.05 mm.

3.1 Length

<i>Electrode Size</i>	<i>Length</i>
	mm
2	250 300 350
2.5	250 300 350
Above 2.5	350 450

The tolerance on the length of individual electrodes shall be ± 3 mm.

4. General Requirements

4.1 Gripping end of the electrode shall be bare and clean to a length of 20 to 30 mm.

4.2 The distance from the arc and to the first point of full cross section of covering shall in no case exceed 1mm in synthetic type and low hydrogen type electrodes. For non low hydrogen this distance shall not exceed a maximum of 1.5 mm.

4.3 Covering shall be sufficiently strong to withstand without damage normal conditions of handling, storage and use.

4.4 The tolerance permitted for uniformity of covering shall be such that maximum core plus one covering

dimension shall not exceed the minimum core plus on covering dimension by more than:

- 5 percent of mean of two dimensions for basic coated electrodes.
- 4 percent of the mean of two dimensions for rutile and oxidizing types.
- 3 percent of the mean of two dimensions for cellulosic type electrodes

5. Tests

- Chemical analysis – See Table 1 of the standard.
- Radiographic test* – Shall have radiographic standard of Grade 1 for EXX0-X & EXXB-X. Shall have a radiographic standard Grade 2 for EXXC-X and EXXR-X.
- All weld tensile test* – Shall conform to those prescribed in Table 4 of the standard.
- All weld impact test* – Shall conform to those prescribed in Table 5 of the standard
- Fillet weld test requirements* – Difference in length of the two legs of each fillet weld shall be as per Table 6 of the standard.
- Moisture test* – of the flux covering shall not exceed the limits prescribed in Table 7 of the standard.

Note 1 – For the range of electrodes covered and the chemical composition of all weld metal see Table 1 of the standard.

Note 2 – For method of test refer to the standard.

For detailed information, refer to IS 1395 : 1982 Specifications for low and medium alloy steel covered electrodes for manual metal arc welding (third revision).

SUMMARY OF

IS 4972 : 1968 RESISTANCE SPOT – WELDING ELECTRODES

1. Scope—Code numbers (in metric units), dimensional requirements, and physical and mechanical properties for a series of spot-welding electrodes, cap electrodes and shanks, mainly intended for resistance spot welding of ferrous and non-ferrous metals. This standard covers

electrodes with standard ISO tapers and with Morse tapers.

2. Materials Recommended

<i>Class</i>	<i>Material</i>	<i>Conductivity Percent (that for Standard Annealed Copper)</i>	<i>Vickers Pyramid Hardness (HV)</i>	<i>Application</i>
I	Cadmium copper containing 0.5 to 1 percent cadmium	85	90	Spot-welding of coated steels, aluminium and its alloys
II	Chromium copper containing 0.5 to 0.8 percent Chromium	80-85	110	Spot-welding of steels other than covered under class II and III
III	Cobalt, beryllium copper	45-50	180	Spot-welding of stainless and heat resisting alloys

3. Specification for Electrodes with Standard ISO Tapers –

3.1 Sizes and Dimensions

3.1.1 The size of an electrode with taper engagement with dimensions of electrode shanks and electrode holders is given Table 1.

3.1.2 Straight electrodes with tapered shanks: Pointed, dome, flat, offset, truncated cone and spherical types. Overall length range from 38 to 102 mm for nominal sizes 1, 2 and 3 and 64 to 125 mm, 76 to 125 mm and 89 to 125 mm for nominal sizes 4, 9 and 10 respectively.

3.1.3 *Electrode nose configurations* – Types same as given in 3.1.2. Available in all sizes (1 to 10).

3.1.4 *Standard single* – Bend electrodes, cold-formed form standard straight electrodes: Pointed, dome, flat, eccentric and truncated types. Overall length 64, 70, 83 and 83 for nominal sizes 5, 6, 7 and 8 respectively.

3.1.5 *Standard double-bend electrodes, cold-formed from standard electrodes* – Types, overall length and sizes are same as given in 3.1.4.

TABLE 1 DIMENSIONS OF ELECTRODE SHANKS AND ELECTRODE HOLDERS

<i>Nominal Size</i>	<i>Major Dia mm</i>	<i>Engage Dia mm</i>	<i>Cooling Hole Dia mm</i>	<i>Taper (Inclusive)</i>	<i>Load</i>
01	13.0	12.7	7.0	} 1/10	For straight loading not over 1500 kgf
02	16.0	15.5	8.5		
03	20.0	19.0	10.5		
04	25.0	24.5	13.5		
05	13.0	12.7	7.0	} 1/10	For eccentric loading
06	16.0	15.5	8.5		
07	20.0	19.0	10.5		
08	25.0	24.5	13.5		
09	31.5	31.0	14.0	} 1/5	For straight loading over 1500 kgf
10	40.0	39.0	16.0		

3.1.6 Caps and adapter shanks Types A to F. Nominal sizes 1 to 3.

Note 1 – For dimensions of socket gauges for shanks, refer to Tables 2 and 3 with Fig. 1 of the standard.

Note 2 – For electrode designations and other dimensional details, refer to Tables 1 and 4 to 8 and Fig. 2 of the standard.

4. Specification for Electrodes with Standard Morse Tapers

4.1 Sizes and Dimensions — Nominal size 1, 2 and 3. Major dia 12.24, 15.87 and 22.22 mm for sizes 1, 2 and 3 respectively.

4.1.1 Morse electrode nose configurations – Pointed, dome, flat, offset, truncated cone and spherical type. Nose lengths (19.0 and 6.5 mm), (22.0 and 10.0 mm) and

(28.5 and 10.0 mm) for nominal sizes 1, 2 and 3 respectively in case of pointed and dome types.

4.1.2 Straight electrode with tapered shanks – Types same as given in 4.1.1. Overall length range 32 to 102 mm for sizes 1 and 2 and 38 to 102 mm for size 3.

4.1.3 Single-bend electrodes, cold-formed from standard straight electrodes – Pointed, dome, flat, eccentric and truncated types. Overall length 64, 70 and 83 mm for nominal sizes 1, 2 and 3 respectively.

4.1.4 Double-bend electrodes; cold-formed from standard straight electrodes – Types, overall lengths and sizes are same as given in 4.1.3.

4.1.5 Morse caps and adapter shanks Types A to F.

Note 1– For dimensions of shanks of electrodes, refer to Fig. 3 and for taper ring and plug gauges, refer to Table 9 of the standard.

Note 2 – For electrode designations and other dimensional details, refer to Tables 10 to 14 and Fig. 4 of the standard.

For detailed information, refer to IS 4972 : 1968 Specifications for resistance spot - welding electrodes.

SUMMARY OF
IS 5511 : 1991 COVERED ELECTRODES FOR MANUAL METAL
ARC WELDING OF CAST IRON
(First Revision)

1. Scope – Specifies a system of classification and coding and covers requirements for covered electrodes for manual metal arc welding of cast iron.

2. Coding

2.1 Method of Coding

- a) Prefix symbol E
- b) Symbol for chemical composition of the electrode core wire or weld metal, using a group of letters and possibly a number ;
- c) Symbol characterising using one or two letters types of coating ; and
- d) Symbol relating to conditions of use :
 - i) Welding positions – using a number
 - ii) Power supply – using a number

2.2 Letter E at the head of the symbol code distinguishes the covered electrodes for arc welding from any other filler product.

2.3 Symbols for Chemical Composition

Basic Group	Symbol	Type of Alloy
Iron Base	FeC1	Grey cast iron
	FeC2	Grey cast iron with steel core
	Fe	Steel
Nickel Base	NiFe	Nickel-iron
	NiCu1	Nickel-copper
	NiCu2	Nickel-copper
	Ni	Nickel
Copper Base	CuAl	Copper-aluminium
	CuSn1	Copper-tin
	CuSn2	Copper-tin
	Z	Other type

2.4 Symbols of Type of Coating – B- basic, G-graphite, BG- basic with graphite, S- Organic salt and V- Other type.

2.5 Symbols for Welding Position

Symbol	Basic Weld Position
1	All
2	All, except vertical downwards
3	Flat (butt and fillet welds) and horizontal vertical (fillet weld)
4	Flat (butt and fillet)
5	As for 3 and recommended for vertical down wards.

2.6 Symbols for Welding Current

Symbol	Direct Current Recommended Polarity	A.C Current Minimum Open- Circuit Voltage, V
0	+	
1	+ or –	50
2	–	50
3	+	50
4	+ or –	70
5	–	70
6	+	70
7	+ or –	90
8	–	90
9	+	90

3. Dimensions

3.1 Size — Shall be designated by the diameter of the core wire expressed in mm. as given in Table 1.

TABLE 1 SIZE OF ELECTRODES

Size Designation	Diameter of Core Wire, mm
2.5	2.50
3.15	3.15
4	4.00
5	5.00
6.3	6.30

3.2 Tolerance on the Size – On the specified diameter of the core wire shall be + 0.00 mm and – 0.15 mm.

3.3 Length – Shall be 350 mm and 450 mm.

3.4 Tolerances on Length – Over nominal length shall be ± 3 mm.

4. Quality Requirements

4.1 The contact end of the electrode shall be bare and clean to a length of 20 to 30 mm.

4.2 The arc striking end of the electrode shall be sufficiently bare to permit easy striking of the arc. The distance from the arc and to the first point where the full cross-section of the covering prevails shall not exceed the diameter of the core wire subject to a maximum of 2.5 mm.

4.3 The covering shall be free from harmful defects and shall be sufficiently robust to withstand normal handling storage and use, without damage.

4.4 The tolerance permitted for uniformity of covering shall be such that the maximum core plus one covering dimensions shall not exceed the minimum core-plus one covering dimension by more than five percent of the mean of the two dimensions.

5. Tests

5.1 *Chemical Analysis* – As per Table 5 of the standard.

5.2 *Usability Test* – Weld area shall be reasonably free from cracks and porosity, not exceeding 6 pores per 10 square centimeter area—with no pores greater than 1.5mm in diameter.

Note 1 – For chemical composition, refer to Table 5 of the standard.

Note 2 – For method of list refer to the standard.

For detailed information, refer to IS 5511 : 1991 Specifications for covered electrodes for manual metal arc welding of cast iron (first revision).

SUMMARY OF

IS 5897 : 1985 ALUMINIUM AND ALUMINIUM ALLOY WELDING RODS AND WIRES AND MAGNESIUM ALLOY WELDING RODS

(First Revision)

1. Scope

1.1 Requirements of bare solid filler rods and wires for welding aluminium and aluminium alloys and filler rods for welding magnesium alloys by inert gas tungsten arc welding (TIG) or gas metal arc welding (MIG) processes. The chemical composition of the filler rods and wire is also specified.

1.2 The standard does not specify the chemical composition and the mechanical properties of the weld deposit.

1.3 The rods and wires specified in this standard are all suitable for use with argon or helium or mixture of these gases.

2. Dimensions and Tolerances

2.1 The diameters of rods and wires shall be as specified below. The tolerances appropriate to the specified diameters are also given.

Form	Diameter	Tolerances	
		Plus	Minus
	mm	mm	mm
Wire	0.6	0.01	0.03
	0.8	0.01	0.04
	1.0	0.01	0.04
Wire and rod	1.2	0.01	0.04
	1.6	0.01	0.04
	2.0	0.01	0.07
	2.4	0.01	0.07
	3.2	0.01	0.07
Rod	4.0	0.01	0.07
	5.0	0.01	0.07

2.2 Length of Rods (Cut Lengths) — Rods less than 2.5 mm in diameter shall be supplied in lengths of 500 or 1 000 mm. Rods 2.5 mm and larger in diameter shall be supplied in lengths of 1 000 mm.

2.2.1 Tolerance on length shall be ± 5 mm.

3. Conditions of Rods and Wires — Finished filler rods and wires shall have a smooth finish free from surface imperfections, corrosion products, grease, excess oxide or other foreign matter which would adversely affect the properties of the weld or the operation of the welding equipment.

4. Classification

4.1 S-A1 19000, S-A1 19500, S-A1 26398, S-A1 31000, S-A1 43000, S-A1 53000, S-A 1 55000 and S-A1 55330 for Aluminium and Aluminium Alloy filler rods and wires on the basis of their chemical composition.

4.1.1 Here, S denotes bars, solid rod or wire and A1 for aluminium alloy. The last part i.e the 5 digit number denotes the IS designation of the material.

4.2 S-mg1, S-mg2, S-mg3 and S-mg4 for magnesium alloy filler rods. Here S denotes the base solid welding rod and Mg for magnesium alloy. The digit used indicates the particular chemical composition.

5. Chemical Composition — Shall be as given in Tables 5 and 6 of the standard.

6. Usability Test — Upon welding, the molten metal shall flow freely and uniformly and shall produce a weld bead of uniform appearance, free from cracks and other deleterious defects.

Note 1 — For requirements of spool and reeling condition, refer to 5 to 6 of the standard.

Note 2 — For method of test, refer to the standard.

For detailed information, refer to IS 5897 : 1985 Specifications for aluminium and aluminium alloy welding rods and wires and magnesium alloy welding rods (first revision).

SUMMARY OF

IS 5898 : 1970 COPPER AND COPPER ALLOY BARE SOLID
WELDING RODS AND ELECTRODES

1. Scope

5.0

1.1 Requirements of bare solid filler rods and wires for welding copper and copper alloys by inert-gas arc process, that is, inert-gas tungsten arc welding (TIG) or gas metal-arc welding (MIG). The chemical composition of the rods and wires is also specified.

1.2 The standard does not specify the chemical composition and mechanical properties of the weld deposit.

1.3 Certain rods and wires specified in this standard are not suitable for use with particular shielding gas. Suitability of their use with a particular shielding gas should, therefore, be ascertained from the manufacturer while purchasing.

2. Dimensions and Tolerances

2.1 Diameter

Form	Diameter	Tolerances	
		Plus	Minus
	mm	mm	mm
Wire	(0.5) 0.6	0.01	0.03
	(0.8) 0.9 1.0	0.01	0.04
Wire and rod	(1.2) (1.6)		
	(2.0) 2.4 2.5 (3.2)	0.01	0.07
Rod	4.0		

2.2 Length of Rods – Rods less than 2.5 mm in diameter shall preferably be in lengths of 500 or 1000 mm. Rods 2.5 mm and larger in diameter shall preferably be supplied in lengths of 1000 mm. Lengths other than these two preferred lengths may be supplied by mutual agreement between the purchaser and the manufacturer.

2.2.1 Tolerance on each length of rod shall be ± 5 mm.

3. Finish – Filler rods and wires shall have smooth finish, free from surface imperfections, corrosion products, grease, excess oxide or oil matter which would adversely affect the properties of the weld or the operation of the welding equipment.

4. Classification — S-Cu1, S-Cu2, S-Cu3 Si, S-Cu Sn1, S-Cu Sn2, S-Cu Al1, S-Cu Al2, S-Cu Al3, S-Cu Zn Al, S-Cu Ni1, S-Cu Ni2, S-Cu Ni3, S-Cu Al Ni, and S-Cu Mn Al1 based on their chemical composition.

Note 1 – For requirement of spools and reeling conditions, refer to 5 and 6 of the standard

Note 2 – For chemical composition, refer to 10.3 to 10.16 of the standard

For detailed information, refer to IS 5898 : 1970 Specifications for copper and copper alloy bare solid welding rods and electrodes.

SUMMARY

IS 6419 : 1996 WELDING RODS AND BARE ELECTRODES FOR
GAS SHIELDED ARC WELDING OF STRUCTURAL STEEL

(First Revision)

1. Scope

1.1 Requirements of solid filler rods and wires for welding structural steels by inert-gas tungsten arc welding (TIG), gas metal arc welding (MIG) or CO₂ welding processes. The chemical composition and tensile properties of filler rods and wires are also specified.

1.2 This standard also specifies the mechanical properties of weld deposits.

2. Dimensions and Tolerances**2.1 Diameter**

Nominal Diameter mm	Tolerance, mm	
	Plus	Minus
0.6	0.01	0.03
0.8	0.01	0.04
0.9	0.01	0.04
1.0	0.01	0.04
1.2	0.01	0.04
1.6	0.01	0.04
1.8	0.01	0.04
2.0	0.01	0.07
2.4	0.01	0.07
2.5	0.01	0.07
2.8	0.01	0.07
3.0	0.01	0.07
3.2	0.01	0.07
4.0	0.01	0.07
5.0	0.01	0.07

2.2 Length of Rods – Rods supplied in straight lengths shall preferably have the following lengths, expressed in millimetres – 250, 350, 450, 500, 600, 750, 900, 1000.

2.3 Tolerance on each length of rod shall be ± 5 mm

3. Condition of Rod and Wire –

3.1 Finish – Filler rods and wires shall have a smooth finish and be free from surface imperfections, corrosion

products, grease, excessive oxide or other foreign matter which would adversely affect the properties of the weld or the operation of the welding equipment. If the rods and wires are supplied with a protective copper coating, it shall be a uniform well-bonded, smooth coating being applied over a thoroughly clean surface. The copper content of the coated rod or wire (or wire plus the coating) expressed as a percentage of the rod shall not exceed 0.5 percent by weight.

3.2 Temper, Cast and Helix

- a) Temper – Shall be such that they are suitable for uninterrupted feeding on automatic or semiautomatic welding equipment. Tensile strength for those wound on spools of 300 mm and greater in diameter shall be as per Table 1.
- b) Cast – Shall be such to impart a curvature to the filler metal so that a specimen sufficient in length to bound one loop or a maximum 3m. When cut and laid on flat surface shall form a circle or part thereof of diameter shown in Table 2.
- c) Helix – Shall be such that the maximum distance from any point on the filler metal to flat surface shall not exceed as shown in Table 2.

TABLE 2 DIAMETER OF CAST AND HELIX

Type of Package	Standard Size mm	Cast mm	Maximum Helix mm
100mm spool	1.2 and less	200-230	13
All except 100 mm spool	0.8 and less 0.9 and more	305 380	25 25

4. Classification – S1, S2, S3, S4, S5 and S6 based on the chemical composition. In a classification for example, S5 - M504, S5 indicates chemical composition of the wire, M indicates that it is a mixed gas, 50 indicates tensile strength of minimum 500 MPa and 4 indicate impact value at 27 joules at minus 30°C.

TABLE 1 TENSILE STRENGTH OF FILLER METAL WIRE

Wire diameter, mm	0.6	0.8	0.9	1.0	1.2	1.6 to 2.0	2.1 to 3.2
Tensile strength, MPa, Min	1100	1100	1000	950	900	700	600

A. Symbol Indicating Tensile Strength and Elongation

<i>Symbol</i>	<i>Yield Strength, Min</i>	<i>Tensile Strength</i>	<i>Percentage Elongation at Gauge Length</i>
	MPa	MPa	$5.65 \sqrt{S_o}$, Min
50	420	500-640	22

B. Symbol Indicating the Impact Energy

<i>Symbol</i>	<i>Minimum Impact Energy of 27 Joules(Charpy V-Notch at °C Specimen)</i>
1	+ 27
2	0
3	- 20
4	- 30

Note – For requirements of reels and reeling conditions refer to 6 and 7 of the standard.

For detailed information, refer to IS 6419 : 1996 Specifications for welding rods and bare electrodes for gas shielded arc welding of structural steel (first revision).

C. Symbol Indicating Shielding Gas

<i>Symbol</i>	<i>Type of Shielding Gas</i>
R	Reducing gas
I	Inert gas
M	Mixed gas
C	Carbon dioxide
F	Nitrogen hydrogen mixture

5. Tests

5.1 Chemical Composition – See 12 of the standard

5.2 Soundness – Radiographs shall reveal no cracks or Zone of incomplete fusion.

5.3 All Weld Metal Mechanical Test – Ultimate tensile strength, yield stress, percentage elongation and impact values shall be as specified in 4.

SUMMARY OF

IS 6560 : 1996 MOLYBDENUM AND CHROMIUM-MOLYBDENUM LOW ALLOY STEEL WELDING RODS AND BARE ELECTRODES FOR GAS SHIELDED ARC WELDING

(First Revision)

1. Scope

1.1 Requirements of solid filler rods and wires for welding. It covers molybdenum and chromium molybdenum low alloy steel rods and wires for use in inert-gas tungsten arc welding (TIG), gas metal arc welding (MIG) or CO₂ welding processes. The chemical composition and tensile properties of filler rods and wires are also specified.

1.2 This standard also specifies the mechanical properties of the weld deposits.

2. Dimensions and Tolerances**2.1 Diameter –**

Nominal Diameter mm	Tolerance, mm	
	Plus	Minus
0.6	0.01	0.03
0.8	0.01	0.04
0.9	0.01	0.04
1.0	0.01	0.04
1.2	0.01	0.04
1.6	0.01	0.04
1.8	0.01	0.04
2.0	0.01	0.07
2.4	0.01	0.07
2.5	0.01	0.07
2.8	0.01	0.07
3.0	0.01	0.07
3.2	0.01	0.07
4.0	0.01	0.07
5.0	0.01	0.07

2.2. Length of Rods – Rods less than 2.5 mm in diameter shall preferably be supplied in lengths of 500 or 1000 mm. Rods 2.5 mm and larger in diameter shall preferably supplied in lengths of 1000 mm. Lengths other than these two preferred lengths may be supplied by mutual agreement between the purchaser and the supplier.

2.3. Tolerance on each length of rod shall be ± 5 mm

3. Conditions of Rods and Wires

3.1 Finish filler rods and wires shall have a smooth finish and be free from surface imperfections, corrosion products, grease, excessive oxide or other foreign matter which would adversely affect the properties of the weld or the operation of the welding equipment. If the rods and wires are supplied with a protective copper coating, it shall be a uniform well-bonded, smooth coating being applied over a thoroughly clean surface. The copper content of the coated rod or wire expressed as a percentage of the rod (or wire) plus the coating shall not exceed 0.35 percent by weight.

- 3.2** a) Temper – Shall be such that they are suitable for uninterrupted feeding on automatic or semi automatic welding equipment. Tensile strength for those wound on spools of 300 mm and greater in diameter shall be as per Table 1.
- b) Cast – Shall be such to impart a curvature to the filler metal so that a specimen sufficient in length to wound one loop or a maximum 3 m. When cut and laid on flat surface shall form a circle or part thereof of diameter shown in Table 2.
- c) Helix – Shall be such that the maximum distance from any point on the filler metal to flat surface shall not exceed as shown in Table 2.

TABLE 1 TENSILE STRENGTH OF FILLER RODS

Wire Diameter (mm)	0.6	0.8	0.9	1.0	1.2	1.6 - 2.0	2.4 - 3.2
Tensile Strength MPa, Min	1 100	1 100	1 000	950	900	700	600

TABLE 2 DIAMETER OF CAST HELIX

Type of package	Standard size mm	Cast mm	Maximum Helix mm
100mm spool	1.2 and less	100–130	13
Al except 100mm	0.8 and less	305	25
spool	0.9 and larger	380	25

4. Classification – SLA-1, SLA-2, SLA-3, SLA-4 and SLA-5 based on chemical composition. In a classification, for example, SLA-5-M 504 where SLA-5 indicates chemical composition of the filler metal, M indicates that it is mixed gas, 50 indicates tensile strength of minimum 500MPa and 4 indicates the impact values of 27 joules at minus 30°C

A. Symbol Indicating Tensile Strength and Elongation

Symbol	Yield Strength, Min	Tensile Strength	Percentage Elongation at Gauge Length
	MPa	MPa	$5.65 \sqrt{S_0}$, Min
50	420	500 - 640	20
53	460	530 - 680	18
56	500	560 - 720	16

B. Symbol Indicating the Impact Energy

Symbol Minimum Impact Energy of 27 Joules
(Charpy V-Notch at °C Specimen)

1	+ 27
2	0
3	- 20
4	- 30

C. Symbol Indicating Shielding Gas

Symbol Type of Shielding Gas

R	Reducing gas
I	Inert gas
M	Mixed gas
C	Carbon dioxide
F	Nitrogen hydrogen mixture

5. Tests

5.1 Chemical Composition – See 11 of the standard

5.2 Soundness — Radiographs shall reveal no cracks or zone of incomplete fusion.

5.3 All Weld Metal Mechanical Test – Ultimate tensile strength, yield stress percentage elongation and impact values shall be as specified in 4.

Note – For requirements of reels and reeling conditions refer to 6 and 7 of the standard.

For detailed information, refer to IS 6560 : 1996 Specifications for molybdenum and chromium-lybdenum, low alloy steel welding rods and bare electrodes for gas shielded arc welding (first revision).

SUMMARY OF
IS 7280 : 1974 BARE WIRE ELECTRODES FOR SUBMERGED ARC
WELDING OF STRUCTURAL STEELS

1. Scope – Requirements of solid filler wires for submerged arc welding of structural steels (28-50 kgf/mm² yield strength and 34-70 kgf/mm² ultimate tensile strength).

Note – This standard is intended to serve as a guide for the manufacture and selection of bare wire electrodes for submerged arc welding of structural steels.

2. Dimensions and Tolerances

2.1 The diameters of wires shall be 1.6, 2.0, 2.5, 3.15, 4.0, 5.0, 6.3 and 8.0 mm.

2.2 Tolerance on the diameters of wires shall be ± 0.05 mm.

3. Conditions of Wires— Filler wires shall have smooth finish and they shall be free from surface imperfections, corrosion products, grease, excessive oxide or other foreign matter. Temper and surface conditions shall be suitable for uniform uninterrupted feeding on automatic or semi-automatic welding equipment. The copper content of the coated wire expressed as a percentage of the wire and the coating shall not exceed 0.4 percent by weight.

4. Classification— AS-1, AS-1 Si, AS-2, AS-2Si, AS-2 Mo, AS-2 Ni, AS-3, AS-3 Mo, AS-3 Mo Ni, AS-4, AS-4 Mo, AS-6 and AS-6 Mo based on their chemical composition.

Note 1– For requirements of reels for wires and reeling conditions, refer to 5 and 6 of the standard.

Note 2– For chemical composition details, refer to 9 of the standard.

For detailed information, refer to IS 7280 : 1974 Specifications for bare wire electrodes for submerged arc welding of structural steels.

SUMMARY OF
IS 8363 : 1976 BARE WIRE ELECTRODES FOR ELECTROSLAG
WELDING OF STEELS

1. Scope – Requirements of solid bare wire electrodes for electroslag welding of carbon and low alloy steels.

Note. – This standard is intended to serve as a guide for the manufacturer and selection of bare wire electrodes for electroslag welding of carbon manganese and low alloy steels.

2. Dimensions and Tolerances

2.1 The diameters of wires shall be 2.0, 3.15, 4.0, 5.0 and 6.3 mm.

2.2 Tolerance on dia on wire shall be $\begin{smallmatrix} +0 \\ -0.05 \end{smallmatrix}$ mm

2.3 Ovality of wire shall not exceed 50 percent of tolerance on dia.

3. Conditions of Wires – Filler wires shall have smooth finish and they shall be free from surface imperfections, corrosion products, grease, excessive oxide or other foreign matter. Temper and surface conditions shall be suitable for uniform uninterrupted feeding on automatic or semi-automatic welding equipment. The copper content of the coated wire expressed as a percentage of the wire and the coating shall not exceed 0.4 percent by weight.

4. Classification – ES-2, ES-2Si, ES-3, ES-3Mo, ES-3MoNi, ES-4, ES-4 Mo, ELS-4, ELS-4 Mo, ELS-2 Mo and ELS-2 Mo Cr based on their chemical composition.

Note 1– For requirements of coils for wires and reeling conditions, refer to **5** and **6** of the standard.

Note 2– For chemical composition details, refer to **9** of the standard.

For detailed information, refer to IS 8363 : 1976 Specifications for bare wire electrodes for electroslag welding of steels.

SECTION 19

**THREADED FASTENERS
AND
RIVETS**

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SUMMARY OF
IS 207 : 1964 GATE AND SHUTTER HOOKS AND EYES
(Revised)

1. Scope – Requirements for gate and shutter hooks and eyes which are commonly used on doors and windows for keeping them in position when kept open.

2. Types

Type 1– Mild steel and hard-drawn brass hooks and eyes, and

Type 2– Cast brass hooks and plates.

3. Size and Dimensions (in mm)

3.1 Type 1– 65 (4.17), 5 (4.52), 100(5.23), 125 (5.59) 150 (5.59), 200 (6.30), 250 (6.30) 300 (7.01).

3.2 Type – 75(4), 100(5), 125(6.5), 200(8)

Note – Figure in brackets indicate diameter (average diameter in case of cast brass hooks) of unthreaded shank.

4. Tolerances

For length upto size 250 \pm 2 mm

For length upto size 300 \pm 3 mm

For average Diameter of \pm 0.5 mm
cast brass hooks

5. Finish – The articles shall be finished bright.

Note – For detailed dimensions and shapes, refer to Table 1 and 11, Fig.1 and 2 of *the standard*

For detailed information, refer to IS 207 : 1964 Specification for gate and shutter hooks and eyes (revised).

SUMMARY OF
IS 723 : 1972 STEEL COUNTER SUNK HEAD WIRE NAILS
(Second Revision)

1. Scope – Requirements of steel countersunk head wire nails.

2. Dimensions and Tolerances (in mm)

2.1 Dimensions

<i>Shank Diameter</i>	<i>Length</i>	<i>Head Diameter</i>
1.25	20	3.4
1.4	20	3.8
1.6	15, 20, 25	4
1.8	25, 30	4.5
2	25, 30, 40, 50	4
2.24	40	4.5
2.5	50	5
2.8	60	5.6
3.15	60	5.7
3.55	80	6.4
4	100	7.2
4.5	90, 100, 125	8.1
5	100, 125, 150	9
6.3	150	11.3
8	200, 225	14.4
10	250	18

2.2 Tolerances (in mm)

a) On shank dia	1.25 to 2.24	±0.04
	2.5	±0.05
	2.8 to 10	±0.06
b) On length	15 to 20	±1
	25 to 30	±1.2
	40	±1.5
	50 to 60	±2.1
	80	±2.6
	90	±3.1
	100	±3.4
	125 to 150	±3.8
	200 to 250	±4.4

2.3 Bend of shank shall not exceed 1 percent of length.

2.4 Eccentricity and ovality of centre of nail head from axis of shank:

a) Maximum 12 percent of shank diameter for nails with shank diameter 2 mm and above.

b) Maximum 14 percent of shank diameter for nails with shank diameter below 2 mm.

Note – For detailed dimensions and tolerances, refer to Tables 1 to 4 of the standard.

3. Designation – As an example, a countersunk head nail of size 4.00 mm and length 100 mm shall be designated as 'Nail 4 × 100 IS : 723'.

4. Finish – Shall be supplied plain finished.

5. Test (Bend Test) – Test piece shall not break or develop crack when doubled over by pressure or hammer blows until internal radius equals diameter of test piece and sides are parallel.

For detailed information, refer to IS 723 : 1972 Specification for steel countersunk head wire nails (second revision).

SUMMARY OF IS 724 : 1964 MILD STEEL AND BRASS CUP, RULER AND SQUARE HOOKS AND SCREW EYES

(Revised)

1. Scope – Requirements for mild steel and brass cup, ruler and square hooks and screw eyes.

- 2. Types** –
- a) Shouldered cup hooks
 - b) Shouldered ruler hooks
 - c) Shouldered square hooks
 - d) Plain cup hooks
 - e) Plain ruler hooks
 - f) Plain square hooks

2.1 *Screw Eyes shall be of One Type Only.*

3. Designation – Shall be based on type, length, and screw designation No. of the fitting. For example, shouldered cup hook of length 25 mm and of screw designation No.5. shall be designated as “Shouldered cup hook 25×No. 5”

4. Dimensions

4.1 Shouldered cup, ruler and square hooks

Dimension	Designation						
	15×No.3	20×No.4	25×No.5	35×No.7	40×No.8	50×No.10	50×No.12
D(mm)	2.39	2.74	3.10	3.81	4.17	4.88	5.59
T(mm)	4.7	6.5	8.0	12.5	14.0	17.5	20.0

4.2 Plain Cup and Ruler Hooks

Dimension	Designation				
	25×No.5	30×No.7	40×No.8	45×No.8	50×No.8
D(mm)	3.10	3.81	4.17	4.17	4.17
T(mm)	8.0	10.0	12.0	15.0	18.0

4.3 Plain Square hooks

Dimension	Designation						
	20×No.4	25×No.5	30×No.6	40×No.7	50×No.9	60×No.12	75×No.14
D(mm)	2.74	3.10	3.45	3.81	4.52	5.59	6.30
T(mm)	8.0	10.0	14.0	15.0	20.0	24.0	28.0M

4.4 Screw eyes

Dimension	Designation					
	16×No.0	20×No.1	20×No.2	25×No.3	25×No.4	30×No.5
D(mm)	1.52	1.78	2.08	2.39	2.74	3.10
T(mm)	5.5	6.5	7.5	9.5	9.0	12.0

Dimension	Designation				
	30×No.6	35×No.8	40×No.10	45×No.12	50×No.14
D(mm)	3.45	4.17	4.88	5.59	6.30
T(mm)	11.0	12.0	12.5	15.0	19.0

Note1–D–Nominal diameter of threaded shank.T– threaded length of shank

Note2 – For detailed dimensions, tolerances and shapes

,refer to Tables 1 to 5 and Fig.1 to7 of the standard

5. Finish – Hooks and eyes shall be finished bright.

For detailed information, refer to IS 724 :1964 Specification for mild steel and brass cup, ruler and square hooks and screw eyes (revised).

SUMMARY OF
IS 725 : 1961 COPPER WIRE NAILS
(Revised)

1. Scope – Covers the following types of copper wire nails:

- a) Rose-head boat nails, square shank, square point.
- b) Countersunk-head boat nails, square shank, sharp square point.
- c) Countersunk-head boat nails, square shank, round point,
- d) Wrought tacks
- e) Cut-lath nails (Cut tacks)

2. Dimensions (in mm) – Lengths of different types of copper nails are given in 2.1 to 2.5. Values given in brackets are the sizes of shank across flats except in case of Type (e) where it is diameter.

2.1 Type (a)

110 (5)	110 (4)	100(5)	100 (4)	100(3.15)	90 (5)	90 (4)	90(3.15)
80 (4.5)	80(4)	80(3.15)	80 (2.5)	70 (4)	70 (3.15)	70 (2.5)	60 (4)
60 (3.15)	60 (2.5)	60 (2)	50 (3.15)	50 (2.5)	50 (2)	45(3.15)	45 (2.5)
45 (2)	40(3.15)	40(2.5)	40(2)	35(3.15)	35(2.5)	35 (2)	30(3.15)
30 (2.5)	30 (2)	25(5)	25 (2.5)	25 (2)	25(1.6)		

2.2 Type (b)

125(5)	100 (5)	100 (4)	100 (3.15)	90(3.55)	80 (5)	80 (3.15)	70 (5)
70 (3.15)	60 (4)	60 (3.15)	50(3.55)	50(3.15)	40 (3.15)	30 (3.15)	25 (3.15)
20 (3.15)							

Note 1– Head diameter of side of square shall be 2.5 times the size of shank in case of Types (a), (b) and (c) and shall be 3 times the size of shank in case of types (d) and (e) copper nails.

Note 2– For detailed dimensions, approximate count of copper nails and tolerances refer to 4 (Table 1) with Fig. 1 to 5 of the standard.

For detailed information, refer to IS 725 : 1961 Specification for copper wire nails (revised).

SUMMARY OF
IS 730 : 1978 HOOK BOLTS FOR CORRUGATED SHEET ROOFING
(Second Revision)

1. Scope – Requirements for hook bolts for corrugated sheet roofing.

2. Types –

- a) J - type hook bolts
- b) L - type hook bolts
- c) U - type hook bolts

3. Dimensions (in mm)

4. Grade – Product grade C according to IS : 1367 (Part 2) Technical supply conditions for threaded steel fasteners : Part 2 product grades and tolerances (*second revision*).

5. Mechanical Properties – Property class 4.60 IS :

1367 (Part 3) – 1979 Technical supply conditions for threaded steel fasteners : Part 3 mechanical properties and test methods for bolts, nuts and stands with full loadability (*second revision*)

6. Designation – The hook bolts shall be designated by the type, size, length, inside width in case of L and U-type bolts) and number of the standard. For example, U hook bolt of type II with square nut of size M10, inside width 80 mm and length 180 mm shall be designated as “U Bolt II M10 × 180N - 80 IS 730”.

7. General Requirements –

7.1 Hook bolts and nuts shall be surface protected with suitable coating.

7.2 The square nuts used with bolts shall conform to IS 2585 : 1968[†].

Type	Size (Dia)	Inside Width	Preferred Length
J-Type Hook Bolts (Types I and II)	M6	12	70 to 150 in steps of 10
	M8	14	70 to 200 in steps of 10
	M10	16	70 to 200 in steps of 10
L-Type Hook Bolts	M8	50, 60, 70	120 to 200 in steps of 10
	M10	80, 95	150 to 200 in steps of 10
		110	180, 190, 200, 225
U-Type Hook Bolts (Types I and II)	M8	50, 60, 80	150 to 200 in steps of 10
		90	225
	M10	50, 60, 80	150 to 200 in steps of 10
		90	225

Note 1– All type of hook bolts are with square nuts.

Note 2– For tolerances and detailed dimensions, refer to Tables 1 to 3 of the standard.

Note 3– The screw threads on the hook bolts shall conform to tolerance class as specified in IS 4218 : (Part 4) ISO metric screw threads – Part IV Tolerance systems (*first revision*).

[†] Black square bolts and nuts (diameter range 6 to 39 mm) and black square screws (diameter range 6 to 24 mm) (*first revision*).

Note – In regard to requirements not covered in the standard, including grade and mechanical properties refer to IS 1367 Technical supply conditions for threaded fasteners.

For detailed information, refer to IS 730 : 1978 Specification for hook bolts for corrugated sheet roofing (second revision).

SUMMARY OF
IS 1120 : 1975 COACH SCREW
(First Revision)

1. Scope – Requirements of hexagon head coach screws (hexagon head wood screws).

2. Dimensions (in mm)

3. Designation — As an example, a hexagon head coach screw of screw No. 10, length 30 mm and made of steel, shall be designated as Coach Screw No.10 x 30 IS 1120 Steel.

<i>Size No. Screw</i>	<i>Diameter of Unthreaded Shank</i>			<i>Range of Preferred Length (See Note 1)</i>
Designation	Nominal	Max	Min	
10	4.88	5.00	4.72	20 - 35
14	6.33	6.43	6.05	20 - 100
18	7.72	7.85	7.47	25 - 110
24	9.86	9.98	9.00	25 - 200
28	11.28	11.40	11.02	25 - 200

Note 1– Preferred lengths – 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190 and 200mm.

Note 2– Threaded portion of the screw shall nearly be equal to two-thirds times the total length of the screw.

Note 3– For detailed dimensions, refer to Table 1 of the standard.

Note 4– For tolerances, refer to 3 (Fig. 1) of the standard.

Note – In regard to the requirements not covered in the standard, refer to IS 451 : 1999 Technical supply conditions for wood screws *(third revision)*.

For detailed information, refer to IS 1120 : 1975 Specification for coach screws (first revision).

SUMMARY OF
IS 1363 (Part 1) : 2002 ISO 4016 : 1999
HEXAGON HEAD BOLTS, SCREWS AND NUTS OF PRODUCT GRADE C
PART 1 : HEXAGON HEAD BOLTS (SIZE RANGE M5 TO M64)
(Fourth Revision)

1. Scope – Gives specifications for hexagon head bolts with threads from M5 up to and including M64 of product grade C.

2. Dimensions M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64.

Note – For details of preferred and non preferred threads refer to Tables 1 and 2 of the standard.

2.1 Preferred threads – M5, M6 and M64

2.2 Non - Preferred threads – M14, M18, M22, M27, M33, M39, M45, M52, and M60

3. Specifications – See Table 1

TABLE 1 SPECIFICATIONS AND REFERENCE STANDARDS

Material		Steel
General requirements	International Standard	ISO 8992
Thread	Tolerance	8g
	International Standards	ISO 724, ISO 965-1
Mechanical properties	Property class ^{a)}	$d \leq 39 \text{ mm}$: 3.6, 4.6, 4.8 $d > 39 \text{ mm}$: as agreed
	International Standards	$d \leq 39 \text{ mm}$: ISO 898-1 $d > 39 \text{ mm}$: as agreed
Tolerance	Product grade	C
	International Standard	ISO 4759-1
Finish in	2) Requirement for non - electrolytically applied zero flake coatings are covered in ISO 10683.	As processed
		(1) Requirements for electroplating are covered ISO 4042. (2) If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier
Acceptability		For acceptance procedure see ISO 3269

a) For other property classes see ISO 898 - 1

4. Designation – Example for the designation of a hexagon head bolt, with thread M12, nominal length $l = 80 \text{ mm}$ and property class 4.6 : Hexagon head bolt IS 1363 (Part I) – ISO 4016 M12 \times 80 – 4.6

Note – For corresponding Indian Standards of certain International standard refer, along with their degree of equivalence, refer the National Foreword of the standard.

For detailed information, refer to IS 1363 (Part I) : 2002 – ISO 4016 : 1999. Specification for Hexagon head bolts, screws and nuts of product grade C : Part I Hexagon head bolts (size range M5 to M64) (fourth revision).

SUMMARY OF
IS 1363 (PART 2) : 2002 ISO 4018 : 1999
HEXAGON HEAD BOLTS, SCREWS & NUTS OF PRODUCT GRADE C
PART 2 : HEXAGON HEAD SCREWS (SIZE RANGE M5 TO M64)
(Fourth Revision)

1. Scope – Gives specifications for hexagon head screws with threads from M5 up to and including M64 of product grade C.

2. Dimensions – M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64.

Note – For details, of preferred and non preferred threads size refer to Tables 1 and 2 of the Standard).

2.1 Preferred the neads

2.2 Non - Preferred theads – M14, M22, M27, M33, M39, M45, M52, M60

3. Specifications – See Table 1

TABLE 1 SPECIFICATIONS AND REFERENCE STANDARDS

Material	Steel	
General requirements	International Standard Tolerance	ISO 8992 8g
Thread	International Standards	ISO 724, ISO 965-1
Mechanical properties	Class ^{a)}	d ≤ 39 mm : 3.6, 4.6, 4.8 d > 39 mm : as agreed
	International Standards	d ≤ 39 mm : ISO 898-1 d > 39 mm : as agreed
	Product grade	C
Tolerance	International Standard	ISO 4759-1 As processed
Finish	2) Requirement for non - electrolytically applied zero flake coategs are covered in ISO 10683.	(1) Requirements for electroplating are covered in ISO 4042.(2) if different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier.
Acceptability		For acceptance procedure see ISO 3269

a) For other property classes see ISO 898 – 1

4. Designation – Example for the designation of a hexagon head screw with thread M12, nominal length $l = 80$ mm and property class 4.6 : Hexagon head screw IS 1363 (Part 2) — ISO 4018- M12 × 80 – 4.6

Note – For corresponding Indian standards of cerain International standard referred, along with their degree of equivalence, refer , the National Forewrd of the standard.

For detailed information, refer to IS 1363 (Part 2) : 2002 ISO 4016 : 1999 Specification for hexagon head bolts, screws and nuts of product grade C : Part 2 Hexagon head screws (size range M5 to M64) (fourth revision).

SUMMARY OF
IS 1363 (PART 3) : 2002 ISO 4034 : 1999
HEXAGON HEAD BOLTS, SCREWS & NUTS OF PRODUCT GRADE C
PART 3 : HEXAGON NUTS (SIZE RANGE M5 TO M64)
(Fourth Revision)

1. Scope – Gives specifications for hexagon nuts with thread diameters from M5 to M64 inclusive and product grade C.

2. Dimensions – M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64.

Note —For details, of preferred and non preferred size refer to Tables 1 and 2 of *the Standard*.

2.1 Preferred threads

2.2 Non – preferred threads – M14, M18, M22, M27, M33, M39, M45, M52, M60

TABLE 1 SPECIFICATIONS AND REFERENCE STANDARDS

Material		Steel
General requirements	International Standard	ISO 8992
Thread	Tolerance	7H
	International Standards	ISO 724, ISO 965 -1
Mechanical properties	Class	d ≤ M16 : 5 M16 < d ≤ M 39 : 4,5 d > 39 mm : as agreed
	International Standards	d ≤ 39 mm : ISO 898-2 d > 39 mm : as agreed
Tolerance	Product grade	C
	International Standard	ISO 4759-1
Finish	2) Requirement for non - electrolytically applied zero flake coatings are covered in ISO 10683.	As processed
		Requirements for electroplating are covered in ISO 4042 If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier.
Acceptability		For acceptance procedure see ISO 3269

4. Designation — Example for the designation of a 5 — Hexagon Nut ISO— 4034: M12—5
hexagon nut with thread size d=M12 and property class

Note — For Corresponding Indian standards of certain International standards referred, along with their degree of equivalence, refer, the National Foreword of *the standard*.

For detailed information, refer to IS 1363 (Part 3) : 2002– ISO 4034 : 1986. Specification for hexagon head bolts, screws and nuts of product grade C : Part 3 Hexagon nuts (size range M5 to M64) (third revision).

SUMMARY OF
IS 1364 (Part 1) : 2002 ISO 4014 : 1999
HEXAGON HEAD BOLTS, SCREWS AND NUTS OF PRODUCT GRADES A
AND B PART 1 : HEXAGON HEAD BOLTS (SIZE RANGE M1.6 TO M64)
(Third Revision)

1. Scope – Gives specifications for hexagon head bolts with threads from M1,6 up to and including M64, of product grade A for threads M1,6 to M24 and nominal lengths up to and including 10 *d* or 150 mm, whichever is shorter and product grade B for threads over M24 or nominal lengths over 10 *d* or 150 mm, whichever is shorter.

2. Dimensions

2.1 Preferred threads – M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64

Note—For details, of preferred and non preferred threads refer to Tables 1 and 2 of the standard.

2.2 None – Preferred threads – M 3.5, M 14, M18, M22, M27, M33, M39, M45, M52, M60

3. Specifications – See Table 1

TABLE 1 SPECIFICATION AND REFERENCE STANDARDS

Material		Steel	Stainless steel	Non-ferrous metal
General requirements	International Standard	ISO 8992		
	Tolerance	6g		
Thread	International Standards	ISO 724, ISO 965-1		
	Property class ^a	<i>d</i> < mm: as agreed 3 mm ≤ <i>d</i> ≤ 39 mm 5.6, 8.8, 9.8, 10.9 <i>d</i> > 39 mm: as agreed	<i>d</i> ≤ 24 mm: A2-70, A4-70 24 mm < <i>d</i> ≤ mm: A2-50, A4-50 <i>d</i> > 39 mm: as agreed	Materials specified ISO 8839
Mechanical properties	International Standard	3 mm ≤ <i>d</i> ≤ 39 mm: ISO 898-1 <i>d</i> < 3 mm and <i>d</i> > 39 mm: as agreed	<i>d</i> ≤ 39 mm: ISO 3506-1 <i>d</i> > 39 mm: as agreed	
	Product grade	Ford ≤ 24 mm and / ≤ 10 <i>d</i> or 150 mm ^b : A Ford > 24 mm or / > 10 <i>d</i> or 150 mm ^b : B		
Tolerance	International Standard	ISO 4759-1		
	Finish and/or coating	As processed Requirements for electroplating are covered in ISO 4042 Requirements for non-electrolytically applied zinc flake coating are covered in ISO 10683 If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier. Limits for surface discontinuities are covered in ISO 6157-1	Plain	Plain Requirements for electroplating are covered in ISO 4042
Acceptability		For acceptance procedure, see ISO 3269.		

^a For other property classes see ISO 898-1 for steel and ISO 3506-1 for stainless steel respectively.

^b Whichever is shorter.

4. Designation : Example for the designation of a 80 mm and property class 8.8 : Hexagon head bolt IS
hexagon head bolt with thread M12, nominal length *l* = 1364 (Part 1) – ISO – 4014 – M12 × 80 – 8.8

Note – For Corresponding Indian standards of certain International standard referred, along with their degree of equivalence, refer to the National Foreword of the standard.

For detailed information, refer to IS 1364 (Part 1) : 1992. Specification for ISO 4014 : 1998. Hexagon head bolts, screws and nuts of product grades A and B – Part 1 – Hexagon head bolts (size range M1.6 to M64) (third revision).

SUMMARY OF
IS 1364 (PART 2):2002 ISO 4017 : 1999
HEXAGON HEAD BOLTS, SCREWS & NUTS OF PRODUCT GRADE
A & B PART 2 : HEXAGON HEAD SCREWS (SIZE RANGE 1.6 TO M64)
(Fourth Revision)

1. Scope – Gives specifications for hexagon head screws with threads from M1.6 upto and including M64, of product grade A for threads M1.6 to M24 and nominal lengths up to and including 10 d or 150 mm, whichever is shorter and product grade B for threads over M24 or nominal lengths over 10 d or 150 mm, whichever is shorter.

2. Dimensions

2.1 Preferred threads – M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64.

2.2 Non-Preferred threads – M3.5, M14, M18, M22, M27, M33, M39, M45, M52, and M60.

Note —For details, of preferred and non preferred threads refer to Tables 1 and 2 of the Standard.

3. Specifications — See Table 1

TABLE 2 SPECIFICATION AND REFERENCE STANDARDS

Material		Steel	Stainless steel	Non-ferrous metal
General requirements	International Standard	ISO 8992		
Thread	Tolerance	6g		
	International Standards	ISO 724, ISO 965-1		
Mechanical properties	Property class ^a	$d < 3 \text{ mm}$: as agreed $3 \text{ mm} \leq d \leq 39 \text{ mm}$: 5.6, 8.8, 9.8, 10.9 $d > 39 \text{ mm}$: as agreed	$d \leq 24 \text{ mm}$: A2-70, A4-70 $24 \text{ mm} < d \leq 39 \text{ mm}$: A2-50, A4-50 $d > 39 \text{ mm}$: as agreed	Materials specified ISO 8839
	International Standard	$d \leq 39 \text{ mm}$: ISO 898-1 $d < 3 \text{ mm}$ and $d > 39 \text{ mm}$: as agreed	$d \leq 39 \text{ mm}$: ISO 3506-1 $d > 39 \text{ mm}$: as agreed	
Tolerance	Product grade	Ford $\leq 24 \text{ mm}$ and $/ \leq 10 d$ or 150 mm ^b : A Ford $> 24 \text{ mm}$ or $/ > 10 d$ or 150 mm ^b : B		
	International Standard	ISO 4759-1		
Finish and/or coating		As processed Requirements for electroplating are covered in ISO 4042 Requirements for non-electrolytically applied zinc flake coating are covered in ISO 10683 If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier. Limits for surface discontinuities are covered in ISO 6157-1	Plain	Plain Requirements for electroplating are covered in ISO 4042
Acceptability		For acceptance procedure, see ISO 3269.		

^a For other property classes see ISO 898-1 for steel and ISO 3506-1 for stainless steel respectively.

^b Whichever is shorter.

4. Designation —Example for the designation of a 80 mm and property class 8.8—Hexagon head bolt IS 1364 (Part 2)—ISO 4017—M12 x 80—8.8
 hexagon screw with thread size M12, nominal length $l =$

Note —For corresponding Indian standards of certain International standards referred, along with their degree of equivalence refer to the National foreword of the standard.

For detailed information, refer to IS 1364(Part 2) :1992— ISO 4017 : 1998. Specification for Hexagon head bolts,screw and nuts of product grades A and B - Part 2- Hexagon head screws (Size range M1.6 to M64) (third revision).

SUMMARY OF
IS 1364 (Part 3) : 2002 ISO 4032 : 1999
HEXAGON HEAD BOLTS, SCREWS AND NUTS OF PRODUCT GRADES A & B
PART 3 : HEXAGON NUTS (SIZE RANGE M1.6 TO M64)
(Fourth Revision)

1. Scope — Gives specifications for hexagon nuts style 1, with thread diameters from M1.6, to M64, with product grade A for threads $d \leq M16$ and product grade B for $d > M16$.

2. Dimensions —

2.1 Threads Preferred threads — M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64.

2.2 Non - preferred threads — M3.5, M14, M18, M22, M27, M33, M39, M45, M52, M60.

Note—For details, of preferred and non preferred sizes refer to Tables 1 and 2 of the Standard.

3. Specifications — See Table 1

TABLE 3 SPECIFICATION AND REFERENCE STANDARDS

Material		Steel	Stainless steel	Non-ferrous metal
General requirements	International Standard	ISO 8992		
Thread	Tolerance	6H		
	International Standards	ISO 724, ISO 965-1		
Mechanical properties	Property class ^a	$d < M3$: as agreed $M3 \leq d \leq M39$: 6,8,10 $d > M39$: as agreed	$d \leq M24$: A2-70, A4-70 $M24 < d \leq M39$: A2-50, A4-50 $d > M39$: as agreed	Materials specified ISO 8839
	International Standard	$M3 \leq d \leq M39$: ISO 898-2 $d < M3$ and $d > M39$ as agreed	$d \leq M39$: ISO 3506-2 $d > M39$: as agreed	
Tolerance	Product grade	$d < M16$: A $d < M16$: B		
	International Standard	ISO 4759-1		
Finish and/or coating		As processed Requirements for electroplating are covered in ISO 4042 Requirements for non-electrolytically applied zinc flake coating are covered in ISO 10683 If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier. Limits for surface discontinuities are covered in ISO 6157-1	Plain	Plain Requirements for electroplating are covered in ISO 4042
Acceptability		For acceptance procedure, see ISO 3269.		

^a For other property classes see ISO 898-1 for steel and ISO 3506-1 for stainless steel respectively.

^a For other property classes see ISO 898-1 for steel and ISO 3506-1 for stainless steel respectively.

4. Designation : Example for the designation of a property class 8: Hexagon nut IS 1364(PART 3)—hexagon nut, style 1, with thread size $d = M12$, and ISO 4032—M12—8

Note —For corresponding Indian standards of certain International standards referred, along with their degree of equivalence, after to the National foreword of the standard.

For detailed information, refer to IS 1364(PART 3) : 1992. Specification for ISO 4032:1986 Hexagon head bolts, screw and nuts of product grades A and B— Part 3— Hexagon nuts (Size range M1.6 to M64) (third revision).

SUMMARY OF
IS 1364 (PART 4) : 2003 ISO 4035 : 1999
HEXAGON HEAD BOLTS,SCREWS&NUTS OFPRODUCTGRADEA &B
PART 4 HEXAGON THIN NUTS (CHAMFERED)
(SIZE RANGE M1.6 TO M64)
(Fourth Revision)

1. Scope – Gives specifications for chamfered hexagon thin nuts, with thread diameters from M1.6 to M64, including , with product grade A for threads $d \leq M16$ and product grade B for threads $d > M16$.

2. Dimensions –

2.1 Preferred threads – M1.6, M2, M2.5, M3, M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56 and M64

2.2 Non-preferred threads – M3.5, M14, M18, M22, M2.7, M33, M39, M45, M52, M60

Note – For details, on preferred and non -preferred sizes refer to Tables 1 and 2 of the standard.

3. Specifications – See Table 1

TABLE 3 SPECIFICATION AND REFERENCE STANDARDS

Material		Steel	Stainless steel	Non-ferrous metal
General requirements	International Standard	ISO 8992		
Thread	Tolerance	6H		
	International Standards	ISO 724, ISO 965-1		
Mechanical properties	Property class ^a	$d < M3$: as agreed $M3 \leq d \leq M39$: 4, 5, $d > M39$: as agreed	$d \leq M24$: A2-35, A4-35 $M24 < d \leq M39$: A2-25 A4-025	Materials specified ISO 8839
	International Standard	$d \leq M3$: as agreed $M3 \leq d \leq M39$: ISO 898-2 $d > M39$: as agreed	$d \leq M39$: ISO 3506-2 $d > M39$: as agreed	
Tolerance	Product grade	$d \leq M16$: A $d < M16$: B		
	International Standard	ISO 4759-1		
Finish and/or coating		As processed Requirements for electroplating are covered in ISO 4042 Requirements for non-electrolytically applied zinc flake coating are covered in ISO 10683 If different electroplating requirements are desired or if requirements are needed for other finishes, thy should be agreed between customer and supplier. Limits for surface discontinuities are covered in ISO 6157-1	Plain	Plain Requirements for electroplating are covered in ISO 4042
Acceptability		For acceptance procedure, see ISO 3269.		

4. Designation : Example for the designation of a $d = M12$, and property class 05 : Hexagon thin nut IS hexagon chamfered hexagon thin nut with thread size 1364 (Part 4) — ISO 4035 — M12 — 05

Note – For corresponding Indian standards of certain International standards referred, along with their degree of equivalence, refer to National Foreword of the standard.

For detailed information, refer to IS 1364 (Part 4):1992. - ISO 4035: 1986 hexagon head bolts, screw and nuts of product grades A and B - Part 4 – Hexagon thin nuts (chamfered) (size range M1.6 to M64) (third revision).

SUMMARY OF
IS 1364 (PART 5): 2002 ISO 4036 : 1999
HEXAGON HEAD BOLTS, SCREWS AND NUTS OF PRODUCT
GRADES A AND B PART 5 HEXAGON THIN NUTS
(UNCHAMFERED) (SIZE RANGE M1.6 TO M10)
(Third Revision)

1. Scope – Gives specifications for hexagon thin nuts with metric dimensions and thread diameters from 1.6, up to and including 10 mm and product grade B.

2. Dimensions – M1.6, M2, M2.5, M(3.5), M4, M5, M6, M8, M10.

Note – For details see 3 of the standard

3. Specifications — See Table

TABLE 4 SPECIFICATION AND REFERENCE STANDARDS

TABLE 1 SPECIFICATION AND REFERENCE STANDARDS			
Material		Steel (S)	Non - ferrous metal
General requirments	International Standard	ISO 8992	
	Thread	Tolerance	6H
	International Standards	ISO 724, ISO 965-1	
	Mechanical	Hardness min.	110 HV30
International Standard			
Tolerances	Product grade	B	
	International Standard	ISO 4759-1	
		As processed	Plain
		Requirements for electroplating are covered in ISO 4042.	
		Requirements for non-electrolytically applied zinc flake coatings are covered in ISO 10683.	
		If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier.	
		Limits for surface discontinuities are covered in ISO 6157- 2	
Acceptability		For acceptance procedure, see ISO 3269.	

4. Designation — Example for the designation made from steel with 110 HV 30.(st): Hexagon nut of an hexagon thin nut with metric thread d=M6 IS 1364 (Part 5) — ISO 4036 M6-st

Note — For corresponding Indian standards of certain International standards referred, along with their degree of equivalence, refer to National foreword of the standard.

For detailed information, refer to IS 1364 (Part 5) :1992 - ISO 4036 : 1979 Hexagon head bolts,screw and nuts of product grades A and B Part 5 Hexagon thin nuts (unchamfered) (Size range M1.6 to M10) (fourth revision).

SUMMARY OF
IS 1365 : 1978 SLOTTED COUNTERSUNK HEAD SCREWS
(Third Revision)

1. Scope—Requirements for slotted countersunk head screws in the diameter range 1 to 20 mm.

2. Requirements

2.1 Mechanical Properties — Shall conform to IS : 1367*. Where brass or aluminium alloy is used, it shall have minimum tensile strength of 300 MPa.

2.2 Grade— Precision Grade (P) of IS : 1367*—

3. Designation — Shall be designated by name, nominal size, length, the number of this standard and the property class. For example, a slotted countersunk head screw of size M4, length 10 mm and of property class 4.8 shall be designated as :

Countersunk Screw M4 × 10—IS 1365—4.8

* Technical supply conditions for threaded fasteners.

4. Dimensions (in mm)

Nominal Size	Diameter			Length
	Nom	Max	Min	
M1	1.9	1.90	1.76	1.10
M1.2	2.3	2.30	2.16	1.12
(M1.4)	2.6	2.60	2.46	1.14
M1.6	3.0	3.00	3.00	2.16
(M1.8)	3.4	3.40	3.10	2.18
M2	3.8	3.80	3.50	2.52
(M2.2)	4.2	4.20	3.90	2.52
M2.5	4.7	4.70	4.40	3.25
M3	5.6	5.60	5.30	4.30
(M3.5)	6.5	6.50	6.14	4.35
M4	7.5	7.50	7.14	5.40
(M4.5)	8.3	8.30	7.94	7.45
M5	9.2	9.20	8.84	7.50
M6	11	11.0	10.57	7.55
M8	14.5	14.5	14.07	9.80
M10	18	18.00	17.57	11.100
M12	22	22.00	21.48	14.120
(M14)	25	25.00	24.48	18.140
M16	29	29.00	28.48	22.160
(M18)	33	33.00	32.38	28.180
M20	36	36.00	35.38	28.200

Note 1— Sizes shown in the Parantheses are of second preference.

For detailed information, refer to IS 1365 : 1978 Specification for slotted countersunk head screws (third revision).

SUMMARY OF
IS 1366 : 2002 ISO 1207 - 1992 SLOTTED
CHEESE HEAD SCREWS
(Third Revision)

- 1. Scope** – Requirements for slotted cheese head screws of product grade A and with the heads from M1.6 to M10.
- 2. Dimensions** – M1.6, M2, M2.5, M3, (M3.5), M4, M6, M8, M12
- 3. Specification** – See Table 1
- 4. Designation** – as per sheet attached.

Material		Steel	Stainless steel	Non-ferrous metal
General requirements	International Standard	ISO 8992		
	Tolerance	6 g		
Thread	International Standards	ISO 261, ISO 965-2		
	Property class	4, 8, 5.8	A2-70, A2-50	
Mechanical properties	International Standards	ISO 898-1	ISO 3506	ISO 8839
	Product grade	A		
Tolerance	International Standard	ISO 4759-1		
		Plain		
Finish		Requirements for electroplating are covered in ISO 4042.		
		If different electroplating requirements are desired or if requirements are needed for other finishes, they should be agreed between customer and supplier.		
Acceptability		Limits for surface discontinuities are covered in ISO 6157-1 and ISO 6157 - 3.		
		Acceptance procedure is covered in ISO 3269.		

For detailed information, refer to IS 1366 : 1982. Specification for Slotted cheese head screws (third revision).

SUMMARY OF IS 1929 : 1982 HOT FORGED STEEL RIVETS FOR HOT CLOSING (12 TO 36 mm DIAMETER)

(First Revision)

1. Scope – Requirements of hot forged solid mild steel and high tensile steel rivets (snap head, flat countersunk head and flat head rivets) for hot closing in the diameter range 12 to 36 mm intended for general engineering purposes.

2. Dimensions

2.1 Range of Preferred Length Diameter Combinations and Diameter of Rivet Holes

Diameter	Range of Preferred Lengths (See Note 2)	Diameter of Rivet Hole
mm	mm	mm
12	28-80	13.5
14	32-95	15.5
16	35-110	17.5
18	40-120	19.5
20	45-125	21.5
22	50-140	23.5
24	55-160	25.5
27	65-180	29
30	70-200	32
33	85-225	35
36	95-225	38

Note 1 – The nominal diameters 14, 18, 22, 27 and 33 mm are of second preference.

Note 2 – Preferred lengths 28, 30, 32, 35, 38, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, and 225 mm.

3. Tolerances – On length, +1.5, – 0 mm for diameter upto 16 mm and +3.0, – 0 mm for diameter above 16 mm.

4. Tests

4.1 Shear Test – Shear strength shall not be less than 260 MPa for mild steel rivets and 280 MPa for high tensile rivets.

4.2 Head Soundness Test – Rivets shall withstand the test without exhibiting any sign of cracking at the fillet between head and shank.

5. Designation – As an example, a high tensile steel snap head rivet of 16 mm diameter having a length of 70 mm shall be designated as ‘Snap Head Rivet 16 × 70HT IS 1929’. In case of mild steel rivet, the symbol ‘HT’ shall not be included in designation.

Note 1 – For detailed dimensions, refer to Tables 1 to 3 of the standard.

Note 2 – For general requirements for supply of rivets and their workmanship, limits of surface cracks on rivets, tolerances, methods of tests, refer to IS 10102 : 1982 Technical supply conditions for rivets.

For detailed information, refer to IS 1929 : 1982 Specification for hot forged steel rivets for hot closing (12 to 36 mm diameter) (first revision).

SUMMARY OF
IS 2016 : 1967 PLAIN WASHERS
(First Revision)

1. Scope – Requirements for plain washers of the following types :

- a) Machined washers, for precision and semi-precision grade of general purpose bolts and screws, in diameter range 1.7 to 155 mm.
- b) Punched washers, Type A, for black grade general purpose bolts and screws, in diameter range 1.8 to 52 mm.
- c) Punched washers, Type B, for slotted head screws, in diameter range 7.8 to 22 mm.

2. Requirements

2.1 Shall be of steel, brass, aluminium or any other specified material.

2.2 The washers shall be free from cracks, burrs, pits and other defects. The holes shall be reasonably concentric with the outer periphery.

3. Designation —A washer shall be designated by name, type, size, number of the standard and material. For example, a punched washer, Type B of size 14 mm made of brass shall be designated as, Punched Washer B 14 IS 2016 — Brass’.

4. Dimensions (in mm)

4.1 Machined Washers

<i>Size (Diameter of Hole)</i>	<i>External Diameter</i>	<i>Thickness</i>	<i>For Bolt/ Screw Size</i>
1.7	4	0.3	M1.6
(2)	5	0.3	(M1.8)
2.2	5	0.3	M2
(2.4)	6	0.5	(M2.2)
2.7	6.5	0.5	M2.5
3.2	7	0.5	M3
(3.7)	8	0.8	(M3.5)
4.3	9	0.8	M4
(4.8)	10	1	(M4.5)
5.3	10	1	M5
6.4	12.5	1.6	M6
(7.4)	14	1.6	(M7)
8.4	17	1.6	M8
10.5	21	2	M10
13	24	2.5	M12
(15)	28	2.5	(M14)
17	30	3	M16

<i>Size (Diameter of Hole)</i>	<i>External Diameter</i>	<i>Thickness</i>	<i>For Bolt/ Screw Size</i>
(19)	34	3	(M18)
21	37	3	M20
(23)	39	3	(M22)
25	44	4	M24
(28)	50	4	(M27)
31	56	4	M30
(34)	60	5	(M33)
37	66	5	M36
(40)	72	6	(M39)
43	78	7	M42
(46)	85	7	(M45)
50	92	8	M48
(54)	98	8	(M52)
58	105	9	M56
(62)	110	9	(M60)
66	115	9	M64
(70)	120	10	(M68)
74	125	10	M72
(78)	135	10	(M76)
82	140	12	M80
(87)	145	12	(M85)
93	160	12	M90
(98)	165	12	(M95)
104	175	14	M100
(109)	180	14	(M105)
114	185	14	M110
(119)	200	14	(M115)
(124)	210	16	(M120)
129	220	16	M125
(134)	230	16	(M130)
144	240	18	M140
(155)	250	18	(M150)

SP 21 : 2005

4.2 Punched Washers, Type A, for Hexagonal Bolts and Screws

(Diameter Size of Hole)	External Diameter	Thickness	For Bolt/ Screw
1.8	4	0.4	M1.6
(2.1)	5	0.4	(M1.8)
2.4	5	0.4	M2
(2.6)	6	0.5	(M2.2)
2.9	6.5	0.5	M2.5
3.4	7	0.5	M3
(4)	8	0.8	(M3.5)
4.5	9	0.8	M4
(5)	10	1	(M4.5)
5.5	10	1	M5
6.6	12.5	1.6	M6
(7.6)	14	1.6	(M7)
9	17	1.6	M8
11	21	2	M10
14	24	2.5	M12
(16)	28	2.5	(M14)
18	30	3.15	M16
(20)	34	3.15	(M18)
22	37	3.15	M20
(24)	39	3.15	(M22)
26	44	4	M24
(30)	50	4	(M27)
33	56	4	M30
(36)	60	5	(M33)
39	66	5	M36
(42)	72	6	(M39)
45	78	6	M42
(48)	85	8	(M45)
52	92	8	M48

4.3 Punched Washers, Type B, for Round and Cheese Head Screws

(Diameter Size of Hole)	External Diameter	Thickness	For Bolt/ Screw
1.8	3.5	0.4	M1.6
(2.1)	3.5	0.4	(M1.8)
2.4	4.5	0.4	M2
(2.6)	4.5	0.4	(M2.2)
2.9	5	0.5	M2.5
3.4	6	0.5	M3
(4)	7	0.5	(M3.5)
4.5	8	0.8	M4
(5)	9	0.8	(M4.5)
5.5	9.5	1	M5
6.6	11	1.6	M6
(7.6)	13	1.6	(M7)
9	14	1.6	M8
11	18	2	M10
14	20	2.5	M12
(16)	24	2.5	(M14)
18	27	3.15	M16
(20)	30	3.15	(M18)
22	33	3.15	M20

Note 1– Sizes in brackets are of second preference.

Note 2– For detailed dimensions of machined washers, refer to Table 1 of the Standard.

5. Tolerances – For tolerances on diameters, thickness, concentricity, permissible deviations for parallelism and flatness for machined and punched washers, refer to precision and ordinary washers respectively as specified in IS 5369 : 1975*.

6. Finish – Plain washers shall be supplied in natural finish. At the request of purchasers, washers may be phosphate coated, nickel plated, tinned, galvanized, copper plated, cadmium plated, etc.

*General requirements of plain washers and lock washers (first revision).

For detailed information, refer to IS 2016 : 1967 Specification for Plain washers (first revision).

SUMMARY OF
IS 2155 : 1982 COLD FORGED SOLID STEEL RIVETS FOR HOT
CLOSING (6 TO 16 mm DIAMETER)
(First Revision)

1. Scope – Requirements of cold forged solid steel rivets for hot closing in the diameter range 6 to 16 mm, intended for general engineering purposes.

2. Dimensions

2.1 Range of Preferred Length – Diameter Combinations and Diameter of Rivet Holes –

<i>Diameter</i> mm	<i>Range of Preferred Lengths (See Note 2)</i> mm	<i>Diameter of Rivet Hole</i> mm
6	12-55	6.3
8	14-70	8.4
10	18-85	10.5
12	20-100	13
14	22-110	15
16	24-110	17

Note 1– The nominal diameter 14 mm is of second preference.

Note 2– Preferred lengths— 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 35, 38, 40, 42, 45, 48, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110 mm.

3. Tolerances –

+0.5 for $l \leq 10$;
+1.0 for $10 < l \leq 20$;
0
+1.5 for $l > 20$
–0

4. Tests

4.1 Shear Test – Shear strength shall not be less than 260 MPa.

4.2 Heat Soundness Test – Rivets shall withstand the test without exhibiting any sign of marking at the fillet between head and shank.

5. Designation – As an example, a snap head rivet of 6 mm diameter having a length of 30 mm shall be designated as Snap Head Rivet 6 × 30 IS 2155.

Note 1 – For detailed dimensions, refer to Tables 1 to 3 of the standard.

Note 2 – For general requirements for supply of rivets and their workmanship, limits of surface cracks on rivets, tolerances, Methods of tests, refer to IS 10102 : 1982 technical supply conditions for rivets.

For detailed Information, refer to IS 2155 : 1982 Specification for cold forged solid steel rivets for hot closing (6 to 16 mm diameter) (first revision).

SUMMARY OF
IS 2585 : 1968 BLACK SQUARE BOLTS AND NUTS
(DIAMETER RANGE 6 TO 39 mm) AND BLACK SQUARE SCREWS
(DIAMETER RANGE 6 TO 24 mm)

(First Revision)

1. Scope – Requirements for black square bolts and nuts in the diameter range 6 to 39 mm and black square screws in the diameter range 6 to 24 mm.

2. Requirements

3. Designation

2.1 Mechanical Properties – Bolts and screws shall conform to the property class 4.6 and those for nuts to property class as specified in the prescribed standard.

2.2 Grade – Shall conform to the black grade B as specified in prescribed

<i>Fastener</i>	<i>Thread Size</i>	<i>Length (mm)</i>	<i>Designation</i>
Square bolt with square nut	M10	30	Square bolt M10×30N — IS 2585
Square bolt only	M10	30	Square bolt M10×30 — IS 2585
Square screw	M10	30	Square screw M10×30 — IS 2585
Square nut	M10	-	Square nut M10 — IS 2585
Square bolt with hexagon nut	M10	30	Square bolt M10×30HN — IS 2585

4. Dimensions (in mm)

<i>Size</i>	<i>Nominal Diameter</i>	<i>Maximum Diameter</i>	<i>Minimum Diameter</i>	<i>Thickness of Head</i>	<i>Length of Head Bolt*</i>	<i>Length of Screw†</i>
M6	6	6.48	5.7	4	25-100	16-40
M8	8	8.9	7.64	5.5	30-120	16-50
M10	10	10.9	9.64	7	35-150	16-60
M12	12	13.1	11.57	8	40-300	20-80
(M14)	14	15.1	13.57	9	45-300	25-80
M16	16	17.1	15.57	10	50-300	25-80
(M18)	18	19.1	17.57	12	55-300	40-80
M20	20	21.5	19.48	13	60-400	45-80
(M22)	22	23.3	21.48	14	65-400	50-80
M24	24	25.3	23.48	15	70-400	55-80
(M27)	27	28.3	26.48	17	80-400	-
M30	30	31.3	29.48	19	90-400	-
(M33)	33	34.6	32.38	21	100-400	-
M36	36	37.6	35.38	23	110-400	-
(M39)	39	40.6	38.38	25	110-400	-

Note 1— Preferred lengths for bolts – 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, and 400.

Note 2— Preferred lengths for screws – 16, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75 and 80

Note 3— Sizes shown in brackets are of second preference.

Note 4— For detailed dimensions, refer to Tables 2 and 3 of the standard.

* Range of preferred lengths for bolts (bolts with lengths less than the minimum preferred lengths are to be treated as screws).

† Range of preferred lengths for screws.

For detailed information, refer to IS 2585 : 1968 Specification for black square bolts and nuts (diameter range 6 to 39 mm) and black square screws (diameter range 6 to 24 mm) (first revision).

SUMMARY OF
IS 2687 : 1991 CAP NUTS
(Second Revision)

1. Scope – Requirements for cap nuts of product Grade A in the size range M4 to M48 with coarse pitch and fine pitch threads.

2. Technical Supply Conditions

Tolerances	Product Grade	A		
Screw Threads	Tolerance	6H		
<i>Material</i>		<i>Steel</i>	<i>Stainless Steel</i>	<i>Non-ferrous Metal</i>
Mechanical Properties	Property Class	<M36 : 5 >M36: as agreed by purchaser and supplier	<36 : A1 – 50 >M36 : as agreed by purchaser and supplier	Brass or Al. Alloy
Finish		As produced or electroplated coatings Hot-dip galvanized coatings	Bright	Min 300 N/mm ² As produced

3. Dimensions – M4, M5, M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, and M48.

Note – For details See Table 1 of the standard.

4. Designation

4.1 The Cap Nuts shall be designated by the nomenclature, thread size and number of this standard.

4.1.1 A Cap Nut of thread size M8 shall be designated as – Cap Nut IS 2687 : M8

4.2 When stainless steel, brass or aluminium alloy is used for manufacture of cap nuts, the word 'Stainless Steel', 'Brass' and 'Aluminium' shall be added at the end of the designation.

4.2.1 A Cap Nut of thread size M10 and made of brass shall be designated as—Cap Nut IS 2687: M10 Brass

5. General Requirements

5.1 With respect to surface discontinuities, the cap nuts shall conform to IS 1367 (Part 10) : 1979.*

5.2 In respect of requirement not covered in this standard, the nuts shall conform to IS 1367 (Part 1) : 1980.

* Technical supply conditions for threaded steel fasteners – Part 10: Surface discontinuities – Nuts (*third revision*)

† Technical supply Part 1: General requirements for bolts, screws and stands (*third revision*)

Note1 – Refer to various Parts of IS 1367 Technical supply conditions for threaded steel fasteners.

Note2 – For references to corresponding Indian standards for tolerances, screw threads, mechanical properties and finish, refer to 3.

For detailed information, refer to IS 2687 : 1991. Specification for cap nuts (second revision)

SUMMARY OF
IS 2907 : 1998 NON-FERROUS RIVETS (1.6 TO 10 mm)
(First Revision)

1. Scope—Requirements of copper, tinned copper, brass and aluminium rivets in the diameter range of 1mm to 10mm, intended for general engineering purposes.

2. Dimensions

a) *Snap head rivets*—Nominal sizes 1, 1.6, 2, 2.5, 3, 4.0, 5, 6, 8 and 10 mm.

b) *Flat Counter sink head – (90° and 120°) rivets*
 Nomininal sizes 1, 1.6, 2, 2.5, 3, 4.0, 5, 6, 8 and 10 mm

c) *Flat head rivets*—Nominal sizes 1, 1.6, 2, 2.5, 3, 4.0, 5, 6, 8 and 10 mm

Note 1— For detailed dimensions refer to Table 1 to 3 of the standard.

Note 2 — For preferred diameter-length combinations refer to Table 4 of the standard.

3. Designation — Shall be designated by type head, nominal diameter, length, material and number of this standard. In case of countersunk head rivets. A

countersunk angle (90° or 120°) shall be included in the designation.

Example—A snap head rivet of 6 mm nominal diameter, having length of 30 mm and made of copper, shall be designated as snap head rivet 6 × 30 IS 2907 Copper.

4. Manufacture — Shall be made by cold forging and shall subsequently be appropriately head treated, if necessary.

5. Tests

5.1 Heat Soundness Test — Shall withstand the prescribed test without exhibiting any sign of cracking at the filled between head and the shank.

6. General Requirement

6.1 In respect of requirements not covered in this standard, the rivets shall conform to IS 10102 : 1982*

6.2 Limits of Surface cracks on rivets shall be in Technical supply conditino for rivels accordance with IS 10102 : 1982*.

Note *— For method of test refer to IS 10102 : 1982 Technical supply condition for rivets.

For detailed information, refer to IS 2907 : 1998 Specification for non-ferrous rivets (1.6 to 10 mm) (first revision).

SUMMARY OF
IS 2998 : 1982 COLD FORGED STEEL RIVETS FOR COLD
CLOSING (1 TO 16 MM DIAMETER)
(First Revision)

1. Scope – Requirements of cold forged rivets, for cold closing in the diameter range 1 to 16 mm, intended for general engineering purposes.

2. Material

- a) Grade 1 – Steel Class 1A, and
- b) Grade 2 – Steel 10C4 of prescribed standards.

3. Dimensions

3.1 Range of Preferred Length – Diameter Combinations and Diameter of Rivet Holes

<i>Diameter</i> mm	<i>Range of Preferred Lengths (See Note 2)</i> mm	<i>Diameter of Rivet Hole</i> mm
1	3-6	1.05
1.2	4-7	1.25
1.4	4-8	1.45
1.6	5-10	1.65
2	6-12	2.1
2.5	6-16	2.6
3	6-35	3.1
3.5	7-40	3.6
4	8-45	4.2
5	10-45	5.3
6	12-55	6.3
7	14-65	7.3
8	14-70	8.4
10	18-85	10.5
12	20-100	13
14	22-110	15
16	24-110	17

Note 1 – The nominal diameters 1.4, 3.5, 7 and 14 mm are of second preference.

Note 2 – Preferred Lengths 3, 4, 5, 6, 7, 8, 9, 10, 12, 14,

4. Tolerances

+0.5_{mm} for ≤ 10
—0

+1.0
—0 for $10 < l \leq 20$

+1.5
—0 for $l > 20$

5. Tests

5.1 Shear Test – Minimum shear strength shall be 230 MPa for Grade 1 and 200 MPa for Grade 2.

5.2 Hardness Test – Hardness on the head of rivet shall be for –

Grade 1 – 56 to 78 HRB (100 – 139 VPM)

Grade 2 – 48 to 73 HRB (91 – 127 VPM)

5.3 Head Soundness Test – Rivets shall withstand the test without exhibiting any sign of cracking at the fillet between head and shank.

6. Designation – As an example, a countersunk head rivet, with a countersunk angle of 90°, diameter 4 mm, length 24 mm and made from material Grade 2 shall be designated as Countersunk Head (90°) Rivet 4x24 Grade 2 IS 2998.

16, 18, 20, 22, 24, 26, 28, 30, 32, 35, 38, 40, 42, 45, 48, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105 and 110 mm.

Note 1 – For detailed dimensions, refer to Tables 1 to 4 of the standard.

Note 2 – For general requirements for supply of rivets and their workmanship, limits of surface crack on rivets, tolerances, refer to IS 10102 : 1982 Technical supply conditions of rivets.

Note 3 – For methods of tests, refer to IS 1500 : 1983 Method for Brinell hardness test for Metallic material (*second revision*) and IS 10102 : 1982 Technical supply conditions for rivets.

For detailed information, refer to IS 2998 : 1982 Specification for cold forged steel rivets for cold closing (1 to 16 mm diameter) (first revision).

SUMMARY OF

**IS 3063 : 1994 FASTENERS-SINGLE COIL RECTANGULAR
SECTION SPRING LOCK WASHERS**

(Second Revision)

1. Scope – Requirements for single coil rectangular section spring lock washers suitable for use with bolt/nut assemblies involving fasteners of property class 5.8 or less in the size range 2 to 100 mm.

2. Types

Type A – Spring lock washers with bent (deflected or tong) ends

Type B – Spring lock washers with flat (square ends)

3. Dimensions – Nominal sizes 2, 2.2, 2.5, 3, 4, 5, 6, 8, 10, 12, 16, 20, 24, 30, 36, 42, 48, 52, 56, 60, 64, 68, 72, 80, 90 and 100 mm.

Nominal sizes of non-preferred sizes are 3.5, 7, 14, 18, 22, 27, 33, 39 and 45 mm.

Note —For detailed dimensions and tolerances refer to Table 1A and 1B of the standard.

4. Material — The spring lock washers shall be made from suitable steel according to IS 4072 : 1975 * to meet the requirements specified

5. Finish— Natural – May be phosphate coated, nickel plated, electro-galvanized, copper plated or cadmium plated if specified.

6. Designation – The spring lock washers shall be designated by the nomenclature, type, nominal size, the number of this standard and the surface protection, if any.

Example – A spring lock washer of nominal size 10 mm, Type A and with phosphate coating shall be designated as follows : Spring Lock Washers A 10 - IS 3063 Phosphate coated

* Steel spring washers (*first revision*).

6.1 In case the spring washer is intended for use with LH thread, the designation shall be modified as follows: Spring Lock Washer LH-A 10 IS 3063 Phosphate coated

7. General Requirements

7.1 The flat faces of washers and the inner and outer peripheries shall be smooth and free from knurling, serrations, die-marks, deep scratches, etc, although slight feed roll marks shall be permissible.

7.2 Washers shall also be free from burrs, rust, pit marks, loose scale and defects that might affect their serviceability.

7.3 The clearances and angles of the cut ends shall be in such degree so that the washers do not cause lapping when they are completely compressed and shall not be liable to tangle or link together when in the free condition.

8. Tests

8.1 Hardness Test – Shall be HV 430 to 530

8.2 Permanent Set Test — Free height of washers after release of load shall not be less than the values specified in Table 2A and 2B of the standard.

8.3 Permanent Load Test – Shall not crack or fracture.

8.4 Twist Test – The washer shall show no sign of fracture.

Note 1– For test detailed, refer to **11** of the standard.

Note 2– For spring force test, refer to Annex A of the standard.

For detailed information, refer to IS 3063 : 1994 Specification for fasteners-single coil rectangular section spring lock washers (second revision).

SUMMARY OF

IS 3121 : 1981 RIGGING SCREWS AND STRETCHING SCREWS

(First Revision)

1. Scope – Requirements regarding materials, components, dimensions, finishing and tests for rigging screws and stretching screws (double-ended and single-ended) of the following nominal size :

- a) Rigging screws – M12 to M90
- b) Stretching screws – M6 to M52

2. Dimensions**2.1 Rigging Screws (With Screwed Eye at Both Ends):**

Nom. Siz (Dia of Screw)	Length		Proof Load kN
	Closed/mm	Open/ mm	
M12	330	525	10.0
M16	370	550	18.0
M20	400	570	28.0
M24	475	700	36.0
M27	550	825	44.0
M30	550	825	63.0
M33	600	875	75.0
M36	600	875	86.0
M39	660	960	100.0
M45	700	960	112.0
M52	750	1 000	144.0
M56	775	1 025	194.0
M60	800	1 050	214.0
M64	1 070	1 450	286.0
M68	1 120	1 590	342.0
M75	1 270	1 700	400.0
M80	1 360	1 760	500.0
M90	1 440	1 860	624.0

2.2 Stretching Screws

Nominal SizeLoad (Dia of Screw)	Body Length mm	Proof kN
M6	100	2.0
M8	125	3.0
M10	160	6.0
M12	200	9.0
M14	225	12.0
M16	250	15.2
M20	315	22.4
M22	355	32.4
M24	400	40.0
M30	450	63.0
M36	450	90.0
M45	450	142.0
M52	450	190.0

Note 1— Safe working load = 1/2 proof load

Note 2— Tolerance ± 5 percent on all dimensions

Note 3— For detailed dimensions and shapes of riggings crews, tubular body, screwed eye, screwed fork, screwed stud eye and stretching screws (open body, screw eyes and swivel eye), refer to Tables 1 to 6 of the Standard.

3. Requirements

3.1 Galvanizing – All components of assembled stretching screw shall be galvanized as per IS 4759 : 1996

All screw threads shall be 'brush' or 'spun' galvanized.

3.2 Workmanship

3.2.1 Rigging screw – The tubular body shall be neatly and clearly made and finished. The screwed eye, screwed fork and screwed stud eye shall be cleanly forged and finished. The thimble, when in place in the fork, shall be capable of free movement.

3.2.2 Stretching screw – The body, the screw eye and the swivel eye shall be solid forging without weld, neatly and cleanly made and finished.

3.2.3 Each component of the completed rigging screw or stretching screw shall be free from any visible flaw or defect.

4. Tests

4.1 Proof Testing – Each screw shall withstand the proof load without any sign of defect.

4.2 Tests for Galvanizing : Shall be tested in accordance with IS 2633 : 1986⁺ and IS 6745 : 1972⁺ if specified.

* Methods of testing uniformity of coating on fine coated articles (*second revision*).

⁺ Methods for determination of weight of zinc coating on zinc coated iron and steel articles.

* Hot dip zinc coatings on structural steel and other allied products (*third revision*).

For detailed information, refer to IS 3121 : 1981 Specification for ringging screws and stretching screws (first revision).

SUMMARY OF
IS 3468 : 1991 PIPE NUTS
(Second Revision)

1. Scope – Requirements for pipe nuts in the size range G 1/8 to G6.

Note 1 – For detailed dimension *see* Table 1 of the standard.

Note 2 – Sizes shown within brackets are of second preference.

2. Specifications

3. Dimensions—Thread sizes

$G \frac{1}{4}$, $G \frac{3}{8}$, $G \frac{1}{2}$, $G \frac{5}{8}$, $G \frac{3}{4}$, $G \frac{7}{8}$, G1, $(G1 \frac{1}{8})$, $(G1 \frac{1}{4})$
 $(G1 \frac{1}{2})$, $(G1 \frac{3}{4})$, G2, $(G2 \frac{1}{4})$, $(G2 \frac{1}{2})$, G3, G4,
 G5 and G6.

	Product grade B		
Tolerances	Indian Standard IS 1367 (Part 2) : 1979 *		
	Type : Pipe threads		
Threads	Indian Standard IS 2643		
	Steel	Stainless Steel	Brass
Mechanical properties	Property Class 14 H	A2-50	Minimum tensile strength 300 MPa
	Indian Standard IS 1367 (Part 7)	IS 1367 (Part 14) ⁺	

3. Designation

3.1 The pipe nuts shall be designated by nomenclature, thread size and number of this standard.

3.1.1 A pipe nut of thread size G6 shall be designated as—Pipe Nut G 6 – IS 3468

3.2 When the pipe nuts are manufactured from stainless steel or brass, the word 'stainless steel' or 'Brass' shall be added at the end of the designation.

3.2.1 A pipe nut of thread size G 3/8 and made from brass shall be designated as
 – Pipe Nut G 3/8 – IS 3468-Brass

4. General Requirements

4.1 With respect to surface discontinuities, the pipe nuts shall conform to IS 1367 (Part 10).

4.2 In respect of requirements not covered in this standard, the nuts shall conform to IS 1367 (Part 1) :

* Technical supply conditions for threaded steel fasteners
(Various Parts)

⁺ Dimension, tolerances and designation for pipe threads where pressure – tight joints are not made on the threads.

⁺ As per sheet attached

[†] As per sheet attached

For detailed information, refer to IS 3468 : 1991 Specification for pipe nuts (second revision).

SUMMARY OF
IS 3757 : 1985 HIGH STRENGTH STRUCTURAL BOLTS
(Second Revision)

1. Scope – Requirements for large series hexagon, high strength structural steel bolts in property classes 8.8 and 10.9 and in the size range M16 to M36 with short thread lengths suitable for use in both friction-type and bearing-type structural steel joints. Bolts to this standard when matched with the appropriate nuts have been designed to provide an assembly with a high level of assurance against failure by thread stripping on overtightening.

Note – Attention is drawn to the importance of ensuring that the bolts are correctly used if satisfactory results are to be obtained.

2. Dimensions and Tolerance

2.1 Thread sizes shall be M16, M20, (M22), M24, (M27), M30 and M36.

Note 1 – For detailed dimensions refer to Table 1 of the standard.

Note 2 – Sizes shown in brackets are of second preference.

2.2 Recommended length size combinations shall be as given in Table 2 of the standard.

2.3 Threads shall conform to tolerance class 6g of IS 4218 (Part 6) *

* ISO Metric screw thread

3. Grade – The bolts shall be of product grade C as specified in IS 1367(Part 2) *

4. Mechanical Properties – The bolts shall as specified in prescribed standard.

5. Finish – Shall be in dull black heat treated condition with a residual coating of light oil.

Where property class 8.8 bolts are required to be hot dip galvanized they shall be galvanized in accordance with the requirements of IS 1367(Part 13) +

Note – Bolts of property class 10.9 should not be hot dip galvanized since this may cause hydrogen embrittlement.

6 General Requirements

6.1 In regard to permissible surface discontinuities, the bolts shall conform to prescribed standards.

6.2 In regard to requirements not covered in the standard, the bolts shall conform to IS 1367(Part I) +

* As per sheet

+ Attached

+ For commercial bolts and nuts (diameter range 1 to 52 mm)
(first revision)

For detailed information, refer to IS 3757 : 1985 Specification for high strength structural bolts (second revision).

SUMMARY OF
IS 4762 : 1984 WORM DRIVE CLAMPS FOR GENERAL PURPOSE
(First Revision)

1. Scope – Requirements for worm drive hose clamps for general purposes.

2. Size – 12, 16, 20, 22, 25, 28, 30, 35, 38, 40, 45, 55, 60, 65, 70, 75, 80, 90, 100, 110, 115, 120, 130, 140, 145, 150 and 160.

Note —For detailed dimensions refer to Table 1 of the standard.

3. Materials – Shall be selected at the manufacturer's discretion provided that the finished clamps meet the test requirements.

4. Manufacture

4.1 Screw – Shall be held captive in the clamp housing

4.2 Band – Shall have a thread form commencing at the free end and extending for a length sufficient to enable the clamp to be tightened on to the smallest diameter of component within the working range for which it is designed.

4.3 Housing – Shall be readily removable from the band.

5. Designation – Shall be designated by nomenclature, size and number of this standard.

5.1 A hose clamp of size 25 mm shall be designated as – Hose clamp 25 – IS 4762.

6. General Requirements

6.1 When the loop is formed, the screw shall be held firmly in engagement with the band during tightening and the clamp shall be capable of being decreased in diameter by turning the screw in clockwise direction and increased in diameter by turning the screw in anti-clockwise direction.

6.2 After expanding until the band is disconnected from the screw, it shall be to open clamps of size 35 and above to provide a gap equal to the largest diameter of the hose for which the clamp is designed and to permit easy fitting and removal of the clamp by passing the clamp over the hose in position without disturbing any connections.

6.3 The clamp shall be so designed that when tightened on the hose, it shall remain positively secured in position without the need for any additional locking device and in firm engagement with the hose on which it is fitted.

7. Finish – Shall be smooth and free from burrs and sharp edges. Clamps other than those manufactured from corrosion-resistant materials shall be protected against corrosion by electroplating as specified.

8. Tests

8.1 Free Turning Torque Test – Shall be conducted to ensure smooth action of the lubricated clamp in its free-turning state.

8.2 Torque Test — Shall reveal no sign of permanent distortion of the housing nor damage detrimental to the efficient functioning of the clamp when tightened to 75 percent of torque load specified. Also, the torque load at permanent distortion or failure shall be in excess of the appropriate value specified.

8.3 Fatigue Torque Loading Test – These shall be no distortion or permanent deformation of the clamp as a whole when tested as prescribed.

8.4 Hydraulic Pressure Test – At leakage or other failure, the pressure shall not be less than the appropriate value specified.

Note — For methods of tests, refer to Table 1 of the standard.

For detailed information, refer to IS 4762 : 1984 Specification for worm drive clamps for general purposes (first revision).

SUMMARY OF
**IS 5369 : 1975 GENERAL REQUIREMENTS FOR PLAIN WASHERS
AND LOCK WASHERS**
(First Revision)

1. Scope — General requirements and permissible deviation for plain washers, lock washers and similar parts.

2. Grades— Precision and ordinary.

3. Requirements

3.1 Finish —Natural. May be phosphate-coated, nickel plated, tinned, galvanized, copper-plated or cadmium-coated.

3.2 Shall be free from cracks, burrs, pits and other defects. All sharp edges shall be removed.

Note— For permissible deviation on main dimensions and concentricity of the hole with respect to outside diameter of precision grade washers as well as of ordinary grade washers, refer to Tables 1 to 4 of the standard.

For detailed information, refer to IS 5369 : 1975 Specification for general requirements for plain washers and lock washers (first revision)

SUMMARY OF
IS 5372 : 1975 TAPER WASHERS FOR CHANNELS (ISMC)
(First Revision)

1. Scope—Requirements for taper washers for use with Indian Standard Medium Weight Channels (ISMC) with bolts in diameter range of 10 to 39 mm.

2. Dimensions (in mm)

Nominal Size (Diameter of Hole)	$L \times B$ (See Note 1)	Thickness		For Bolt Size
		Thin End	Thick End	
11	22 × 22	2	4.3	M10
14	26 × 30	2.5	5.7	M12
18	32 × 36	3	6.8	M16
22	40 × 44	3.5	8.1	M20
(24)	44 × 50	4	9.2	(M22)
26	56 × 56	4	9.9	M24
(30)	56 × 56	4	9.9	(M27)
33	62 × 62	4	10.5	M30
(36)	68 × 68	4	11.2	(M33)
39	75 × 75	4	11.9	M36
(42)	80 × 80	4	12.4	(M39)

For detailed information, refer to IS 5372 : 1975 Specification for taper washers for channels (ISMC) (first revision).

Note 1— $L \times B$ are dimensions for taper washers in plan.

Note 2— Sizes shown in brackets are of second preference.

Note 3— For detailed dimensions, refer to Table 1 of the standard.

3. Grade— ‘Ordinary’ grade of IS 5369 : 1975*

4. Designation— Shall be designated by the name, size and number of the standard. For example, a taper washer of nominal size 18 mm shall be designated as ‘Taper Washer 18 - IS : 5372’.

* General requirements for plain washers and lock washers (first revision).

SUMMARY OF IS 5373 : 1969 SQUARE WASHERS FOR WOOD FASTENINGS

1. Scope – Requirements for square washers intended for use in wood fastenings with bolts in diameter range 10 to 52 mm.				39	110	8	M36
				(42)	125	8	(M39)
2. Dimensions (in mm)				45	135	8	M42
<i>Nominal Size</i>	<i>Sides</i>	<i>Thickness</i>	<i>For Bolt Size</i>	48	140	8	M45
<i>(Dia of Hole)</i>				52	150	10	M48
				56	160	10	M52
11.5	30	3	M10	Note 2 – Sizes shown in brackets are of second preference. 3. Designation – As an example, a square washer for wood fastenings having a nominal size of 18 mm shall be designated as 'Square Washer18 – IS 5373'.			
14	40	4	M12				
18	50	5	M16				
23	60	5	M20				
24	70	6	M22				
27	80	6	M24				
(30)	90	6	(M27)				
33	95	6	M30				
(36)	100	6	(M33)				

Note— Other Requirements not covered in the standard shall conform to IS : 5369-1975 General requirements for plain washers and lock washers (*first revision*).

For detailed information, refer to IS 5373 : 1969 Specification for square washers for wood fastenings.

SUMMARY OF
IS 5374 : 1975 TAPER WASHERS FOR I-BEAMS (ISMB)
(First Revision)

1. Scope—Requirements for taper washers for use with Indian Standard Medium Weight Beams (ISMB) with bolts of 10 mm to 39 mm diameter.

2. Dimensions (in mm)

Nominal Size (Diameter of Hole)	$L \times B$ (See Note 1)	Thickness		For Bolt Size
		Thin End	Thick End	
11	22 × 22	1.5	4.6	M10
14	26 × 30	2	6.2	M12
18	32 × 36	2.5	7.6	M16
22	40 × 44	3	9.2	M20
(24)	44 × 50	3	10	(M22)
26	56 × 56	3	10.8	M24
(30)	56 × 56	3	10.8	(M27)
33	62 × 62	3	11.7	M30
(36)	68 × 68	3	12.6	(M33)
39	75 × 75	3	13.6	M36
(42)	80 × 80	3	14.2	(M39)

Note 1— $L \times B$ are dimensions for taper washers in plan

Note 2— Sizes shown in brackets are of second preference.

Note 3— For detailed dimensions, refer to Table 2 of the Standard.

3. Grade— ‘Ordinary’ grade of IS : 5369-1975 *

4. Designation— As an example, a taper washer of nominal size 18 mm shall be designated as ‘Taper Washer 18 IS : 5374.

* General requirements for plain washers and lock washers
(first revision).

For detailed information, refer to IS 5374 : 1975 Specification for taper washers for I-beams (ISMB) (first revision).

SUMMARY OF
IS 5624 : 1993 FOUNDATION BOLTS
(First Revision)

1. Scope – Requirements for foundation bolts in the size range M8 to M72.

2. Technical Supply Conditions

3. Dimensions – M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, M56, M64, and M72

3.1 Dimensions and Preferred – See Table 1 of the standard Length-Dia Combination

Material		Steel
Thread	Tolerances	8g
	Indian Standards	IS 4218 (Part 5) : 1979 * IS 4218 (Part 6) : 1978 +
Mechanical Properties	Property Class	4.6
	Indian Standard	IS 1367 (Part 3) : 1991 ++
Tolerance	Produce Grade	C
	Indian Standard	IS 1367 (Part 2) : 1979 +
		As produced or Hot-dip galvanized, IS 1367** (Part 13): 1983, + if agreed between supplier and purchaser.

5. Designation – Shall be designated by the nomenclature, thread size, length and number of this standard.

Example – A foundation bolt of thread size M20 and length 200 mm shall be designated as – Foundation Bolt M20 × 200 IS 5624

5.1 When foundation bolts are required/supplied with hexagon nuts conforming to IS 1363 (Part 3)[§] letter 'N' shall be added after length, in the designation.

Example – A foundation bolt of thread size M20, length 200 mm supplied with hexagon nut shall be designated as – Foundation Bolt M20 × 200 N IS 5624

a) Hexagon head bolts screws and nuts of product grade C.

Note — For some typical shank forms and their dimensions see Annex A of the standard.

5.2 If foundation bolts are to be hot dip galvanized the word 'GALV' shall be added at the end of the designation.

Example – A foundation bolt of thread size M20, length 200 mm and hot dip galvanized shall be designated as – Foundation Bolt M20 × 200 IS 5624 GALV

5.3 In addition, type of the shank form required may also be indicated with the designation. However, if no shank form is specified in the designation it shall be at the discretion of the manufacturer.

6. General Requirements – In respect of requirements not covered in this standard, the nuts shall conform to IS 1367 (Part 1)[§]

+ Technical supply conditions for threaded steel fasteners.

* ISO Metric Screw Threads.

§ Hexagon head bolts, screws and nuts of product grade C-Part 3: Hexagon Nuts (size range M5 to M64) (third revision)

For detailed information, refer to IS 5624 : 1993 Specification for foundation bolts (first revision)

SUMMARY OF IS 6113 : 1970 ALUMINIUM FASTENERS FOR BUILDING PURPOSES

1. Scope — Requirements for J-type hook bolts and nuts, mushroom head seam bolts and nuts, and washers of aluminium for roofing sheets.

2. Requirements

2.1 Material — Aluminium and aluminium alloys, as specified in the standard.

2.2 Grade — Black Grade B.

3. Dimensions (in mm)

3.1 J-Type Hook Bolts

<i>Size</i>	<i>Nominal Dia</i>	<i>Thread Length, Min</i>	<i>Size of Nut</i>	<i>Preferred Lengths</i>
M6	6	25	M6	70, 80, 90, 100, 110, 120, 130, 140 and 150
M8	8	25	M8	70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190 and 200
M10	10	25	M10	70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190 and 200

3.2 Mushroom Head Seam Bolts and Nuts —

<i>Size</i>	<i>Nominal Dia</i>	<i>Thickness of, Head (Nom)</i>	<i>Size of Nut</i>	<i>Preferred Lengths</i>
M5	5	3	M5	12, 14, 16, 20, 25, 30, 35, 40, 45 and 50
M6	6	4	M6	12, 14, 16, 20, 25, 30, 35, 40, 45, 50, 55, 60, 70, 80, 90 and 100
M8	8	5	M8	12, 14, 16, 20, 25, 30, 35, 40, 45, 50, 55, 60, 70, 80, 90 and 100
M10	10	6	M10	12, 14, 16, 20, 25, 30, 35, 40, 45 and 50

3.3 Washers — Types A, B, C and D. Hole diameter 5.8, 7, 10 and 12 for size 5, 6, 8 and 10 respectively.

Note — For detailed dimensions of bolts, nuts and washers, refer to Tables 1 to 3 of the standard

4. Designation — As an example, seam bolt size M8, length 20 mm and material HG 19 shall be designated as 'Seam Bolts M8 x 20, IS 6113— HG 19'.

Note — For other requirements in regard to manufacture tolerance, test etc of bolts and nuts, refer to the prescribed standards

For detailed information, refer to IS 6113 : 1970 Specification for aluminium fasteners for building purposes.

SUMMARY OF
IS 6610 : 1972 HEAVY WASHERS FOR STEEL STRUCTURES

- 1. Scope** – Requirements for heavy washers for use in steel structures in the diameter range 14 to 42 mm. **2. Dimensions (in mm)**

<i>Nominal Size (Diameter)</i>	<i>Tolerance on Size</i>	<i>Outer Dia</i>	<i>Tolerance on Outer Dia</i>	<i>Thickness</i>	<i>Suitable for Bolt Size</i>
14	+0.43	24	-1.30	8	M12
18	+0.43	30	-1.30	8	M16
22	+0.52	37	-1.60	8	M20
24	+0.52	39	-1.60	8	M22
26	+0.52	44	-1.60	8	M24
30	+0.52	50	-1.60	8	M27
33	+0.62	56	-1.90	8	M30
36	+0.62	60	-1.90	8	M33
39	+0.62	66	-1.90	8	M36
42	+0.62	72	-1.90	8	M39

- 3. Material** – Shall be made from steel.

- 4. Designation** – By nominal size and the number of this standard. *Example* – Washer 14 IS 6610.

Note – Other requirements of washers shall be as specified in IS 5369 : 1975 General requirements for plain washers and lock washers (*first revision*).

For detailed information, refer to IS 6610 : 1972 Specification for heavy washers for steel structures.

SUMMARY OF

IS 6623 : 2004 HIGH STRENGTH STRUCTURAL NUTS

(Second Revision)

1. Scope – Requirements for large series hexagon, high strength structural steel nuts in property classes 8 and 10 and in the size range M16 to M36 suitable for use in both friction-type and bearing-type structural steel connections. Nuts to this standard when matched with the appropriate bolts have been designed to provide an assembly with a high level of assurance against failure by thread stripping on overtightening.

Note – Attention is drawn to the importance of ensuring that the nuts are correctly used if satisfactory results are to be obtained.

2. Dimensions and Tolerances

2.1 Thread Sizes – M12, M16, M20, (M22), M24, (M27), M30 and M36

Note 1 – Sizes shown in brackets are of second preference

Note 2 – For detailed dimensions refer to Table 1 of the standard

2.2 Threads of the nuts shall be in accordance to IS 4218 [Parts (1, 2, 3 and 4)]

3. Grade – Unless otherwise specified the nuts shall be of product grade B as specified in IS 1367 (Part 2).

The tolerances on the threads shall conform to tolerance 6H of IS 14962 [Part (1, 2 and 3) and in case of hot dip galvanized with the tolerances shall be in accordance with IS 14962 [(Part 4 and 5)]

* Technical supply conditions for threaded steel fasteners (various parts)

+ ISO metric Threads

4. Mechanical Properties – Shall be of property class B 10 as per the specified standard, except that all nuts shall be or C hardened and then tempered at a temperature of at least 425°C and the proof load and hardness values as given in Table 2 of the standard.

5. Finish : Shall be supplied in the dull black heat-treated condition with a residual coating of light oil.

6.1 Where property class 10 nuts are required to be hot-dip galvanized, they shall be galvanized in accordance with the requirements of IS : 1367 (Part 13)-1983. * The hot-dip galvanized nuts shall be subjected to the anti-seizing test.

6. Requirements —In regard to permissible surface discontinuities, the nuts shall conform to IS 1367 (Part 10) :2002 *

6.1 In regard to requirements not covered in the standard, the nuts shall conform to IS 1367 (Part 1) :2002*

6.2 The high strength structural bolts to be used with these nuts shall conform to the requirements of IS : 3757**

7. Designation — Shall be designated by name, size, the number of this standard and the property class identification symbol 8s or 10s. In case of hot dip galvanized nuts the word galvanized shall be added to the designation.

Example – A high strength structural nut of size M24, property class 8 and galvanized shall be designated as — High Strength Structural Nut M24 IS 6623—8S Galvanized

** High strength structural bolts (second revision)

For detailed information, refer to IS 6623 : 2004 Specification for high strength structural nuts (second revision).

SUMMARY OF

IS 6639 : 1972 HEXAGON BOLTS FOR STEEL STRUCTURES

1. Scope—Requirements for hexagon bolts in the size range 12 to 39 mm for steel structures.

2. Dimensions (in mm)

Note 1—For other requirements of bolts, refer to IS 1367 (Part 1) and IS 14394** and for requirements of hexagon nuts used with bolts, refer to IS 1363 (Part 3).

Note 2—For approximate weight of bolts with nuts, refer to Appendix A of the standard for guidance.

Size	Diameter			Distance Between Parallel Side, Nom	Length of Bolts Nom (see Note 1)
	Nom	Max	Min		
M12	12	12.70	11.30	19	30-120
M16	16	16.70	15.30	24	35-150
M20	20	20.84	19.16	30	40-175
(M22)	22	22.84	21.16	32	40-200
M24	24	24.84	23.16	36	45-200
(M27)	27	27.84	26.16	41	60-200
M30	30	30.84	29.16	46	80-200
(M33)	33	34.00	32.00	50	100-200
M36	36	37.00	35.00	55	100-200
(M39)	39	40.00	38.00	60	110-200

Note 1— Range of preferred lengths.

Note 2— Preferred lengths - 30, 35, 40, 45, 50, 55, 60, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195 and 200.

Note 3— Sizes shown in brackets are of second preference.

Note 4— For detailed dimensions, refer to Table 1 and for tolerance, refer to Fig. 1 of the Standard.

Note 5— For clamping lengths for bolts, refer to Table 2 of the Standard.

3. Requirements

3.1 Mechanical Properties— Shall conform to property class 4.6 or 5.6 of IS 1367(Part 3) : 1991*. The bolts shall withstand a minimum shear stress of 260 MPa (for bolt testing purposes and is not related to actual design stresses).

3.2 Grade— Product grade C according to IS 1367(Part 2) : 1979 *

(various Parts)

4. Designation— By size, length, number of the standard and property class.

Example—Hex Bolt M12 × 30— IS 6639—4.6

+ Hexagon head bolts, screws and nuts of product grade C.

** Industrial Hexagon nut of product grade C Hot dip galvanized (size range M12 to M36 fasteners)

* Technical supply conditions for threaded fasteners

For detailed information, refer to IS 6639 : 1972 Specification for hexagon bolts for steel structures.

SUMMARY OF
IS 6649 : 1985 HARDENED AND TEMPERED WASHERS FOR HIGH
STRENGTH STRUCTURAL BOLTS AND NUTS
(First Revision)

1. Scope – Requirements for through hardened and tempered steel washers intended for assembly with large series hexagon, high strength structural bolts and nuts in the size range M16 to M36.

2. Types

- Type A – Plain hole circular washers.
- Type B – Square taper washers for use with channels (6° taper)
- Type C – Square taper washers for use with I-beams (8° taper)

3. Dimensions and Tolerances—

3.1 Nominal Size (Thread Size of Associated Bolt)

M16, M20, (M22), M24, (M27), M30 and M36.
 See Tables 1 and 2 of the standard.

3.2 The washers shall be flat with a maximum deviation not exceeding 0.25 mm from the straightedge laid along a line passing through the centre of the hole.

3.3 The hole of the washer shall be concentric with the outside dimensions within 0.50 mm.

3.4 When circular or square taper washers are required to be clipped to provide clearance, the clipped edge shall not be closer to the centre of the washer than 0.9 of the bolt diameter. In case of square taper washers, these may be clipped along the thin edge parallel to the opposite edge.

4. Grade – Shall conform to IS 5369 : 1975⁺.

5. Material – The washers shall be made from 45C8 steel as perscribed.

6. Hardness – Shall be between 35 to 45 HRC. The minimum for hot-dip galvanized washers shall be 26 HRC.

7. Finish – Shall be supplied in the dull black heat-treated condition with a residual coating of light oil.

7.1 Where washers are required to be hot-dip galvanized, they shall conform to the prescribed standard except that the minimum value of average mass of coating shall be 300 g/m².

8. General Requirements – In regard to requirements not covered in the standard, the washers shall conform to the requirements specified for ordinary washers according to IS 5369 : 1975.

8.1 The high strength structural bolts to be used with these washers shall conform to the requirements of IS 3757:1985.[#]

8.2 The high strength structural nuts to be used with these washers shall conform to the requirements of IS 6623:1985.*

9. Designation – Shall be designated by the word 'washer', nominal size, type and the number of this standard. In case of hot-dip galvanized washers the word galvanized' shall be added to the designation.

Examples – A plain hole circular washer of nominal size M24 conforming to this standard and galvanized shall be designated as – Washer M24A – IS 6649 galvanized.

9.1 A square taper washer of 6° taper for use with channels, of nominal size M24 conforming to this standard and galvanized shall be designated as – Washer M24B– IS 6649 galvanized.

[#] High strength structural bolts (*second revision*).

* High strength structural nuts (*first revision*).

⁺ General requirements for plain washers and lock washers (*first revision*)

For detailed information, refer to IS 6649 : 1985 Specification for hardened and tempered washers for high strength structural bolts and nuts (first revision).

SUMMARY OF

IS 6733 : 1972 WALL AND ROOFING NAILS

1. Scope – Requirements of wall and roofing nails.

2. Dimensions (in mm)

Type of Nail	Size (Dia of Shank)	Dia of Head	Length	Approx No. of Nails/kg
Wall nail	4.00	8.0	30	260
	4.50	9.0	40	190
Wall nail	5.60	13.4	50	95
			60	80
	6.30	15.1	70	60
			80	50

2.1 Maximum eccentricity and ovality of the centre of the nail head from axis of shank shall be 14 percent of shank diameter, *Max.*

Note 1— For tolerance, refer to Table 1 of *the standard*.

Note 2— Length of tapered portion (pointed at bottom) of the nail shall be 1 to 1.5 times the diameter of shank.

3. Designation – Shall be designated by size, length and the number of the standard.

Example— Wall nail 4×30 — IS 6733

Roofing nail 5.6×50 — IS 6733

4. General Requirements – Nails shall be machine made and may have die marks and feeding knife marks on shank. They shall be uniformly circular in section, straight, free from wastes. Wall nails shall have sharp points and roofing nails, a chisel point. The heads shall be properly formed and concentric with shanks.

5. Finish – Plain finished.

6. Test

6.1 Bend Test – Nails when cold shall not break or crack when doubled over either by pressure or by blows from a hammer until the internal radius is equal to the diameter of the test piece

For detailed information, refer to IS 6733 : 1972 Specification for wall and roofing nails.

SUMMARY OF
**IS 6736 : 1972 SLOTTED RAISED COUNTERSUNK HEAD
WOOD SCREWS**

1. Scope – Requirements for slotted raised countersunk head wood screws.

2. Dimensions (in mm)

No. Screw	Dia of Unthreaded shank			Range of Preferred Lengths (see Note 1)
Designation)	Nom	Max	Min	
0	1.52	1.55	1.47	8-12
1	1.78	1.85	1.70	8-12
2	2.08	2.16	1.98	8-12
3	2.39	2.46	2.29	8-12
4	2.74	2.87	2.64	12-25
5	3.10	3.23	2.97	12-30
6	3.45	3.58	3.33	12-40
7	3.81	3.94	3.68	12-40
8	4.17	4.29	4.04	12-75
9	4.52	4.65	4.39	15-75
10	4.88	5.00	4.72	15-75

12	5.59	5.72	5.38	20-75
14	6.30	6.43	6.05	25-75
16	7.01	7.14	6.76	30-75
18	7.72	7.85	7.47	30-75
20	8.43	8.56	8.18	30-75
24	9.86	9.98	9.60	30-75

Note 1– Preferred lengths - 8, 10, 12, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70 and 75mm

Note 2– Threaded portion of the screw shall nearly be equal to 2/3 times the total length of the screw.

Note 3– Dia of head (Max) shall be 2 times the diameter of unthreaded shank (Nom).

Note 4– For detailed dimensions, refer to Table 1 of the standard.

Note 5– For tolerances, see Fig 1 of the standard.

3. Designation – As an example, a slotted raised countersunk head wood screw No. 8, length 20 mm and made of steel shall be designated as 'Wood Screw No. 8 × 20 IS 6736 Steel.

Note – In regard to the requirements not covered in the standard, Refer to IS 451 : 1999 Technical supply conditions for wood screws (third revision).

For detailed information, refer to IS 6736 : 1972 Specification for slotted raised countersunk head wood screws.

SUMMARY OF

IS 6739 : 1972 SLOTTED ROUND HEAD WOOD SCREWS

1. Scope – Requirements for slotted round head wood screws.

2. Dimensions (in mm)

No. Screw Designation)	Dia of Unthreaded Shank			Range of Preferred Lengths (See Note 1)
	Nom	Max	Min	
0	1.52	1.55	1.47	8-12
1	1.78	1.85	1.70	8-12
2	2.08	2.16	1.98	8-12
3	2.39	2.46	2.29	8-12
4	2.74	2.87	2.64	12-25
5	3.10	3.23	2.97	12-30
6	3.45	3.58	3.33	12-40
7	3.81	3.94	3.68	12-40
8	4.17	4.29	4.04	12-75
9	4.52	4.65	4.39	15-75
10	4.88	5.00	4.72	15-75

12	5.59	5.72	5.38	20-75
14	6.30	6.43	6.05	25-75
16	7.01	7.14	6.76	30-75
18	7.72	7.85	7.47	30-75
20	8.43	8.56	8.18	30-75
24	9.86	9.98	9.60	30-75

Note 1— Preferred lengths - 8, 10, 12, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70 and 75 mm

Note 2— Threaded portion of the screw shall nearly be equal to 2/3 times the total length of the screw.

Note 3— Dia of head (*Max*) shall be 2 times the diameter of unthreaded shank (*Nom*).

Note 4— For detailed dimensions, refer to Table 1 of the standard.

Note 5— For tolerances, see Fig 1 of the standard.

3. Designation – As an example, a slotted round head wood screw No. 8, length 20 mm and made of steel shall be designated as 'Wood Screw No. 8×20 – IS 6739 Steel'.

Note – In regard to the requirements not covered in the standard, Refer to IS 451 : 1999. Technical supply conditions for wood screws (*third revision*).

For detailed information, refer to IS 6739 : 1972 Specification for slotted round head wood screws.

SUMMARY OF

IS 6760 : 1972 SLOTTED COUNTERSUNK HEAD WOOD SCREWS

1. Scope – Requirements for slotted countersunk head wood screws.

2. Dimensions (in mm)

No. (Screw Designation)	Dia of Unthreaded Shank			Range of Preferred Lengths (See Note 1)
	Nom	Max	Min	
0	1.52	1.55	1.47	8-12
1	1.78	1.85	1.70	8-12
2	2.08	2.16	1.98	8-12
3	2.39	2.46	2.29	8-12
4	2.74	2.87	2.64	12-25
5	3.10	3.23	2.97	12-30
6	3.45	3.58	3.33	12-40
7	3.81	3.94	3.68	12-40
8	4.17	4.29	4.04	12-75
9	4.52	4.65	4.39	15-75
10	4.88	5.00	4.72	15-75

12	5.59	5.72	5.38	20-100
14	6.30	6.43	6.05	30-100
16	7.01	7.14	6.76	30-200
18	7.72	7.85	7.47	30-200
20	8.43	8.56	8.18	30-200
24	9.86	9.98	9.60	30-200

Note 1— Preferred lengths - 8, 10, 12, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 110, 125, 150, 175 and 200 mm

Note 2 – Threaded portion of the screw shall nearly be equal to 2/3 times the total length of the screw.

Note 3 – Dia of head (*Max*) shall be 2 times the diameter of unthreaded shank (*Nom*).

Note 4 – For detailed dimensions, refer to Table 1 of the Standard

Note 5 – For tolerances, see Fig 1 of the Standard.

3. Designation – As an example, a slotted countersunk head wood screw No. 8, length 20 mm and made of steel shall be designated as 'Wood Screw No. 8×20 – IS 6760 Steel'.

Note – In regard to the requirements not covered in the standard, Refer to IS 451 : 1999 Technical supply conditions for wood screws (*third revision*).

For detailed information, refer to IS 6760 : 1972 Specification for slotted countersunk wood screws.

SUMMARY OF
IS 8033 : 1976 WASHERS WITH SQUARE HOLE FOR WOOD
FASTENINGS

1. Scope – Requirements for washers with square hole for use in wood fastenings with bolts in dia range 6 to 24 mm.

2. Grade – Ordinary grade as specified in IS 5369

3. Dimensions (in mm)

<i>Size (Side of of Internal Square)</i>	<i>External Dia / Side</i>	<i>Thickness</i>	<i>Suitable Bolt Size</i>
6.6	22	1	M6
9	28	2	M8
11	34	2	M10
14	45	3.15	M12
18	58	4	M16
22	68	4	M20
26	92	4	M24

4. Designation – As an example, a round washer with square hole of nominal size 14 mm shall be designated as 'Washer With Square Hole 14 IS : 8033'.

* General requirements for plain washers and lock washers
(first revision)

Note 1—Dimensional tolerances as well as tolerances for form and position shall conform to those of ordinary washers of IS 5369.

Note 2— In regard to requirements not covered, refer to IS 5369.

For detailed information, refer to IS 8033 : 1976 Specification for round washers with square hole for wood fastenings.

SUMMARY OF

IS 8412 : 1977 SLOTTED COUNTERSUNK HEAD BOLTS FOR STEEL STRUCTURES

1. Scope – Requirements of slotted countersunk head bolts for steel structures in the dia range 10 to 24 mm.

2. Dimensions (in mm)

<i>Nominal Size</i>	<i>Nominal Dia</i>	<i>Range of Preferred Lengths (See Note 1)</i>
M10	10	20-160
M12	12	25-160
M16	16	30-160
M20	20	50-160
M22	22	55-160
M24	24	60-160

Note 1– Preferred lengths – 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 90, 100, 110, 120, 130, 140, 150 and 160 mm.

Note 2– For detailed dimensions and tolerances, refer to Table 1 of the Standard.

Note 3 – For lengths of fully threaded bolts, refer to Table 2 of the Standard.

3. Grade – Black grade (B) as specified in the prescribed standard.

4. Designation – As an example, a slotted countersunk head bolt of nominal size M16, length 70 mm with nut and property class 8.8 shall be designated as 'Slotted Countersunk Head Bolt M16 × 70 N IS 8412—8.8'.

4.1 When the bolts are required without nuts, the letter 'N' appearing between length and number of the standard in the designation shall be omitted.

5. Mechanical Properties – Property classes 4.6 or 8.8 of the prescribed standard.

6. General Requirements – Nuts used with slotted countersunk head bolts shall conform to the requirements as specified in the prescribed standard.

For detailed information, refer to IS 8412 : 1977 Specification for slotted countersunk head bolts for steel structures.

SUMMARY OF

IS 8869 : 1978 WASHERS FOR CORRUGATED SHEET ROOFING

1. Scope—Requirements for washers for corrugated sheet roofing.

2. Types

- a) Bituminous felt washers,
- b) Steel washers, and
- c) Lead washers.

2.1 Bituminous felt washers and lead washers are of two types namely Type A and Type B, and steel washers are four types namely Type A, Type B, Type C and Type D.

3. Dimensions (in mm)

<i>Nominal Size (Dia of Hole)</i>	<i>Thickness</i>	<i>Suitable Bolt Size</i>
7	1.6	M6
10	1.6	M8
12	1.6	M10

Note 1—The dimensions given in the above table shall be applicable to all types of washers mentioned in 2 and 2.1.

Note 2— For detailed dimensions and shapes of washers of all types, refer to Tables 1 to 3 of the standard.

4. Grade— Ordinary grade specified in IS 5369.

5. Designation— As an example, a bituminous felt washer, Type A of nominal size 7 shall be designated as 'Bituminous Felt Washer A7 – IS 8869.

6. General Requirements

6.1 Steel washers shall be galvanized by hot dipping.

6.2 Bituminous felt washers shall be suitably impregnated. These washers when heated and maintained at a temperature of $75 \pm 1^\circ\text{C}$ for 1 hour shall not get separated and flow out.

* General requirements for plain washers and lock washers (*first revision*).

For detailed information, refer to IS 8869 : 1978 Specification for washers for corrugated sheet roofing.

SUMMARY OF

**IS 10238 : 2001 FASTENERS – THREADED STEEL
FASTENERS – STEP BOLT FOR STEEL STRUCTURES**
(First Revision)

1. Scope

1.1 Covers the requirements for step bolt used in steel structures including transmission towers to gain access to the top.

1.2 Each bolt shall be supplied with two hexagon nuts.

2. Dimensions and Tolerances – Shall be as given in **figure 1** of the standard.

3. Grades – The step bolts shall be of product Grade C as specified in IS 1367 (Part 2)⁺

4. Mechanical Properties – The step bolts shall conform to the requirements of property class 4.6 as specified in IS 1367 (Part 3)⁺⁺

5. Mating Nuts and Washers

5.1 Nuts – The hexagon nuts used with step bolts covered in this standard shall be of property class 5 and conforms to the requirements of the prescribed standard.

5.2 Washers – The plain washers used on these bolts

shall be of Type A punched washers type and conform to the requirements given in the prescribed standard except the thickness of washers which shall be 5 ± 1 mm. The washers supplied along with bolts shall be hot-dip galvanized

6. General Requirements – The permissible surface discontinuities of the step bolts shall conform to IS 1367(Part 9/Sec2).*

7. Finish

7.1 The step bolts shall be galvanized in accordance with IS 1367(Part 13)*

8. Tests

8.1 The step bolts shall not have any permanent set when subjected to the cantilever test as shown in Fig. 2 of the standard.

9. Designation – The step bolts shall be designated by the size, length and the number of this Indian Standard. The letter NN shall be added to the designation to indicate supply with two nuts.

Example – A step bolt of size M16 and length 175mm with two hexagon nuts shall be designated as – Step bolts M16×175 NN IS 10238

⁺ Technical supply conditions for threaded steel fasteners

For detailed information, refer to IS 10238 : 2001 Specification for Fasteners – Threaded steel fasteners – Step bolt for steel structures.

SUMMARY OF

**IS 12427 : 2001 FASTENERS – THREADED STEEL
FASTENERS – HEXAGON HEAD TRANSMISSION TOWER BOLTS**
(First Revision)

1. Scope – Covers the requirements for hot-dip galvanized hexagon head transmission tower bolts in the size range M12 to 24 for use in the construction of transmission towers, sub-stations and similar steel structures

1.1 The bolts covered in this standard are not suitable for applications requiring improved low temperatures characteristics.

2. Dimensions

2.1 The dimensions of the bolts shall be as given in Table 1 when read with Fig 1. of the standard.

2.2 The length-size combinations as well as grip ranges shall be as given in Table 2 of the standard.

3. Grades – Unless otherwise specified, the bolts shall be of product grade ‘C’ as specified in IS 1367 (Part 2) *

4. Mating Nuts and Washers

4.1 Nuts—The hexagon nuts used with these bolts shall conform to the requirements given in IS 14394.

4.2 Washers

4.2.1 The plain washers used with these bolts shall be of type A, punched washer type and shall conform to the requirements of the prescribed standard to except the thickness of the washer which shall be 5 ± 1 mm. The washers supplied along with these bolts shall be hot-dip galvanized.

5. Mechanical Properties

5.1 The bolts shall be of property class 5.6, 5.8 or 8.8 as specified in IS : 1367 (Part 3)* and shall be tested full size.

5.2 Shear Strength

5.2.1 The Bolts with shank lengths l_s more than the nominal diameter shall withstand a minimum shear stress as given below—

<i>Property Class</i>	<i>Minimum Shear Stress (MPa)</i>
5.6	310
5.8	322
8.8	515

6. Finish

6.1 The bolts and nuts shall be hot-dip galvanized in accordance with the requirements of IS 1367 (Part13)*

7. General Requirements—The permissible surface discontinuities of the bolts shall conform to IS 1367 (Part 9/sec 1) *

8. Designation – The bolts shall be designated by nomenclature, thread size, nominal length, number of this standard and property class.. The letters N and W shall be added to the designation to indicate supply with nut and plain washer respectively.

Example – A transmission tower bolt of thread size M16 and nominal length 50mm with nut and property class 5.6 shall be designated as—Transmission Tower Bolts M16 × 50 N– 5.6 IS 12427.

A transmission tower bolt of thread size M16, nominal length 50mm, property class 5.6 with nut and plain washers shall be designated as:

Transmission Tower Bolt M16× 50NW—5.6 IS 12427.

*Technical supply conditions for threaded steel fasteners

For detailed information, refer to IS 12427 : 2001 Specification for fasteners – Threaded steel fasteners hexagon head transmission tower bolts (first revision).

SECTION 20

WIRES ROPES AND WIRE PRODUCTS

CONTENTS

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SUMMARY OF

IS 278 : 1978 GALVANIZED STEEL BARBED WIRE FOR FENCING

(Third Revision)

1. Scope – Requirements for two types of galvanized steel barbed wire with two strands of wire.

2. Types –

2.1 Types A (Iowa Type) – Barbs shall have 4 points, formed by twisting two point wires, each two turns, tightly around both line wires making altogether four complete turns.

2.2 Types B (Glidden Type) – Barbs shall have 4 points, formed by twisting two point wires, each two turns, tightly around one line wire making altogether four complete turns.

Note — For details, see Fig. 1 of the standard.

3. Sizes (in mm)

Sizes Designation	Nominal Diameter		Mass of Complete Barbed Wire g/m	Distance Between Two Barbs
	Line Wire	Point Wire		
1.	2.50	2.50	136-155	75±12
2.	2.50	2.50	108-120	150±12
3.	2.50	2.00	108-125	75±12
4.	2.50	2.00	89-103	150±12
5.	2.24	2.00	97-106	75±12
6.	2.24	2.00	78-85	150±12

Note – Number of lays between the two consecutive barbs shall vary between 2 to 7.

3.1 Tolerances – ± 0.08 mm on diameter of line wire and point wire.

4. Requirements

4.1. Material — Galvanized mild steel wire conforming to IS 280 : 1978.*

* Mild steel wire for general engineering purposes (third revision)

4.2 Freedom from Defects

4.2.1 Line and point wires shall be circular in section, free from scales and other defects and shall be uniformly galvanized.

4.2.2 Line wire shall be in continuous lengths and shall not contain any welds other than those in rod before it is drawn. The distance between two successive weldings in the line of finished barbed wire shall not be less than 15 m.

Note — For requirements in regard to manufacture, galvanizing and chromating, refer to 6 and 7 of the standard.

5. Designation – A galvanized steel barbed wire of Type A and of size designation 1 shall be designated as:

Steel Barbed Wire, A-1 IS 278

6. Tests

6.1 Tensile Test – Tensile strength of line wire shall be 390 to 590 N/mm². Minimum breaking loads of completed barbed wire and individual line wires shall be 3.7 and 3.0 kN for 2.50 and 2.24 line wire respectively.

6.2 Zinc Coating –

6.2.1 Line wire – Shall satisfy the requirements as for minimum medium coated wire given in IS 4826 : 1979†, subject to a reduction of not more than 15 percent of the specified values.

6.3 Ductility Test – Line wire shall withstand wrapping and unwrapping eight turns round its own diameter without fracture.

† Hot-dipped galvanized coatings on round steel wires (first revision).

Note – For methods of tests refer to IS 1608 : 1995 Mechanical testing of metals—tensile testing (second revision), IS 1755 : 1983 Method for wrapping test of metallic wire (first revision) and IS 4826 : 1979 Hot-dipped galvanized coatings on round steel wires (first revision).

For detailed information, refer to IS 278 : 1978 Specifications for galvanized steel barbed wire for fencing. (third revision).

SUMMARY OF
IS 2140 : 1978 STRANDED GALVANIZED STEEL WIRE FOR
FENCING
(First Revision)

1. Scope – Requirements for galvanized strand fencing wire of 3-ply and 7-ply construction.

2. Dimensions

2.1 Wire Strand, 3-Ply Construction

Nominal Dia of Single Wire	Minimum Breaking Load		Length of Lay	Tolerance on Length of Lay
	Single Wire 540 N/mm ²	Completed Strand*		
mm	N	N	mm	mm
1.60	1080	3078	40	±10
2.24	2160	6156	50	±10
2.50	2700	7695	60	±10
2.80	3240	9234	60	±10
3.15	4320	12312	70	±10
3.55	5400	15390	80	±10

*The minimum breaking load of the completed strand is 95 percent of the minimum aggregate breaking load.

2.2. Wire Strand, 7- Ply Construction

Nominal Dia of Single Wire	Minimum Breaking Load		Length of Lay	Tolerance on Length of Lay
	Single Wire 540 N/mm ²	Completed Strand **		
mm	N	N	mm	mm
0.50	135	898	40	±10
0.80	270	1796	50	±10
1.25	735	4888	60	±10
1.60	1080	7182	60	±10
2.24	2160	14362	70	±10
2.50	2700	17955	80	±10
2.80	3240	21546	80	±10
3.15	4320	28728	90	±10
3.55	5400	35910	100	±10

**The minimum breaking load of the completed strand is 95 percent of the minimum aggregate breaking load.

3. Material –

3.1 Shall be manufactured from galvanized mild steel wire conforming to IS 280 : 1978*. The wire shall have a tensile strength of 540 N/mm², *Min.*

3.2 The galvanized Mild steel wire used shall conform to the requirements for galvanizing as laid down for the 'heavily-coated wire' or 'medium coated wire as per the prescribed standard.

* Mild steel wire for general engineering purposes (*third revision*).

4. Lay – Shall be right-hand. The strand shall be evenly and uniformly laid. The length of the lay shall be as specified in 2.1 and 2.2.

5. Freedom from Defects – Shall be free from scale, irregularities, imperfections, flaws, sand-spills and other defects. The galvanizing shall be smooth, even and bright.

6. Tests

6.1 Minimum Breaking Load — As given in 2.1 and 2.2

For detailed information, refer to IS 2140 : 1978 Specifications for stranded galvanized steel wire for fencing (first revision).

SUMMARY OF
IS 2365 : 1977 STEEL WIRE SUSPENSION ROPES FOR LIFTS,
ELEVATORS AND HOISTS
(First Revision)

1. Scope – Requirements of steel wire ropes for use with lifts, elevators and hoists having cars or platforms carrying passengers or goods and working in guides. Does not apply to ropes used for winding purposes in mines. Following rope constructions and size ranges are covered:

2.2 The actual diameter of rope shall be within +4 and -1 percent of the nominal diameter.

3. General Requirements – The wire ropes shall conform to IS 6594 : 1977* and also meet the following requirements of 3.1 to 3.3.

<i>Construction</i>	<i>Tensile Designation</i>			<i>Core</i>		<i>Size Range</i> mm
	1230	1420	1570	<i>Fibre</i>	<i>Steel</i>	
6×19(12/6/1)	×	×	×	×	--	6 to 12
6×19(9/9/1)	×	×	×	×	--	6 to 20
6×19(12/6+6F/1)	×	×	×	×	--	6 to 20
8×19(9/9/1)	×	×	×	×	--	8 to 20
8×19(12/6+6 F/1)	×	×	×	×	--	8 to 20

2. Rope Size, Tolerance and Minimum Breaking load

2.1 The sizes of the rope, designated as 'nominal diameter' shall be 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 19 and 20 mm. Size range of breaking load and mass for different rope construction is given below:

3.1 The main core of rope shall be of fibre only.

3.2 If jointing by tucking is required, it shall be in case of wires 0.5 mm diameter and smaller.

3.3 The mass of ropes given in 2.1 are for fully greased ropes.

* Technical supply conditions for wire ropes and strands (first revision).

<i>Nominal Diameter</i> mm	<i>Approximate Mass Range</i> kg/100m	<i>Range of Minimum Breaking Load Corresponding to Tensile Designation of Wires of</i>		
		1230 kN	1420 kN	1570 kN
6	12.5 to 13.7	13.6 to 15	15.7 to 17.3	17.4 to 19.1
7	17.0 to 18.6	18.5 to 20.4	21 to 23	24 to 26
8	22.1 to 24.3	23 to 27	26 to 31	29 to 34
9	28.0 to 30.8	29 to 34	33 to 39	37 to 43
10	34.6 to 38.0	35 to 42	41 to 48	45 to 53
11	41.9 to 46.0	43 to 50	49 to 58	55 to 64
12	49.8 to 54.7	51 to 60	59 to 69	65 to 76
13	58.9 to 64.3	60 to 70	69 to 81	76 to 90
14	68.3 to 74.5	69 to 81	80 to 94	88 to 104
16	89.2 to 97.3	90 to 106	104 to 123	115 to 136
18	113 to 123	114 to 135	132 to 155	146 to 172
19	126 to 137	127 to 150	147 to 173	161 to 191
20	139 to 152	141 to 166	163 to 192	180 to 212

Note 1—The nominal diameter 19 mm is non-preferred.

Note 2—For exact value of minimum breaking load and approximate mass corresponding to each rope construction, refer to Tables 1 to 5 of the standard.

For detailed information, refer to IS 2365 : 1977 Specifications for steel wire suspension ropes for lifts, elevators and hoists (first revision)

SUMMARY OF

IS 2721 : 1979 GALVANIZED STEEL CHAIN LINK FENCE FABRIC

(First Revision)

1. Scope – Requirements for galvanized steel chain fence fabric intended for various purposes. This standard does not cover the requirements pertaining to straining posts, struts, base plates and other fittings.

Table 1 Dimensions and Tolerances

Mesh Size	Nominal Dia of Mesh Wire	Line Wire		
		Diameter	Number of wires	
			Up to and including 2 m width	Above 2 m width
(1)	(2)	(3)	(4)	(5)
25 ± 3	2.00	2.50	2	3
	2.50	3.15	2	3
	3.15	4.00	2	5
40 ± 4	2.00	2.50	2	3
	2.50	3.15	2	3
	3.15	4.00	2	3
	4.00	4.50	2	3
50 ± 4	2.00	2.50	2	3
	2.50	3.15	2	3
	3.15	4.00	2	3
	4.00	4.50	2	3
63 ± 4	3.15	4.00	2	3
	4.00	4.50	2	3
	4.50	5.00	2	3
75 ± 4	3.15	4.00	2	3
	4.00	4.50	2	3
	4.50	5.00	2	3
	5.00	5.50	2	3
100 ± 5	3.15	4.00	2	3
	4.00	4.50	2	3
	4.50	5.00	2	3
	5.00	5.50	2	3
125 ± 5	4.00	4.50	2	3
	4.50	5.00	2	3
	5.00	5.50	2	3
150 ± 5	4.00	4.50	2	3
	4.50	5.00	2	3
	5.00	5.50	2	3

Note – Sizes other than those mentioned above shall be supplied subject to agreement between the purchaser and the manufacturer.

*Mild steel wire for general engineering purposes
(third revision)

2. Dimensions – See Table

2.1 Mesh Size – Shall be determined by measuring the minimum clear distance between the wires forming the parallel sizes of the mesh when measured in normal structured condition.

2.2 Width – Shall be the overall dimension from one extreme line wire to other extreme line wire and shall be checked in fully stretched condition. The tolerance on the width shall be ± 0.7 of the mesh size.

2.3 Length – Shall be supplied in rolls of 5, 10, 15, 20, and 25m or as per the requirements of the purchaser. The supplied length shall not be less than the above values when measured in fully stretched condition.

2.4 Tolerances – As per IS 280 *

3. Material – The mesh wire and the line wire of the fabric shall be manufactured from galvanized steel conforming to IS 280* having a tensile strength within the range of 400 to 550 MPa.

4. Galvanizing – The chain link fence fabric shall have zinc coating of type ‘heavy’ as given in the prescribed standards.

5. Workmanship and Finish – Each roll shall be warranted to contain no weld joint or splice whatever. The wire shall be circular and shall be free from scales, irregularities, imperfections, flaws, sand splits and other defects. The zinc coating shall be smooth, even and bright.

5.1 The fabric shall be manufactured in widths of 0.90 m, 1.20m, 1.50 m, 1.80 m, 2.00 m, 2.50, and 3.00 m, or as per the requirements of the purchaser.

6. Test –

6.1 Tensile Test – Tensile strength shall be within the range of 400 to 550 N/mm².

6.2 Wrapping Test – Wires shall not break or split when wrapped eight times round its own diameter and subsequently straightened.

6.3 Twist Test – Mesh and line wires shall withstand not less than 18 twists on a length equal to 100 diameters between rices.

6.4 Bend test– Mesh wire and line wire of 5 mm diameter and above shall be subjected to this test. The wire shall withstand being bent through an angle of 90° round a former of diameter equal to twice its own diameter without breaking or splitting.

6.5 Galvanizing Test – Shall be up to 10 percent less than the minimum mass of zinc coating specified in the prescribed standard and withstand one dip of half minute duration less than specified.

for details of tests for fabric refer to cl.9. of the standard

For detailed information, refer to IS 2721 : 1979 Specifications for galvanized steel chain link fence fabric (first revision).

SECTION 21

GLASS

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SUMMARY OF
IS 2553 (PART 1) : 1990 SAFETY GLASS
PART 1 GENERAL PURPOSE
(Third Revision)

1. Scope – Requirements and the methods of sampling and test for safety glass meant for general purposes such as for use in glazing windows, doors of buildings and railway coaches.

2. Types

- a) Toughened safety (tempered) glass (TS)
- b) Toughened float safety glass (TF),
- c) Laminated safety glass (LS) and
- d) Laminated float safety glass (LF).

3. Requirements

3.1 General

3.1.1 Material – Safety glass shall be made of ‘A A’ and ‘A’ quality [see IS 2835 : 1987*] from flat transparent glass.

Note – Safety glass may also be made from float glass, if agreed to between the manufacturer and the purchaser.

3.1.1.1 Safety glass may be flat or curved and tinted/coloured itself or by providing coloured interlay(s), as agreed to between the manufacturer and the purchaser.

3.1.2 Measurement of thickness — The thickness of safety glass shall be measured in accordance with the method prescribed in 5.1 and Annex B of IS 2835 : 1987.*

3.1.3 Distribution of allowable defects — Safety glass made from AA or A quality sheet glass shall not have defects greater than those specified for AA or A quality of sheet glass as the case may be in Table 2 of IS 2835 : 1987.*

Note — Safety glass made from float glass shall not have waviness more than 8 mm (Refer IS 2835:1987* test for waviness) both in central and outer area and for other defects it shall not have more than those specified for AA quality of sheet glass of IS 2835 : 1987.

* Flat transparent sheet glass (third revision).

3.1.3.1 Toughened safety glass made from float glass shall not have cluster of defects more than those specified for ‘AA’ quality of sheet glass and toughened safety glass made from ‘AA’ or ‘A’ quality and sheet glass shall not have cluster of defects more than those specified respectively for ‘AA’ or ‘A’ quality of sheet glass, as the case may be in Table 2A of IS 2835.

3.1.3.2 As the laminated safety glass contains two pieces or more of sheet glass, cluster of defects in the product made from AA or A quality of sheet glass or float glass as the case may be shall be as agreed to between the purchaser and the manufacturer.

3.2. Specific Requirements for Toughened Safety Glass—

3.2.1 Thickness – Toughened safety glass shall be of nominal thickness and range of thickness as specified in Table 1 of IS 2835 : 1987.*

3.2.2 Dimensional tolerances on cut size (length and width) – Tolerance on length and width of the toughened safety glass shall be in accordance with Table 1 of IS 2835 : 1987.*

3.2.3 Fragmentation test – It shall pass the prescribed test.

3.2.4 Warp – It shall not exceed 0.5 percent for arc and 0.3 percent for wave pattern for flat glasses.

Note – This test is meant for flat safety glass only.

3.2.5 Resistance to shock test – Shall pass the prescribed test.

Note – This test shall apply to the toughened safety glasses having a thickness of 5.0 mm and above. For glasses having a thickness of less than 5.0 mm, adoption of the test and interpretation of the results shall be as agreed to between the purchaser and the manufacturer.

3.3. Specific Requirements for laminated Safety glass—

* Specified Requirements for laminated Safety glass—

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3.3.1 Thickness – Laminated safety glass shall be of thickness as specified in Table 1.

3.3.1.1 If agreed between the purchaser and the supplier, nominal thickness of laminated safety glass, other than those specified in Table 1 may also be supplied. In such cases the range of thickness shall be those which are applicable to immediately lower thickness as specified in Table 1.

TABLE 1 NOMINAL THICKNESS, RANGE OF THICKNESS, DIMENSIONAL TOLERANCE ON LENGTH AND WIDTH OF LAMINATED SAFETY GLASS (CLAUSES 3.3.1, 3.3.1.1 AND 3.2)

SL. No	Nominal Thickness	Range of Thickness	Dimensional Tolerance on Cut Size Length and Width
(1)	(2) mm	(3) mm	(4) mm
i)	3.5	3.1 to 3.7	2.5
ii)	4.0	4.0 to 4.8	2.5
iii)	5.0	5.0 to 5.8	2.5
iv)	6.0	6.0 to 6.8	2.5
v)	8.0	8.0 to 8.8	3.0
vi)	10.0	9.8 to 11.0	3.5

Note – For methods of tests, refer to Annexes A to E of the standard.

For detailed information, refer to IS 2553 (Part 1) : 1990 Specifications for safety glass : Part 1 General Purposes (third revision).

3.3.2 Cut sizes — For matching the edges of laminates in laminated safety glass, the tolerance limit within which overlapping of edges shall be maintained shall not exceed ± 1.5 mm, but overall dimensional tolerance on the cut sizes (length and width) shall be subjected to the limit specified, in col 4 of the Table 1.

3.3.3 Light stability test – Laminated safety glass shall pass the requirements of light stability test as prescribed.

3.3.4 Boil test – Laminated safety glass shall pass the requirements of boil test as prescribed.

3.3.5 Fracture and adhesion test – Laminated safety glass shall pass the requirements of fracture and adhesion test as prescribed.

SUMMARY OF
IS 2835 : 1987 FLAT TRANSPARENT SHEET GLASS
(Third Revision)

1. Scope – Requirements and methods of sampling and test for flat transparent sheet glass for use in the manufacture of photographic plates, projection slides, silvered glass mirrors, toughened or laminated safety glasses and for glazing and framing purposes.

2. Classification

- a) *AA Quality or Special Selected Quality (SSQ)* – Intended for use where superior quality of safety glass, high quality mirrors, photographic plates, projection slides, etc.
- b) *A quality or selected quality (SQ)* – Intended for selected glazing, manufacture of mirrors, safety glass etc.
- c) *B Quality or Ordinary Quality (OQ)* – Intended for glazing and framing purposes; and

- d) *C Quality or Greenhouse Quality (GQ)* – Intended for green house glazing, production of frosted glass, strips for flooring, etc.

3. Requirements

3.1 Material – Sheet glass shall be flat, transparent and clear as judged by the unaided eye. It may, however, possess a light tint, when viewed edge-wise. It shall be free from any cracks.

3.2 Dimensions – Nominal thickness, range of thickness and dimensional tolerance on cut sizes (length and width) of sheet glass shall be as prescribed in Table 1.

3.2.1 If agreed between the purchaser and the supplier, thickness other than those specified in Table 1 may be supplied. In such cases, range of thickness and

tolerance on cut size shall be those which are applicable to immediate lower thickness specified in Table 1.

TABLE 1 NOMINAL THICKNESS, RANGE OF THICKNESS OF SHEET GLASS AND DIMENSIONAL TOLERANCE ON CUT SIZES

SL No.	Nominal Thickness	Range of Thickness	Dimensional Tolerance on Cut Sizes
(1)	(2) mm	(3) mm	(4) ±mm
i)	1.0	0.85-1.15	1.5
ii)	1.5	1.35-1.65	1.5
iii)	2.0	1.80- 2.20	1.5
iv)	3.0	2.80- 3.20	1.5
v)	3.5	3.30- 3.70	2.0
vi)	4.0	3.80- 4.20	2.0
vii)	5.0	4.70- 5.30	2.0
viii)	5.5	5.20- 5.80	2.0
ix)	6.3	5.90- 6.70	2.0
x)	8.0	7.50- 8.50	3.0
xi)	10.0	9.50-10.50	3.0
xii)	12.0	11.00-13.00	3.0
xiii)	15.0	13.50-16.50	4.0
xiv)	19.0	17.00- 21.00	4.0
xv)	25.0	22.00- 28.00	5.0
xvi)	32.0	28.50- 35.50	6.0

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3.3 Distribution of Allowable Defects – Sheet glass shall not have defects greater than those specified in Table 2.

3.3.1 Allowable cluster of defects – Sheet glass shall not have cluster of defects more than those specified in Table 2A.

TABLE 2 DISTRIBUTION OF ALLOWABLE DEFECTS IN SHEET GLASS

Sl.No.	Defects	'AA' Quality		'A' Quality		'B' Quality		Remark
		Central	Outer	Central	Outer	Central	Outer	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Gaseous inclusion max size, mm	1.0	2.0	3.0	6.0	12.0	18.0	Separated by at least 30.0cm
ii)	Opaque Gaseous inclusion, max, size in mm	Nil	0.5	3.0	6.0	6.0	12.5	Separated by at least 60.0cm
iii)	Knots, dirt and stones*, max size, mm	Nil	1.0	1.0	1.0	1.5	2.0	Separated by at least 60.0cm
iv)	Scratches, cubs and frush	Faint	Faint	Faint	Light	Light	Medium	Separated by atleast 60.0cm
v)	Bow, percent, Max	0.25	0.25	0.5	0.5	1.0	1.0	
vi)	Reams strings and lines	Light	Light	Light	Light	Medium	Heavy	
vii)	Waviness, mm	10	10	15.0	15.0	20.0	20.0	(see Appendix A of the standard)
viii)	Sulphur stains	Nil	Nil	Nil	Nil	Inconspicuous one allowed		--
ix)	Corner breakage and chip	Not more than nominal thickness of sheet glass	Not more than nominal thickness of sheet glass			Not more than nominal thickness of sheet glass		

Note – 'C' quality sheet glass may have defect of any size or intensity but shall have no stones or knots which may cause breakage.

*There shall be none which hinders serviceability for automobile industry.

TABLE 2A ALLOWABLE CLUSTER OF DEFECTS MENTIONED UNDER SL.NO.(I), (II) AND (III) OF TABLE 2

SL. No	Quality of Sheet Glass	Central Area	Outer Area
(1)	(2)	(3)	(4)
i)	AA	Nil	One cluster of maximum 3 defects comprising only one from (iii) and 2 from either (i) or (ii), or one each from (i) and (ii) in an optional circle of 30 cm dia.
ii)	A	One cluster of maximum 3 defects comprising only one from (iii) and 2 from either (i) or (ii), or one each from (i) and (ii) in an optional circle of 30 cm dia	One cluster of maximum 5 defects of any type mentioned in (i), (ii) and (iii) but the presence of stone should not be more than one in optional circle of 30 cm dia.
iii)	B	-----do-----	One cluster of maximum 6 defects of any type mentioned in (i), (ii) and (iii) but the presence of stone should not be more than one in optional circle of 30cm dia.

Note – For methods of measurement and test refer to 5, Annex A and B of the standard.

For detailed information, refer to IS 2835 : 1987 Specifications for flat transparent sheet glass (third revision).

SUMMARY OF
IS 3438 : 1994 SILVERED GLASS MIRRORS FOR GENERAL
PURPOSES
(Second Revision)

1. Scope – Requirements and methods of sampling and test for silvered glass mirrors used for general purposes.

2. Requirements

2.1 General – Mirrors shall consist of glass sheet coated with silver on one surface. The silver shall be protected by a metallic copper film which in turn shall be covered by a suitable protective paint coating.

2.2 Glass Sheet – The Glass sheet used for mirrors shall comply with the requirements prescribed for AA and A qualities of IS 2835 : 1987

Note – Float glass may also be used if agreed to between the purchaser and the supplier.

2.3 Silvering – Silvering shall be a coating of deposited silver. It shall be free from defects or blemishes in the reflecting surface, such as, lifting or separation of the silver from the glass, sulphide or other spots, haze of any other visible defects. The amount of silver deposit shall not be less than 0.8 g/m².

* Flat transparent sheet glass (*third revision*)

2.4 Copper Costing – The silvered surface shall be protected by a film of deposited copper. The amount of copper deposit shall be not less than 0.4 g/m².

2.5 Protective Coating – A suitable protective paint coating shall be applied over the copper coating.

2.5.1 This paint coating shall not crack or peel the silver or copper coating due to change in the atmospheric temperature or age-dying.

2.6 Reflectance – Reflectance of the mirrors shall not be less than 80 percent for clear (untinted) glass mirrors.

3. Tests – Shall pass the prescribed tests for:

- a) Test for waviness
- b) Salt spray test
- c) Hot water test
- d) Testing for copper and silver plating.

Note— For methods of tests refer to 5 and Appendices A to D of the standard.

For detailed information, refer to IS 3438 : 1994 Specifications for silvered glass mirrors for general purposes (second revision).

SUMMARY OF
IS 5437 : 1994 FIGURED, ROLLED AND WIRED GLASS
(First Revision)

1. Scope – Requirements and methods of sampling and test for figured, rolled and wired glass.

2. General Requirements

2.1 May be clear or tinted as agreed.

2.2 Shall not contain any stones with cracks.

2.3 Shall not contain any stones bigger than 2 mm diameter or which protrude from either side of the glass.

2.4 Stones shall be separated by at least 60 cms.

2.5 The glass sheet shall have not more than one gaseous inclusion greater than 3.5 mm or equivalent elliptical inclusion up to 20 mm long in 1m² of each cut sheet.

2.6 Warpage – Shall not be more than 1 percent.

3. Thickness and Dimensional Tolerance of Figured and Rolled Glass

3.1 Thickness and dimensional tolerances of figured and rolled glass shall be as given below. Any other thickness as agreed to between purchaser and supplier may be provided.

Sl. No.	Nominal Thickness (mm)	Thickness Tolerance (mm)	Dimensional Tolerance (mm)
(1)	(2)	(3)	(4)
i.	2.0	±0.2	±1.5
ii.	3.0	±0.2	±2.0
iii.	4.0	±0.2	±2.0
iv.	5.0	±0.3	±2.0
v.	6.0	±0.3	±2.0

Note – For methods of measurements and tests, refer to the standard.

For detailed information, refer to IS 5437 : 1994 Specifications for figured, rolled and wired glass (first revision).

4. Specific Requirements for Wired Glass –

4.1 Thickness — Thickness of wired glass shall be 6.0 ±0.4 mm.

Note – The thickness can also be as agreed to between the purchaser and the supplier and the maximum tolerance on thickness shall be 9 percent of the nominal thickness

4.2 Dimensional Tolerance – Tolerance on cut size of wired glass shall be ± 3.0 mm.

4.3 Wire Mesh – The wire mesh used in the wired glass or wired figured glass shall be made of steel wire 0.46 to 0.56 mm in diameter. The pattern of mesh shall be square or diamond with wires welded or hexagonal with wires twisted. In the case of welded mesh, the wire running across the manufacturing width shall be measured.

4.4 Position of Wire Mesh – The wire mesh shall be embedded completely in the glass sheet at least 1mm from the surface and shall not be exposed at any place.

4.5 Broken Wires – Wire mesh shall not contain more than 3 broken wires per square metre of the wired glass or wired figured glass.

4.6 Flame Proofness – Shall satisfy the prescribed test.

SECTION 22

FILLERS, STOPPERS AND PUTTIES

CONTENTS

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IS 419 : 1967	Putty for use on window frames (<i>first revision</i>)	22.4
IS 423 : 1961	Plastic wood for joiners filler (<i>revised</i>)	22.5
IS 3709:1966	Mastic cement for bedding of metal windows	22.6

SUMMARY OF
IS 110 : 1983 READY MIXED PAINT, BRUSHING, GREY FILLER,
FOR ENAMELS FOR USE OVER PRIMERS
(Second Revision)

1. Scope – Requirements, and the methods of sampling and test for ready mixed paint, brushing, grey filler, for enamels, for use over primers. The material is used as a filler over the primer in the painting system normally followed by enamels.

2. Requirements

2.1 Composition – The material shall be of such a composition as to satisfy the requirements of this standard. In order to obtain satisfactory flattening properties, use of slate powder along with suitable extenders and pigments, as may be necessary, is recommended.

2.2 Flattening Properties – The material shall not be inferior to the approved sample.

2.3 Hold Out Property – The material shall pass the test as prescribed in Appendix B of the standard.

2.4 The material shall also comply with the requirements given in Table 1.

2.5 Water Content – If water is suspected to be present in the material, it shall not exceed 0.5 percent.

2.6 Mass in kg/10 litres – The minimum mass in kg/10 litres of this material shall be 14. It shall be, however within ± 3 percent of the sample approved against this specification.

2.7 Opacity – The paint, after having been thinned to a consistency of 35 seconds (Ford cup viscometer No. 4) with petroleum hydrocarbon solvent 145/205, low aromatic grade, when applied by a brush on a chequer board surface having alternate black and white squares shall satisfactorily obscure the lines of demarcation between the black and white squares.

2.8 Dry Film Thickness – The paint, thinned with petroleum hydrocarbon solvent, to a consistency of 35 seconds (Ford cup viscometer No. 4), when applied by a brush, shall give a minimum dry film – thickness of 20 micro metres in one coat.

TABLE 1 REQUIREMENTS FOR READY MIXED PAINT, BRUSHING, GREY FILLER, FOR ENAMELS, FOR USE OVER PRIMERS

<i>SL</i> (1)	<i>Characteristic</i> (2)	<i>Requirement</i> (3)
i)	Drying Time a) Surface dry b) Hard dry	Not more than 20 minutes Not more than 8 hours
ii)	Consistency	Smooth, uniform and suitable for brushing without appreciable drag on the brush
iii)	Viscosity by flow cup method	Not less than 80 seconds
iv)	Finish	Smooth and matt to semi- glossy
v)	Colour	Grey
vi)	Residue on sieve, percent by weight, <i>Max</i>	2.0
vii)	Flexibility and adhesion (after 48 hours air-drying)	No visible damage or detachment of film
viii)	Flash point	Not below 30°C
ix)	Keeping properties	Not less than six months

Note – For test procedures, refer to the standard and IS 101: 1964 Methods of test for ready mixed paints and enamels (*second revision*).

For detailed information, refer to IS 110 : 1983 Specifications for ready mixed paint, brushing, grey filler, for enamels, for use over primers (second revision).

SUMMARY OF
IS 419 : 1967 PUTTY, FOR USE ON WINDOW FRAMES
(First Revision)

1. Scope—Requirements, and the methods of sampling and test for putty for use in fixing glass panes on wood and metal frames and for filling splits, cracks and holes in wood or metal.

2. Requirements—

2.1 Form and Condition— Shall be homogeneous paste and shall be free from grit and other visible impurities.

2.2 Composition— Shall consist of mainly whiting and linsed oil, if necessary, varnish and suitable additives.

2.2.1 The calcium carbonate content of extracted pigment, from putty, shall be not less than 80 percent.

2.3 Consistency— The material, after thorough working in hands, shall have good plastic quality without sliminess or stickness that would render it difficult to handle and apply. It shall work readily and smoothly under a palette knife without crumbling or cracking. After

being moulded in place, it shall convert itself into a cohesive mass which will not yield to specified pressure after 72 hours.

2.4 The material shall also comply with the requirements given in Table 1.

TABLE 1 REQUIREMENTS FOR PUTTY, FOR USE ON WINDOW FRAMES

1	2	3	4
i)	Residue on sieve, percent by weight, <i>Max</i>	5.0	IS 101 (Part 8/Sec 1):1989 ¹⁾
ii)	Water content, percent by weight, <i>Max</i>	1.5	IS 101 (Part 2/Sec 1):1988 ²⁾
iii)	Keeping properties	Not less than 6 months	IS 101 (Part 6/Sec2): 1989 ³⁾

¹⁾ Method of sampling and test for paints, varnishes and related products : Part 8 Tests for pigments and other solids, Section 1 Residue on sieve (*third revision*)

²⁾ Method of sampling and test for paints, varnishes and related products : Part 2 Tests on liquid paints (chemical examination), Section 1 Water content (*third revision*).

³⁾ Method of sampling and test for paints, varnishes and related products : Part 6 Durability tests on paint films, Section 2 Keeping properties (*third revision*)

Note—For methods of tests, refer to IS 85 : 1950 Methods of test for oil pastes for paints; and for method of determination of calcium carbonate content and setting time, refer to Appendix A and B of the standard.

For detailed information, refer to IS 419 : 1967 Specifications for putty, for use on window frames (first revision).

SUMMARY OF
IS 423 : 1961 PLASTIC WOOD FOR JOINERS FILLER
(Revised)

1. Scope – Requirements, and methods of test for material commercially known as plastic wood, for joiners fillers. The material is used for filling holes, cracks and other irregularities in wood to produce a smooth surface capable of taking suitable stain to match timber.

2. Requirements

2.1 Form and Condition – Shall be homogeneous and free from grit and other visible impurities.

2.2 Composition

- | | |
|---------------------------|-----------|
| a) Nitrocellulose syrup | 77 |
| percent, <i>Min</i> | |
| b) Wood dust passing | Remainder |
| through IS Sieve No.15 | |
| (aperture 151 microns) | |
| With a maximum mois- | |
| ture content of 5 percent | |

Note —The nitrocellulose syrup shall consist of nitrocellulose, suitable resins, plasticizers, solvent and dilluent.

2.3 Consistency – It shall be in such a condition that it can be easily worked into a smooth paste suitable for application by a palette knife for filling.

2.4 Performance – Twenty-four hours after application, it shall be in such a condition that it has not shrunk unduly, cracked or fallen away from the wooden surfaces to which it was applied. Shall be capable of being worked by a chisel, plane or saw, as if it were timber, and of holding nails screws and similar fixtures.

2.5 Keeping Qualities – Six months from the date of manufacture, in original sealed containers.

2.6 Marking – Containers shall be marked “HIGHLY INFLAMMABLE” in red letters and flash point below 24.4° C.

For detailed information, refer to IS 423 : 1961 Specification for plastic wood for joiner filler (revised).

SUMMARY OF

IS 3709 : 1966 MASTIC CEMENT FOR BEDDING OF METAL WINDOW

1. Scope – Requirements and methods of sampling and test for mastic cement for bedding of metal windows. The material is intended for application by hand or with a putty knife. It is used for bedding, one metal window into another, metal windows into wooden frames, or metal frames into masonry or concrete. It is expected to be suitable for taking paint without lifting, bleeding or cracking.

2. Requirements

2.1 Shall be in the form of a homogeneous paste which after working in the hands, shall have good plastic quality. Shall work smoothly under a knife without crumbling or cracking and without sticking unduly to hand or knife.

2.2 Composition

- | | |
|------------|----------------------------|
| a) Whiting | 80 to 85 percent by weight |
| b) Oils | 15 to 20 percent by weight |

Note 1 — Up to 10 percent of whiting may be replaced by asbestos fibrous powder. One to two percent shall be replaced by yellow ochre to distinguish it from putty for fixing glass.

Note 2 — Oils shall be a mixture of 85 percent raw linseed oil and 15 percent castor oil.

2.3 Adhesion – The material shall satisfactorily adhere to wood, masonry, concrete and metal frames of painted or etched galvanized steel or pre-treated aluminium.

2.4 Water Content – Not more than 0.5 percent.

2.5 Setting Properties – Spread material to a thickness of 5 to 6 mm on a mild steel plate 300 × 300 mm and approximately 2.5 mm thick. Keep it in vertical position under standard atmospheric conditions for 7 days. There shall be no cracks or sagging of the film and shall remain plastic.

2.6 Keeping Properties – Six months from the date of manufacture in original sealed containers.

Note – For Methods of test, refer to IS 85 : 1950 Methods of test for oil pastes for paints.

For detailed information, refer to IS 3709 : 1966 Specification for mastic cement for bedding of metal windows.

SECTION 23

THERMAL INSULATION MATERIALS

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SUMMARY OF
IS 3677 : 1985 UNBONDED ROCK AND SLAG WOOL FOR
THERMAL INSULATION
(Second Revision)

1. Scope – Requirements and the methods of sampling and test for unbonded rock and slag wool for thermal insulation.

2. Types –

2.1 Type 1 – Loose rock and slag wool, shall be a fluffy, light weight material.

2.2 Type 2 – Stitched rock and slag wool mats. Shall be in the form of stitched mats provided with a confining media on one or both sides. If the confining medium provided is of metallic cage, it shall be attached to the mat either stabbing at not more than 250 mm centres of by stitching at not more than 250 mm along the width and 150 mm along the length with twine or metallic wire of 0.7 mm or 0.56 mm diameter or as agreed. If the confining medium provided is of hessian cloth, scrim cloth, kraft paper or glass tissue, it shall be stitched to the mat with a suitable twine.

3. Requirements

3.1 Apparent Density — The apparent density of Type 2 of the material shall be as agreed to between the purchaser and the supplier. A tolerance of ± 15 percent shall be allowed on the manufacturer's declared value.

3.2 Apparent Density Under Specified Load – The apparent density under specified load of both types of the material shall be not more than the following values.

Load Kg/cm ²	Apparent Density Under Specified Load, Max	
	At Factory Kg/m ³	At Site Kg/m ³
0.01	95	115
0.02	105	130
0.05	136	165
0.07	150	185
0.10	165	200

3.3 Shot Content – Shall be not more than the values given below. Any shot present shall not be greater than 5 mm in any dimension.

IS Sieve	Shot Content, Percent by Mass, Max
500-micron	5
250-micron	10

3.4 Moisture Absorption – The material shall not gain in mass by more than 2 percent.

3.5 Incombustibility – The material shall be rated as incombustible when it passes the prescribed test. The loss in total mass, when determined by this test, shall not exceed 5 percent.

3.6 Thermal Conductivity or k-Value — At specified apparent densities shall not exceed the following values

Mean Temperature (1)	Thermal Conductivity (k-Value) of Material at Different Apparent Densities			
	200 Kg/m ³ (2)	150 Kg/m ³ (3)	120 Kg/m ³ (4)	100 Kg/m ³ (5)
°C	mW/cm deg C	mW/cm deg C	mW/cm deg C	mW/cm deg C
50	0.42	0.46	0.48	0.50
100	0.50	0.52	0.54	0.56
150	0.60	0.62	0.66	0.68
200	0.72	0.75	0.78	0.80
250	0.83	0.88	0.89	1.02

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3.7 Sulphur Content – The material, after removal of the confining media, if any, shall not contain more than 0.6 percent of sulphur.

3.8 Width – Type 2 material shall be supplied in width of 90 ± 5 cm or any other width mutually agreed upon between the buyer and the supplier.

3.9 Thickness – Type 2 material shall be supplied in thickness of 25, 40, 50, 60, 75, 90 and 100 mm or as agreed upon between the purchaser and the supplier. The usual tolerance allowed is – 5 mm.

3.10 Optional Requirements

3.10.1 Moisture content – Shall not contain more than 2 percent moisture.

3.10.2 Resistance to micro-organisms – Shall not show any mould or bacterial growth.

3.10.3 Odour emission test – There shall be no apparent difference in odour of the butter when compared with the blanks.

3.10.4 Oil content – Shall be as agreed to between the purchaser and the supplier but it shall be not more than 2 percent.

3.10.5 Carbon content – Shall not contain more than 0.3 percent of total carbon.

3.10.6 Resistance to vibration – Shall show not more than 1 percent by height of settlement.

3.10.7 Resistance to jolting – Shall show not more than 3 percent by height of settlement, or as agreed to between the purchaser and the supplier.

3.10.8 Heat resistance – Shall not suffer visible deterioration in the fibrous structure when heated to the maximum recommended temperature of use.

3.10.9 Fibre diameter – The average fibre diameter of the wool shall not be more than 7 microns.

3.10.10 Alkalinity – The pH of the solution of the material shall be between 7.0 and 10.0.

3.10.11 Corrosive attack – Shall not cause corrosion of the surface on which it is applied.

Note – It has been found that if the chloride content in the material exceeds 0.01 percent by mass and if the conditions are such that chloride concentration can take place on the surface of certain austenitic stainless steels, there is a possibility of stress corrosion at elevated temperature.

If such an instance arises, suitable measures should be taken during the applications of insulation, for example, aluminium foil should be wrapped around the surface to be insulated before the application of insulation or an anticorrosive paint should be applied prior to the application of insulation.

Note – For methods of tests, refer to IS 3144 : 1992 Mineral wool thermal insulation materials-Methods of tests (*second revision*).

For detailed information, refer to IS 3677 : 1985 Specifications for unbonded rock and slag wool for thermal insulation (second revision).

SUMMARY OF
IS 4671 : 1984 EXPANDED POLYSTYRENE FOR THERMAL
INSULATION PURPOSES
(First Revision)

1. Scope – Requirements and the methods of sampling and test for expanded polystyrene in the form of rough shapes, finished boards and blocks, and pipe sections / segments for thermal insulation primarily for use in refrigeration and building applications in the temperature range - 150° to 80°C.

2. Types

Type 1– Non-self extinguishing type and,
 Type 2– Self extinguishing type

3. Requirements

3.1 Bulk Density – The bulk density of the material, calculated at nominal thickness, excluding facing, shall be 15, 20, 25, 30 or 35 kg/m³. A tolerance of ±5 percent shall be allowed on bulk density.

3.2 Dimensions

3.2.1 Size – 1.0 x 0.5 m or other agreed sizes. Pipe sections / segments — 1.0 m or 0.5 m in length, or other agreed length.

3.2.2 Thickness – 15, 20, 25, 40, 50, 60, 75 and 100 mm unless otherwise agreed.

3.2.3 Tolerance

<i>Finished Boards and Blocks</i>	<i>Tolerance</i>
Length, width and thickness	± 2 mm
Pipe Laggings	
Outside diameter	± 3 mm
Inside diameter	± 2 mm

3.3 Thermal Conductivity – Shall not exceed the values given below:

<i>Bulk Density</i> kg/m ³	<i>Thermal Conductivity</i> mW/cm ⁰ C	
	0°C	10°C
15.0	0.34	0.37
20.0	0.32	0.35
25.0	0.30	0.33
30.0	0.29	0.32
35.0	0.28	0.31

Note – To convert values from mW/cm deg to kcal/m h deg or vice versa, the following conversion factors are used :

<i>Kilocalories / m h °C</i>	<i>Milliwatts / cm °C</i>
1	11.630 0
0.085 985	1

3.4 The material of both the types shall also comply with the requirements given in Table 1.

3.5 Special requirement for Type 2 only.

3.5.1 Flammability – The material shall be of self extinguishing type when tested by the method prescribed in Appendix F of the standard.

TABLE 1 REQUIREMENTS FOR EXPANDED POLYSTYRENE

Sl. No.	Characteristic	Requirements at Various Nominal Apparent Densities, kg/m ³				
		15	20	25	30	35
i)	Compressive strength at 10 percent deformation, at kg/cm ² , Min	0.7	0.9	1.1	1.4	1.7
ii)	Cross-breaking strength, kg/cm ² , Min	1.4	1.6	1.8	2.2	2.6
iii)	Water vapour permeance, in g/m ² .24 h, Max	50	40	30	20	15
iv)	Thermal stability, percent, Max	1	1	1	1	1
v)	Moisture absorption, percent	2	1	1	1	1

Note – For method of tests, refer to Appendices A to F of the standard and IS 3346 : 1980 Method of determination of thermal conductivity of thermal insulation materials (two slab, guard hot-plate method) (first revision).

For detailed information, refer to IS 4671 : 1984 Specifications for expanded polystyrene for thermal insulation purposes (first revision).

SUMMARY OF

IS 6598 : 1972 CELLULAR CONCRETE FOR THERMAL INSULATION

1. Scope – Requirements and the methods of sampling and test for cellular concrete for thermal insulation.

Note – Cellular concrete (formed by producing gas or air bubbles in a cement or cement-sand slurry) is a versatile construction material on account of its light weight, high thermal insulation, resistance to sulphate action, resistance to alternate cooling and thawing (when high pressure steam cured) and resistance to penetration of water. When cast in situ, it can be applied over flat roofs for thermal insulation.

2. Types and Grades

2.1 Two types of material depending on manner of manufacture, namely :

Type 1 – High pressure steam cured (auto claved) material in the form of precast blocks.

Type 2 – Cured under normal conditions (that is, under ambient pressure and temperature) by water. Either cast in situ or as precast blocks.

2.2 Each of these two types shall have three grades, namely :

- Grade A — Light weight
- Grade B — Medium weight
- Grade C — Heavy weight

3. Materials

- a) *Aggregate* – Sand, ground quartz, shale, fly ash, granulated slag, etc.
- b) *Binders* – Portland cement or lime.
- c) *Glassing agents* – Organic foaming agents based on resin soap, glue, surface active agents, or fine aluminium powder, zinc dust, calcium carbide, calcium hypochlorite, etc.

4. Requirements**4.1 Density**

Grade	Average Bulk Density, kg/m ³
A	Min 320
B	321 to 400
C	401 to 500

4.2 Crushing Strength

Grade	Strength, Min kgf/m ²	
	Type 1	Type 2
A	7.0	2.5
B	12.0	4.5
C	20.0	8.0

4.3 Capillary Absorption – Shall not exceed 20 percent in case of Type 1 cellular concrete.

4.4 Thermal Conductivity –

Grade	Thermal Conductivity at 50°C Mean Temp, Max mW/cm°C
A	0.7
B	0.85
C	1.0

4.5 Dimensions – For Type 1 and Type 2, length 50 or 60 cm; width 20, 25 or 30 cm; thickness 7.5, 10, 15, 25 or 40 cm.

4.6 Tolerance – ± 3 percent on width and height and ± 1 percent on thickness.

Note – For method of test refer to Appendix A of the standard and IS 3346 : 1980 Method for determination of thermal conductivity of thermal insulation materials (two slab, guarded hot-plate method) (first revision).

For detailed information, refer to IS 6598 : 1972 Specifications for cellular concrete for thermal insulation

SUMMARY OF
IS 7509 : 1993 THERMAL INSULATING CEMENT
(First Revision)

1. Scope – Requirements and the methods of sampling and test for thermal insulating cements for use at temperatures up to 950°C.

2. Types –

Type 350 – for use of temperatures up to 350° C,

Type 750 – for use of temperatures up to 750°C, and

Type 950 – for use of temperatures up to 950° C.

3. Requirements – The material shall be in the form of dry powder and/or granulated aggregate. The material shall also conform to the requirements given in Table 1.

TABLE 1 REQUIREMENTS OF THERMAL INSULATING CEMENTS

SI No.	Characteristic	Requirements		
		Type 350	Type 750	Type 950
i)	Service temperature	350° C	750° C	950° C
ii)	Consistency, percent			
	a) Method A	35 to 45	35 to 45	—
	b) Method B	175 to 230	175 to 235	—
iii)	Dry covering capacity m ² , 1 cm, in thickness per 100 kg of dry cement, <i>Min</i>	17.5	20.0	14.0
iv)	Compressive strength at 5 percent deformation, kg/cm ² , <i>Min</i>	3.5	3.5	5.0
v)	Volume change (shrinkage) upon drying, percent, <i>Max</i>	25	25	30
vi)	Linear shrinkage (length) after heat soaking at service temperature, percent, <i>Max</i>	2.0	3.0	3.0
vii)	Dry adhesion to steel, kg/cm ² , <i>Min</i>	0.35	0.35	0.50
viii)	Thermal conductivity W/mK, <i>Max</i>			
	Mean Temp, °C			
	100	0.09	0.07	0.14
	200	0.11	0.09	0.16
	300	—	0.11	0.18
	400	—	—	0.20

Note – For methods of tests, refer to IS 3346 : 1980 Method for determination of thermal conductivity of thermal insulation materials (two slab, guarded hot – plate method) *(first revision)* IS 5724 : 1970 Method of tests for thermal insulation cements; and IS 9490 : 1980 Method for determination of thermal conductivity of insulation material (water calorimeter method)

For detailed information, refer to IS 7509 : 1993 Specification for thermal insulating cements (first revision).

SUMMARY OF
IS 8154 : 1993 PREFORMED CALCIUM SILICATE INSULATION
(FOR TEMPERATURES UPTO 650 °C)
(First Revision)

1. Scope – Requirements and the methods of sampling and test for performed calcium silicate insulation intended for use on surface which reach temperatures upto 650°C.

2. Requirements

2.1 Material – Shall be predominantly composed of reacted hydrous calcium silicate reinforced with suitable fibres such that the physical requirements prescribed in 2 are satisfied.

2.2 Bulk Density – Average value shall be between 200 to 280 kg/m³. For any particular density, a tolerance of ±10 percent shall be allowed on the purchaser's declared value and shall be within the range specified above.

2.3 Compressive Strength – The reduction in thickness under the following conditions shall not exceed 5 percent.

- a) dry under a load of 415 kN/m², and
- b) wet (after 18 h immersion in water) under a load of 170 kN/m².

Note – For compressive strength for pipes / curved segments an equivalent flat slab shall be used for performing the test.

2.4 Flexural Strength – The average minimum value shall be 240 kN/m².

2.5 Heat Resistance – When tested at increasing temperatures, the material shall be deemed suitable for use under conditions of soaking heat for 24 hours at 650°C up to the temperature at which the following requirements are met:

- a) Linear shrinkage (Length), 2 percent, *Max*
- b) Loss in mass, percent, *Max* 15
- c) Compressive strength – Reduction in thickness not exceeding 5 percent under a load of 345 kN/m².

2.6 Thermal Conductivity — The average value shall be as given below :

<i>Mean Temperature</i>	<i>Thermal Conductivity, Max</i>
°C	W/m.K
100	0.060
150	0.070
200	0.080
300	0.100

Note – For thermal conductivity determination for pipes / curved segment

2.7 Moisture Content – Shall not exceed 7.5 percent by mass.

2.8 Alkalinity – The pH of the solution of the material shall be between 8 and 11.

2.9 Standard Shapes, Sizes and Dimensional Tolerance –

2.9.1 Shapes — Preformed calcium silicate shall be supplied in the form of flat blocks, bevelled lags, pipe section of radiused and bevelled lags.

2.9.2 Standard sizes

2.9.2.1 Flat blocks

Length	—	500 mm, 600 mm or 900 mm
Width	—	150 mm, 300 mm, 450 mm or 600 mm
Thickness	—	25 mm, 40 mm, 50 mm, 60 mm, 75 mm, or 100 mm

2.9.2.2 Bevelled lags

Length	—	500 mm, 600 mm or 900 mm
Major width	—	75 mm to 166 mm
Thickness	—	40 mm, 50 mm, 60 mm or 75 mm

2.9.2.3 Pipe Sections

Length	—	500 mm, 600 mm or 900 mm
Diameter	—	To fit standard pipes of external dia up to 219 mm

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Thickness — 40 mm, 50 mm or 75 mm

2.9.2.4 Curved segments (radiused and bevelled lags)– Shall be furnished in lengths of 500 mm, 600 mm or 900 mm and in thickness of 40 mm, 50 mm, 60 mm or 75 mm for curved surface having external radius greater than 110mm.

2.9.3 Dimensional Tolerance – The dimensional tolerance of preformed insulation material shall be as follows –

a)	Flat blocks	
1)	Length and width	± 3 mm
2)	Thickness	-1.5 mm + 3 mm
b)	Pipe sections	
1)	Length	±3 mm
2)	Inside diameter	0 mm +5 mm
3)	Thickness (average)	-1.5 mm +3 mm

2.9.3.1 Uniformity – The local thickness at any point shall not vary from the average thickness by more than ±3 mm.

Note – For method of tests, refer to Appendices A and B of the standard, IS 3846 : 1980 Methods for determination of thermal conductivity of thermal insulation materials (two slab, guarded hot-plate method) (*first revision*), IS 5688 : 1982 Methods of test for preformed block-type and pipe covering type thermal insulation (*first revision*), IS 5724 : 1970 Method of test for thermal insulating cement, and IS 9490 : 1980 Method for determination of thermal conductivities of insulating materials (water calorimeter method)

For detailed information, refer to IS 8154 : 1993 Specifications for preformed calcium silicate insulation (for temperatures upto 650°C) (first revision).

SUMMARY OF
IS 8183 : 1993 BONDED MINERAL WOOL
(First Revision)

1. Scope – Requirements and the methods of sampling and test for bonded mineral wool for thermal insulation.

2. Requirements

2.1 Description – The material shall be mineral wool made from rock, slag or glass processed from a molten state into fibrous form and shall be bonded with a suitable binder. The slabs are normally supplied unfaced. Certain applications may require an applied finish of cloth, foil, wire netting, glass tissue, polythene or any other suitable material on one or both faces and these may be obtained as agreed to between the purchaser and the supplier.

2.2 Bulk Density

Group	Bulk Density Maximum Recommended kg/m ³	Hot Face Temperature °C
1	12-50	Up to 250
2	51-80	Up to 400
3	81-120	Up to 550
4	121-160	Up to 750

2.2.1 For any particular product, the variation from the manufacturer's declared value for bulk density shall not exceed ± 15 percent. When tested in accordance with the method prescribed in 9 of IS 3149 except that nominal / specified thickness shall be used for calculating the bank density.

2.3 Recovery After Compression – The recovery, after compression of 75 percent of the original thickness, shall not be less than 90 percent of the original thickness.

2.4 Shot Content – Shall not be more than the values given below. Any shot present in the bonded mineral wool shall not be greater than 5 mm in any dimension.

IS Sieve	Shot Content, Percent by Mass, Max
500 micron	5
250 micron	15

2.5 Moisture Content and Moisture Absorption – Shall not contain more than 2 percent moisture. It shall not gain in mass by more than 2 percent.

2.6 Incombustibility – Shall be rated as incombustible when it passes the prescribed test.

2.6.1 The loss in total mass when determined by this test shall not exceed 5 percent.

2.7 Thermal conductivity – The thermal conductivity or k-value of the material shall not exceed the values given below when determined in accordance with the method prescribed in 11 of IS 3346.

Mean Temperature °C	Thermal Conductivity mW/cm °C			
	Group1	Group2	Group3	Group4
50	0.49	0.43	0.43	0.43
100	0.69	0.52	0.52	0.52
150	0.95	0.64	0.62	0.62
200	—	0.78	0.73	0.68
250	—	0.93	0.84	0.80
300	—	1.10	0.95	0.90

2.8 Sulphur Content – Shall not contain more than 0.6 percent of sulphur. When determined by the method prescribed in 19 of IS 3144.

2.9 Dimensions – The bonded mineral wool shall be supplied in widths of 50, 60, 75 and 100 cm and lengths of 100, 120 and 140 cm or as agreed to between the purchaser and the supplier. The thickness of the bonded mineral wool shall be 25, 40, 50, 65, 75 mm or as agreed to between the purchaser and the supplier.

2.9.1 Dimensional Tolerances – For width and length, the dimensional tolerance of the bonded mineral wool slabs shall be: 1/2 percent. For nominal thickness in the range of 25 to 75 mm the tolerance shall be: 2 mm. An excess in all dimensions is permitted.

2.10 Optional Requirements

2.10.1 Resistance to micro-organisms – Shall not show any mould or bacterial growth.

2.10.2 Odour emission test – There shall be no apparent difference in odour of the butter when compared with the blanks.

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2.10.3 Resistance to vibration – Shall show not more than 1 percent height of settlement.

2.10.4 Resistance to jolting – Shall show not more than 3 percent height of settlement.

2.10.5 Heat resistance – Shall not suffer any visible deterioration of the fibrous structure and shall not show

any evidence of internal self-heating when heated to the maximum recommended temperature of use, as specified by the manufacturer.

2.10.6 Alkalinity – The pH of the solution of the material shall be between 7.0 and 10.0.

2.10.7 Corrosive Attack – Shall not cause corrosion of the surface on which it is applied.

Note – For method of tests, refer to Appendices A and B of the standard, IS 3144 : 1992 Mineral wool thermal insulation materials-Methods of tests (*second revision*) and IS 3346 : 1980 Method of determination of thermal conductivity of thermal insulating materials (two slab guarded hot plate method) (*first revision*).

For detailed information, refer to IS 8183 : 1993 Specifications for bonded mineral wool (first revision)

SUMMARY OF
IS 9428 : 1993 PREFORMED CALCIUM SILICATE INSULATION
(FOR TEMPERATURES UP TO 950°C)
(First Revision)

1. Scope – Requirements and the methods of sampling and test for preformed calcium silicate insulation intended for use with surfaces with reach temperatures up to 950°C.

2. Requirements

2.1 Bulk Density – The average value shall be between 220 and 280 kg/m³. For any particular product, a tolerance of ± 10 percent shall be allowed on the purchaser's declared value and shall be within the range specified above.

2.2 Compressive Strength – The reduction in thickness under the following conditions shall not exceed 5 percent.

- a) Dry, under a load of 415 kN/m²; and
- b) Wet (after 18 hours immersion in water), under a load of 170 kN/m².

2.3 Flexural Strength – The minimum value shall be 240 kN/m².

2.4 Heat Resistance – When tested at increasing temperatures, the material shall be deemed suitable for use under conditions of soaking heat, for 24 hours, up to the temperature at which the following requirements are met:

a) Linear shrinkage (length), percent	2 percent
b) Loss in mass, percent, <i>Max</i>	15 percent
c) Compressive strength	Reduction in thickness not exceeding 5 percent under a load of 345 kN/m ²

2.5 Thermal Conductivity

<i>Mean Temperature</i> °C	<i>Thermal Conductivity, Max</i> W/mK
200	0.080
250	0.088
300	0.097
350	0.110
400	0.121
450	0.135
500	0.148

2.6 Moisture Content – Shall not exceed 7.5 percent by mass.

2.7 Alkalinity – The pH of the solution of the material shall be between 8.0 and 11.0.

2.8 Standard Shapes, Size and Dimensional Tolerance

2.8.1 Shapes – Shall be supplied in the form of flat slabs, bevelled lags, pipe sections or radiused and bevelled lags.

2.8.2 Standard sizes –

a) <i>Flat blocks</i>	–	
Length	–	500 mm, 600 mm or 900 mm
Width	–	150 mm, 300 mm, 450 mm or 600 mm
Thickness	–	25 mm, 40 mm, 50 mm, 60 mm, 75 mm, or 100 mm
b) <i>Bevelled lags</i>	–	
Length	–	500 mm, 600 mm or 900 mm
Major width	–	75 mm to 166 mm
Thickness	–	40 mm, 50 mm, 60 mm or 75 mm
c) <i>Pipe sections</i>	–	
Length	–	500 mm, 600 mm or 900 mm
Diameter	–	To fit standard pipe of external dia up to 219 mm
Thickness	–	40 mm, 50 mm or 75 mm

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2.8.2.1 Curved segments (radiused and bevelled lags) – Shall be furnished in lengths of 600 mm or 900 mm and in thickness of 40 mm, 50 mm, or 75 mm for curved surface having external radius greater than 110mm.

2.8.3 Dimensional Tolerance

a)	Flat blocks	
	Length and width	± 3 mm
	Thickness	– 1.5 mm
		± 3 mm

b)	Pipe sections	
	Length	± 3 mm
	Inside diameter	– 0 mm
		+ 5 mm
	Thickness (average)	– 1.5 mm
		+ 3 mm

2.8.3.1 Uniformity – The local thickness of the preformed thermal insulation material at any point shall not vary from the average thickness by more than ±3 mm.

Note – For method of tests, refer to Appendices A and B of the standard, IS 5688 : 1982 Method of test for preformed block-type and pipe covering type thermal insulation (*first revision*), IS 5724 : 1970 Methods of tests for thermal insulating cements and IS 9490 : 1980 Method of determination of thermal conductivity of insulation materials (water calorimeter method).

For detailed information, refer to IS 9428 : 1993 Specifications for preformed calcium silicate insulation (for temperatures upto 950°C) (first revision).

SUMMARY OF
IS 9742 : 1993 SPRAYED MINERAL WOOL THERMAL INSULATION
(First Revision)

1. Scope – Requirements and the methods of sampling and test for sprayed mineral wool thermal insulation.

2. Material

2.1 Mineral Wool – Mineral wool conforming to IS 3677 : 1985* shall be used.

2.2 Sprayable Mineral Wool – Mineral wool with suitable binder, uniformly blended to ensure that it does not separate during normal handling and spraying operations shall be used.

3. Requirements

3.1 Density – The density of the applied and dried material shall be in the range of 200 to 250 kg/m³ and shall also not vary by more than ±15 percent from the value declared by the manufacturer.

3.2 Compressive Strength

<i>Deformation Percent</i>	<i>Compressive Strength, Min Pa (N/m²)</i>
10	4 550
15	6 460

3.3 Thermal Conductivity

<i>Mean Temperature °C</i>	<i>Thermal Conductivity, Max W/mK</i>
100	0.066
150	0.072
200	0.079
250	0.085
370	0.101

3.4 Heat Resistance – Shall not suffer visible deterioration of the fibrous structure when tested by heating to 600°C.

3.5 Incombustibility – Shall be found to be incombustible.

3.6 Fire Protection – When the material is to be used for fire protection purposes, it shall satisfy the heating conditions (time-temperature curve) as specified in IS 3809 : 1979** for determination of fire resistance rating.

3.7 Thickness – The thickness of finished, sprayed-on insulation shall not vary from the nominal value by more than +10 mm -3 mm for thickness up to 100 mm and by -5 +15 percent for the thickness above 100 mm.

3.8 Corrosion Protection – Shall not corrode the surface on which it is applied.

3.9 Optional Requirements –

3.9.1 Resistance to Vibration – Shall show not more than 1 percent by height of settlement.

3.9.2 Resistance to Jolting – Shall show not more than 3 percent by height of settlement.

** Fire resistance test for structures (*first revision*).

* Unbonded rock and slag wool for thermal insulation (*second revision*)

Note – For methods of tests, refer to IS 3144 : 1992 Mineral wool thermal insulation materials methods of tests (*second revision*), IS 3346 : 1980 Methods of determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method) (*first revision*), IS 5688 : 1982 Methods of test for preformed block -type and pipe covering type thermal insulation (*first revision*) and IS 5724 : 1970 Methods of tests for thermal insulating cements.

For detailed information, refer to IS 9742 : 1993 Specifications for sprayed mineral wool thermal insulation (*first revision*).

SUMMARY OF
IS 9743 : 1990 THERMAL INSULATION FINISHING CEMENTS
(First Revision)

1. Scope

1.1 Requirements for thermal insulation finishing cements, prepared by mixing with water for application to insulating materials after they have been applied at site to the plant of piping systems.

Note – Some of these finishing cements are used for services at temperatures below ambient, in which case a vapour barrier is required. This standard does not prescribe requirements for setting time.

1.2 This standard does not prescribe requirements for setting time.

2. Types

Type 1 – Hard-setting compositions.

Type 2 – Self-setting cements

Type 3 – Gypsum plaster compositions, and

Type 4 – Fire-proof finishing cements

2.1 *Type 1* – finishing cements are a mixture of inorganic fillers and well distributed reinforcing fibres with a clay bonding agent, and set by removal of water by natural drying or on heating. The normal ratio of hard-setting cements will be 1 part of hydraulic cement to 4 parts of hard-setting composition.

2.2 *Type 2* – finishing cements consist of well distributed reinforcing fibres (1 part) with a hydraulic cement (3 parts) as binder, with or without plasticizing agents or fillers. These set without the application of heat.

2.3 *Type 3* – finishing cements set without the application of heat and consist of calcium sulphate hemihydrate, and well distributed reinforcing fibres, usually to a lower percentage by mass than for self-setting cement.

2.4 *Type 4* – fire-proof cement is non-combustible and could effectively be used as a finishing cement over

turbine insulation applications, etc. where the finishing cement should not give rise to fire due to oil leakage, etc.

Note – Thermal insulation finishing cements of Type 1 and Type 3 are not suitable for exposure to weather conditions without further protection

3. Requirements

3.1 *Description* – Shall be thoroughly permixed and free from unopened or badly distributed fibres or coarse constituents.

3.2 *Bulk Density* – The average value shall be as given below :

<i>Type of the Finishing Cement</i>	<i>Density kg/m³, Max</i>
1	1 500
2	1 800
3	1 600
4	1 300

3.3 *Wet Covering Capacity* – Wet covering of the four types of finishing cements shall be not less than 6 m²/100 kg at 10 mm thickness.

3.4 *Inertness* – Shall not include any substance that may promote corrosive attack of the surfaces with which it is in contact, for example, wire netting used as reinforcement.

3.5 Compressive Strength

<i>Type of the Material</i>	<i>Compressive Strength kN/m², Min</i>
1	1 030
2	1 720
3	820
4	1 800

3.6 Flexural Strength – For Type 1 shall be not less than 2000 kN/m².

3.7 Resistance to Impact – The average diameter of five indentations shall not exceed 30 mm. Any cracking of the specimen that is observed shall be reported.

3.8 Heat Resistance – The blocks of the finishing cement shall neither disintegrate, nor have observable cracks.

3.9 Consistency of Wet Mixed Material – Shall be 35 to 45 percent.

3.10 Moisture Content – For hard setting compositions, the maximum free moisture content shall be not greater than 5 percent, and self-setting compositions and gypsum plaster shall be supplied dry.

Note – For method of test refer to Annex A of the standard, IS 3144 : 1992 Mineral wool thermal insulation materials methods of test (*second revision*), IS 5688 : 1982 Method of test for preformed block type and pipe covering type thermal insulation (*first revision*) and IS 5724 : 1970 Methods of test for thermal insulating cement.

For detailed information, refer to IS 9743 : 1990 Specifications for thermal insulation finishing cement (first revision).

SUMMARY OF
IS 9842 : 1994 PREFORMED FIBROUS PIPE INSULATION
(First Revision)

1. Scope – Requirements and methods of sampling and test for preformed fibrous pipe sections for thermal insulation.

2. Requirements

2.1 Description – Shall be mineral wool made from rock, slag or glass, processed from a molten state into fibrous form and bonded with a suitable binder. The sections shall normally be supplied unfaced. Certain applications may require an applied finish of aluminium foil, paper, roofing felt or other material.

2.2 Bulk Density

Group	Bulk Density, kg/m ³	Maximum Recommended Hot Face Temperature, °C
1	50-80	Up to 400
2	81-120	Up to 550
3	121-160	Up to 650
4	161-250	Up to 750

2.2.1 For any particular product, the variation from the manufacturer's declared value for bulk density, calculated at the nominal thickness, shall not exceed ± 15 percent. The actual bulk density shall, however, be within the bulk density range given in **2.2**.

2.3 Shot Content – Shall be not more than the values given below. Any shot present in the bonded mineral wool shall not be greater than 5 mm in any dimension.

IS Sieve	Shot Content, Percent by Mass, Max
500 micron	5
250 micron	15

2.4 Moisture Content and Moisture Absorption – Shall not contain more than 2 percent moisture and shall not gain in mass by more than 2 percent.

2.5 Incombustibility – Shall be found to be incombustible. The loss in total mass, when tested for incombustibility, shall not exceed 5 percent.

2.6 Thermal Conductivity – Shall not exceed the values given below:

Mean Tempe- rature °C	Thermal Conductivity mW/cm°C			
	Group 1	Group 2	Group 3	Group 4
50	0.43	0.43	0.43	0.43
100	0.52	0.52	0.52	0.52
150	0.64	0.62	0.62	0.62
200	0.78	0.73	0.70	0.68
250	0.93	0.85	0.85	0.80
300	1.10	1.00	1.00	0.90

2.7 Dimensions – Shall be supplied as hollow cylinders split lengthwise on one or both sides of the cylindrical axis, with lengths of 50 cm, 60 cm, 75 cm, 90 cm and 100 cm to fit standard size of pipe and tubing. The nominal thicknesses regularly furnished shall be 25 mm, 40 mm, 50 mm, 60 mm, 75 mm, 90 mm and 100 mm. Nominal thicknesses greater than 60 mm may be furnished in multiple layers.

2.7.1 Dimensional Tolerance – For length, the tolerance shall be 0.5 percent; excess is permitted. For nominal thickness up to 75 mm the tolerance shall be + 5 mm, – 2 mm. For greater nominal thicknesses, the tolerance on thickness shall be as agreed to between the purchaser and the supplier. When installed on the pipe of the specified size, sections shall fit snugly and shall have tight longitudinal and circumferential joints.

2.8 Linear Shrinkage – Shall be not greater than 2 percent when subjected to condition of soaking heat at the static maximum temperature of use for 24 hours.

Note– To avoid crushing the ends of the specimen, travelling microscope should be used.

2.9 Heat Resistance – Shall not suffer any visible deterioration of the fibrous structure and shall not show any evidence of internal self-heating when heated to the maximum recommended temperature of use, as specified by the manufacturer.

2.10 Recovery After Compression – The recovery, after compression to 75 percent of the original thickness, shall be not less than 90 percent of the original thickness.

2.11 Sulphur Content – Shall not contain more than 0.6 percent of sulphur.

2.12 Optional Requirements

2.12.1 Alkalinity – The pH of the solution of the material shall be between 7.0 and 10.0.

2.12.2 Resistance to Micro-organisms – Shall not show any mould or bacterial growth.

2.12.3 Odour Emission Test – There shall be no apparent difference in odour of the butter, when compared with the blanks.

2.12.4 Corrosive Attack – Shall not cause corrosion of the surface on which it is applied.

Note – For method of tests, refer to Appendices A and B of the standard, IS 3144 : 1992 Mineral wool thermal insulation materials – Methods of test (*second revision*), IS 3346 : 1980 Method of determination of thermal conductivity of thermal insulating materials (two slab guarded hot plate method) (*first revision*), IS 5688 : 1982 Methods of test for preformed block-type and pipe covering type thermal insulation (*first revision*), and IS 5724 : 1970 Method of test for thermal insulating cements.

For detailed information, refer to IS 9842 : 1994 Specifications for Preformed fibrous pipe insulation (first revision).

SUMMARY OF

IS 11128 : 1984 SPRAY – APPLIED HYDRATED CALCIUM SILICATE THERMAL INSULATION

1. Scope – Requirements and methods of sampling and test for spray-applied, hydrated calcium silicate thermal insulation.

2. Requirements

2.1 Sprayable hydrated calcium silicate insulation shall be composed predominantly of calcium silicate mineral or refractory fibres and a suitable proportion of inorganic, heat-resistant binder. The binder and the fibres shall be uniformly blended and shall not separate during normal handling and spraying operations. The fibre content shall be less than 15 percent.

2.2 Density — The applied and dried density of the material shall be in the range of 160-350 kg/m³ and shall not vary by more than ± 10 percent from the value declared by the manufacturer.

2.3 Compressive Strength — Shall be as given below:

<i>Deformation, Percent</i>	<i>Compressive Strength, kPa (kN/m²), Min</i>
5	285
10	500

2.4 Thermal Conductivity – Shall not exceed the values given below:

<i>Mean Temp- erature °C</i>	<i>Thermal Conductivity W/m.K</i>
100	0.069
200	0.081
300	0.097
400	0.117
500	0.144

2.5 Adhesion – Adhesion of dried thermal insulation to steel shall be 3.65 kN/m².

2.6 Heat Resistance – Shall not suffer visible deterioration when tested to the maximum recommended temperature of use. At increasing temperatures, the material shall be deemed suitable for use conditions of soaking heat for 24 hours up to the specified temperature at which the following requirements are met :

- a) Linear shrinkage – 2 percent, *Max*
- b) Loss in mass – 15 percent, *Max*
- c) Compressive strength – 10 percent, *Max*
reduction in thickness
under a load of 345 kN/m²

2.7 Incombustibility – Shall be found to be incombustible.

2.8 Moisture Content – Shall not exceed 7.5 percent.

2.9 Optical Requirement

2.9.1 Fire Protection – When the material is to be used for fire protection, it shall satisfy the time-temperature curve as agreed to between the purchaser and the supplier.

Note – For method of tests, refer to IS 3144 : 1992 Mineral wool thermal insulation materials – Methods of test (*second revision*), IS 3346 : 1980 method of determination of thermal conductivity of thermal insulating materials (two slab guarded hot plate method) (*first revision*), IS 5688 : 1982 Methods of test for preformed block-type and pipe covering type thermal insulation (*first revision*), and IS 5724 : 1970 Method of test for thermal insulating cements.

For detailed information, refer to IS 11128 : 1984 Specifications for spray - applied hydrated calcium silicate thermal insulation.

SUMMARY OF

IS 11307 : 1985 CELLULAR GLASS BLOCK AND PIPE THERMAL INSULATION

1. Scope – Requirements and methods of sampling and test for cellular glass block and pipe thermal insulation intended for use on surfaces operating at temperatures between -200°C and 425°C .

2. Requirements

2.1 General – Shall consist of a glass composition that has been formed or cellulated under molten conditions, annealed, and set to form a rigid incombustible material with hermetically-sealed cells. The material shall be trimmed into blocks of standard dimensions or commercial sizes. It shall not have visible defects that may adversely affect its service qualities.

2.2 Bulk Density – The average value shall be $160 \pm 15 \text{ kg/m}^3$.

2.3 Thermal Conductivity – The average value shall be as given below:

Mean Temperature $^{\circ}\text{C}$	Thermal Conductivity, Max W/mK
150	0.082
65	0.064
0	0.048
-65	0.043

2.4 Compressive Strength – The average value shall be not less than 520 kPa with the exception given in 3.4 of the standard.

2.5 Flexural Strength – The average minimum value shall be 410 kPa with the exceptions given in 3.5 of the standard .

2.6 Water Absorption – Shall be not more than 0.6 percent by volume.

2.7 Standard Shapes, Sizes and Dimensional Tolerances

2.7.1 Flat Blocks – Block shall be of rectangular sections and shall be true to form and dimension, the corners square and the sides and edges parallel. Sizes and thickness shall be as given below, and the tolerance on each nominal dimension shall be $\pm 1.6 \text{ mm}$.

Length	450 or 600 mm
Width	300 or 450 mm
Thickness	25, 40, 50, 60, 75, 100 or 125 mm

2.7.2 Pipe Sections – Pipe sections shall be supplied, with or without facing as agreed to between the purchaser and the supplier, as hollow cylindrical shapes split in half lengthwise (in plane including the cylindrical axis) or as curved segments. The insulation shall be furnished in sections or segments of dimensions given below, and the tolerance on each nominal dimensions shall be $\pm 3.2 \text{ mm}$.

Length	450 or 600 mm
Diameter	To fit standard pipes of external dia up to 219 mm
Thickness	20, 25, 40, 50, 60, 75 or 100 mm

2.7.3 Special Shapes – Dimensions and tolerances on nominal dimensions of special shapes shall be as agreed to between the purchaser and the supplier.

2.7.4 Uniformity – The local thickness of the insulation material at any point shall not vary from the average thickness by more than $\pm 3 \text{ mm}$.

Note – For method of tests, refer to Appendix A of the standard, IS 3346 : 1980 Method of determination of thermal conductivity of thermal insulating materials (two slab guarded hot plate method) (*first revision*), and IS 5688 : 1982 Methods of test for preformed block-type and pipe covering type thermal insulation (*first revision*).

For detailed information, refer to IS 11307 : 1985 Specifications for cellular glass block and pipe thermal insulation.

SUMMARY OF

IS 11308 : 1985 HYDRAULIC SETTING THERMAL INSULATING
CASTABLES FOR TEMPERATURE UPTO 1250°C

1. Scope – Requirements and methods of sampling and test for hydraulic setting thermal insulating castables for use as either hot face or cold face backing of refractory linings, at temperatures up to 1250°C.

2. Types

- a) Type 1050 – Suitable for use at temperatures up to 1 050°C, and
- b) Type 1 250 – Suitable for use at temperatures up to 1 250°C.

3. Requirements

3.1 General – Shall be in the form of dry powder with maximum grain size 5 mm.

3.2 Moisture Content – Shall not contain more than 2 percent moisture by mass.

3.3 The material shall also conform to the requirements given in Table 1.

3.4 Ferric Oxide Content – For temperatures up to 1 250°C shall be 5 percent, maximum

**TABLE 1 REQUIREMENTS FOR HYDRAULIC SETTING THERMAL INSULATING
CASTABLES FOR TEMPERATURES UPTO 1 250°C.**

Sl No.	Characteristic	Requirements	
		Type 1 050	Type 1 250
i)	Density after moulding and drying at 110°C kg/m ³ , <i>Max</i>	1 000	1 400
ii)	Crushing strength after curing and drying at 110°C, kN/m ² , <i>Min</i>	1 350	3 000
iii)	Thermal conductivity, W/mk <i>Max</i> : <i>Mean Hot face</i> <i>Temperature Temperature</i> <i>(Approximate)</i> °C °C		
	200 350	0.23	0.46
	400 725	0.30	0.51
	500 900	0.30	0.58
iv)	Heat resistance when subjected to soaking heat for 24 hours at 1 050°C and 1 250°C respectively:		
a)	Linear shrinkage (length) percent, <i>Max</i>	1.5	1.5
b)	Loss in mass, percent, <i>Max</i>	15	15
c)	Crushing strength, kN/m ² , <i>Min</i>	900	2000

Note – For method of tests, refer to Appendix A of the standard, IS 3144 : 1992 Mineral wool thermal insulation materials - Methods of test (*second revision*), IS 3346 : 1980 Method of determination of thermal conductivity of thermal insulating materials (two slab guarded hot plate method) (*first revision*), IS 5688 : 1982 Methods of test for preformed block-type and pipe covering type thermal insulation (*first revision*), and IS 5724 : 1970 Method of test for thermal insulating cements, and IS 9490 : 1980 Method of determination of thermal conductivity of insulation materials (water calorimeter method).

For detailed information, refer to IS 11308 : 1985 Specification for hydraulic setting thermal insulating castables for temperatures up to 1250°C.

SUMMARY OF

IS 12436 : 1988 PREFORMED RIGID POLYURETHANE (PUR) AND POLYISOCYANURATE (PIR) FOAMS FOR THERMAL INSULATION

1. Scope – Requirements, and the methods of sampling and test for preformed rigid polyurethane (PUR) and polyisocyanurate (PIR) foam for thermal insulation in the form of boards, cut and moulded slabs, cut and moulded pipe sections, cut and moulded radiused and bevelled lags, panels with adhesive integrally laminated facings, panels with adhesive applied facings, and cut and moulded special shapes.

2. Classification

2.1 Type – The rigid preformed cellular urethane thermal insulation materials shall be of two types:

Type 1 – For general use.

Type 2 – For use where there is a requirement for greater resistance to compressive forces.

5. Standard Sizes and Dimensions – In the case of finished boards of both the types, the sizes shall be either 1.0×0.5 m or 1.22×0.61 m or as agreed to between the purchaser and the supplier. The size for pipe-section and lags shall be 1.0 or 0.5 m length unless otherwise agreed to between the purchaser and the supplier, and the bore shall be the specified outside diameter of the pipe to be lagged.

2.2 Grades – The rigid preformed cellular urethane thermal insulation materials shall be of two grades:

PUR – Rigid polyurethane foam whose maximum recommended operating temperature is up to 110°C.

PIR – Rigid polyisocyanurate foam whose maximum recommended operating temperature is up to 140°C.

3. Compositions – Shall consist of rigid polyurethane or rigid polyisocyanurate foam with substantially closed cell structure.

4. Requirements – Shall conform to the requirements given in Table 1.

5.1 Thickness — The material shall normally be supplied in thickness of 20, 25, 30, 40, 50, 60, 75, 90 and 100 mm or as agreed to between the purchaser and the supplier.

5.2 Tolerance — See Table 2 and 3.

TABLE 1 REQUIREMENTS FOR RIGID PREFORMED CELLULAR URETHANE FOAM THERMAL INSULATION MATERIALS

Sl No.	Characteristic	Requirements			
		PUR 1	PUR 2	PIR 1	PIR 2
i)	Dimensional Stability at $100 \pm 2^\circ\text{C}$ percent, for 24 h, <i>Max</i>	± 2	± 2	± 2	± 2
ii)	Water vapour transmission, <i>Max</i> , ng/Pasm	5.5	5.5	8.5	8.5
iii)	Closed cell content, Min, Percent	85	85	85	85
iv)	Compressive strength at 10 percent deformation, Min, kN/m ²	115	205	115	205
v)	Thermal conductivity (w/m.k), <i>Max</i> , at 50°C 10°C	0.023	0.023	0.023	0.023
vi)	Horizontal burning, <i>Max</i> , mm	125	125	25	25

TABLE 2 DIMENSIONAL TOLERANCES FOR PIPE SECTIONS AND LAGS

Sl No.	Dimensions	Permissible Deviations Moulded/Cut Pipe Sections and Lags mm
i)	Lengths	± 3
ii)	Bores less than 150 mm	+ 2 – 0
iii)	Bores 150 mm and above	+ 3 – 0
iv)	Outside diameters less than 150 mm	+ 2 – 0
v)	Outside diameters 150 mm and above	+ 3 – 0

6. Workmanship and Finish

6.1 General — Shall not have visible defects that would adversely affects its service qualities.

6.2 Pipe Sections — Shall be supplied in two semi-circular pieces; the longitudinally mating faces shall be flat and in the same plane so that when the two pieces are put together no gaps exist between the mating surfaces.

Note — It is common practice for the mating faces while still being flat in the length-wise direction to have a variable profile in the radial direction. This is acceptable provided that the mating surfaces so created still fits snugly together. In many cases, this practice enhances the snugness of the fit.

6.2.1 The ends shall be flat and normal to the

TABLE 3 DIMENSIONAL TOLERANCES FOR SLABS

All dimensions in millimeters.			
Sl Lengths Noor Widths	Permissible Deviations of Lengths or Widths	Max Differences in the Lengths of the Diagonals of Rectangular Slab	Thickness Tolerance
i) Up to and including 1000	± 2	5	±2
ii) Over 1000 up to and including 2500	±4	8	±2

longitudinal axis of the sections.

6.3 Radiused and Bevelled Lags – The mating bevelled edges shall be flat, so that when they are put together to form a cylinder no gaps exists between abutting lags.

6.3.1 The ends shall be flat and normal to the longitudinal axis of the lag.

Note — No values are specified for their width on the outer and inner faces.

6.4 Moulded Components – All moulded items shall be free from grease or other mould release agent that will adversely reduce the adhesion of insulation, mastics and adhesives.

6.5 Colour Identification – PIR foam shall be supplied coloured pink. PUR foam shall be supplied in any other colour or without added colour, as required.

Note 1– For notes on guidance to user/designers refer to Appendix A of the standard.

Note 2– For method of tests, refer to IS 3346 : 1980 Method of determination of thermal conductivity of thermal insulation material (two slab guarded hot plate method) (*first revision*) and relevant parts of IS 11239 : 1985 Method of test for cellular thermal insulating materials.

For detailed information, refer to IS 12436 : 1988 Specifications for Preformed rigid polyurethane (PUR) and polyisocyanurate (PIR) foams for thermal insulation.

SUMMARY OF

IS 13204 : 1991 RIGID PHENOLIC FOAM FOR THERMAL INSULATION

1. Scope – Requirements and methods of sampling and test for rigid for phenolic foam for thermal insulation purposes. It applies to slab (blocks, boards and profiled sheets) and profiled sections (pipe sections and radiused or bevelled lags) cut from pipes. The nominal temperature range for which the insulation material is suitable is -180 to $+130^{\circ}\text{C}$ without any facing. The material is normally supplied with craft paper facing on both sides.

This standard is not applicable to continuously extended phenolic foam pipe insulating sections.

2. Requirements

2.1 Composition — Shall consist of phenolic foam of uniform cellular structure.

2.2 The rigid phenolic foam faced or unfaced shall conform to the requirements given in Table 1.

TABLE 1 REQUIREMENT OF RIGID PHENOLIC FOAM

Sl No.	Characteristic	Requirement
i)	Density, kg/m^3	32-60
ii)	Compressive strength at 10 percent deformation, <i>Min</i> , kPa	100
iii)	Dimensional stability; percent linear change after 7 days at $70\pm 2^{\circ}\text{C}$ and 95 ± 5 percent RH, <i>Max</i>	1.5
iv)	Water vapour permeability rate at 38°C and 88 percent RH, ng/Pa.s.m , <i>Max</i>	5.5
v)	Apparent water absorption percent by volume, <i>Max</i>	7.5
vi)	Horizontal burning, mm, <i>Max</i>	25
vii)	Closed cell content, percent, <i>Min</i>	60
viii)	Thermal conductivity at 53°C after 30 days of manufacture W/m , $^{\circ}\text{K}$, <i>Max</i>	0.034

3. Sizes and Dimensions

3.1 In the case of finished boards of all the three types, the sizes shall be either $1.0\text{ m} \times 0.5\text{ m}$ or $1.22\text{ m} \times 0.61\text{ m}$

or as agreed to between the purchaser and the supplier. The size for pipe-section and lags shall be 1.0 or 0.5 m length unless otherwise agreed to between the purchaser and the supplier, and the bore shall be the specified outside diameter of the pipe to be lagged.

3.2 Thickness – The material shall normally be supplied in thickness of 20, 25, 30, 40, 50, 60, 75, 90 and 100 mm.

3.3 Tolerance – Shall not deviate from those specified by more than the appropriate tolerances given in Tables 2 and 3. For slabs, the permissible thickness deviations shall be $\pm 2\text{ mm}$.

TABLE 2 DIMENSIONAL TOLERANCES FOR PIPE SECTIONS AND LAGS

Sl No.	Dimensions	Permissible Deviations	
		Moulded	Cut Pipe Section and Lags
		mm	mm
i)	Lengths	± 3	± 3
ii)	Bores less than 150 mm	$+2$ -0	$+2$ -0
iii)	Bores 150 mm and above	$+3$ -0	$+3$ -0
iv)	Outside diameters less than 150 mm	$+2$ -0	$+2$ -0
v)	Outside diameters 150 mm and above	$+3$ -0	$+3$ -0

TABLE 3 DIMENSIONAL TOLERANCES FOR SLABS

Sl No	Lengths or Widths	Permissible Deviations of Lengths or Widths	Max Differences in the Lengths of the Diagonals of Rectangular Slab	Thickness Tolerance
	mm	mm	mm	mm
i)	Up to and including 1000	± 2	5	± 2
ii)	Over 1000 up to and including 2000	± 3	7	± 2

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4. Workmanship and Finish

4.1 General – Shall not have visible defects that would adversely affects its service qualities.

4.2 Profiled Sections –

4.2.1 Pipe Sections – Pipe sections shall be supplied in two semicircular pieces with the longitudinally mating surfaces flat and in the same plane, so that when the

two pieces are put together no gap exist between the mating surfaces. The ends shall be flat and normal to the longitudinal axis of the sections.

4.2.2 Radiused and Bevelled Lags – The mating bevelled edges shall be flat, so that when they are put together to form a cylinder no gaps exist between abutting lags. The ends shall be flat and normal to the longitudinal axis of the lag.

Note1 – For notes on guidance to user/designers refer to Appendix A of the standard.

Note2 – For method of tests, refer to IS 3144 : 1992 Mineral wool thermal insulation materials Methods of tests (*second revision*), IS 3346 : 1980 Method of determination of thermal conductivity of thermal insulating materials (two slab guarded hot plate method) (*first revision*) and relevant parts of IS 11239 : 1985 Method of test for cellular thermal insulating materials.

For detailed information , refer to ISI 13208 : 1991 Specifications for rigid phenolic foam for thermal insulation.

SECTION 24

PLASTICS

CONTENTS

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IS 2036 : 1995	Phenolic laminated sheets (<i>second revision</i>)	24.3
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IS 14443 : 1997	Polycarbonate sheets	24.17
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SUMMARY OF
IS 2036 : 1995 PHENOLIC LAMINATED SHEETS
(Second Revision)

1. Scope

1.1 Requirements and the methods of sampling and test for phenolic resin bonded laminated sheets of one class in which the mechanical properties in directions A and B are of the same order, with asbestos, woven cotton fabric and cellulose paper reinforcements and covers seventeen types.

1.2 Covers only sheets of a nominal thickness from 0.4 to 50 mm for cellulose paper based types and nominal thickness from 0.4 mm to 100 mm for woven cotton fabric and asbestos reinforced types.

1.3 Also prescribes requirements for phenolic resin bonded paper laminated sheet sanded on one side, of nominal thickness in the range 0.4 mm to 3 mm inclusive.

Note — It is permissible for sheet complying with this standard to contain additives.

2. Classification

- a) Group A – Sheets with asbestos reinforcement comprising of following types—

Type	Reinforcement
A 1	Asbestos felt
A 2 and A 5	Asbestos paper
A 3 and A 4	Woven asbestos cloth

- b) Group F – Sheets with fabric reinforcement made from cotton or cotton/synthetic fibre mixture comprising types F1, F2, F2/1, F3, F4 and F5.

- c) Group P – Sheets with cellulose paper reinforcement comprising types P1, P2, P2/1, P3, P3/1 and P4.

Note — For applications and distinguishing properties refer to Table 1 of the standard.

3. Requirements**3.1 Appearance and Workmanship**

3.1.1 Shall be free from blisters, wrinkles and cracks and from other visible defects. Sheets shall be of uniform appearance and be free from other small defects, for example, scratches, dents, inclusions, excessive mottling and discolouration. Sheets shall be supplied with trimmed edges.

3.2 Flatness – When any sheet of nominal thickness 3 mm or more is placed without restraint, concave side up, on a flat horizontal surface, the departure at any part of the upper surface of the sheet from a light straightedge laid in any direction upon it shall not exceed the values given in Table 1.

TABLE 1 DEPARTURE FROM STRAIGHTEDGE

All dimensions in millimeters.

Thickness	Departure from straightedge	
	1 000 mm Straight-edge	500 mm Straight-edge
3 to 8 inclusive	8	2
Over 8	6	1.5

3.3 Nominal Thickness and Permissible Deviations – Preferred nominal thickness shall be 0.4, 0.5, 0.6, 0.8, 1.0, 1.2, 1.6, 2.0, 3.0, 4.0, 5.0, 6.0, 8.0, 10.0, 12.0, 14.0, 16.0, 20.0, 25.0, 30.0, 35.0, 40.0, 45.0, 50.0, 60.0, 70.0, 80.0, 90.0 and 100.0 mm.

Note — Thickness of the sheet at any point shall not deviate by more than the value given in Table 3 of the standard.

3.4 Machinability – When sawn, drilled turned, routed, milled or punched in accordance with the manufacturer's recommendations the sheet shall not show any sign of splitting, cracking or delamination.

3.5 Resistance to Hot Oil – Sheets shall not show any sign of splitting, blistering, disintegration, appreciable warping or delamination.

3.6 Physical and Electrical Properties — Shall further comply with the requirements in Tables 4 to 6 of the standard.

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4. Optional Requirements – Shall comply with requirements given in Table 7 of the standard, if agreed.

5. Sanded Sheets

5.1 General – Sanded sheets of types P2/1, P3, P3/1 and P4 of any nominal thickness in the range of 0.4 mm to 3 mm shall be produced by sanding one or both sides. Before sanding, the sheets shall comply with requirements of **3** except **3.3**.

5.2 Deviations of Thickness – ± 0.050 mm for thickness up to and including 1.6 mm + 0.1 mm at higher values up to and including 3 mm.

5.3 Insulation Resistance – Shall not be less than following –

<i>Types</i>	<i>Values, m Ω</i>
P2/1	30
P3	500
P3/1	100
P4	1000

5.4 Water Absorption – Shall not exceed the limits specified.

Note – For methods of tests, refer to Appendices A to K of the standard, IS 1998 : 1962, Methods of test for thermosetting synthetic resin bonded laminated sheets, and, IS 13411 : 1992 Glass reinforced polyester dough moulding compound (DMC).

For detailed information, refer to IS 2036 : 1995 Specifications for phenolic laminated sheets (second revision).

SUMMARY OF
IS 2046 : 1995 DECORATIVE THERMOSETTING SYNTHETIC
RESIN BONDED LAMINATED SHEETS
(Second Revision)

1. Scope – Requirements and the methods of sampling and test for decorative laminated sheets (HPL) classified according to their performance and main recommended fields of application and provides also for materials of special characteristics, for example, post formability or defined reaction to fire. They are intended for interior applications.

2. Classification – Consists of a materials type with three index numbers describing levels of performance. An alphabetical classification system can also be used as an alternative. Table 1 compares the two systems and typical application.

2.1 Index numbers for specifying HPL properties –

- a) Index for – resistance to surface wear (First Index Number)
- b) Index for – resistance to impact by small diameter ball (Second Index Number)
- c) Index for resistance to scratching (Third Index Number)

Note — For details refer Table 2, 3 and 4 of the standard

2.2 *Special Characteristics* – Material type

Type S–Standard type decorative laminated sheet

Type P–Post formable Decorative laminated sheet

Type F–Decorative laminated sheets having defined reaction to fire.

2.3 *Nomenclature* – In addition to the prefix HPL and the number of this standard, materials can be specified either by the type and index number system or by the alphabetical classification system.

For Example, horizontal general purpose post forming laminate can be specified as, HPL - IS 2046-P333 or HPL - IS 2046- HGP.

3. Requirements

3.1 *Colour and Pattern* – When inspected in daylight (or D 65 standard illuminant and again under a tungsten illuminant) there shall be no significant difference between a standard agreed by the supplier and the specimen under test.

3.2

Surface Finish

3.2.1 When inspected at a different viewing angles, there shall be no significant difference between a standard agreed by the supplier and the specimen under test.

3.2.2 *Reverse side/bonding* – The reverse side of sheets having only one decorative surface shall be suitable for adhesive bonding if so required.

3.3 *Thickness* – No requirements specified, however, variations from the nominal thickness supplies shall at no point exceed the limits shown in Table 2.

TABLE 2 PERMITTED VARIATIONS OF THICKNESS

All dimensions in millimeters.		
Sl No.	Nominal Thickness, <i>t</i>	Maximum Variation
i)	$0.5 \leq t \leq 1.0$	± 0.10
ii)	$1.0 < t \leq 2.0$	± 0.15
iii)	$2.0 < t \leq 2.5$	± 0.18
iv)	$2.5 < t \leq 3.0$	± 0.20
v)	$3.0 < t \leq 4.0$	± 0.25
vi)	$4.0 < t \leq 5.0$	± 0.30
vii)	$5.0 < t$	As agreed

3.4 *Appearance* – The following inspection requirements are intended as a general guide, indicating the minimum acceptable quality to laminate supplies as full size sheets:

- i) Surface defects
- ii) Edge defects
- iii) Broken corners
- iv) Sanding defects
- v) Warping (Flatness)
- vi) Length and width of a full size laminate
- vii) Straightness of edges
- viii) Squareness of the laminate

Note – For details refer to 5.4 of the standard.

TABLE 1 CLASSIFICATION SYSTEM AND TYPICAL APPLICATIONS

Sl No.	Performance Category	Type	Index Number			Equivalent Alphabetical Classification	Typical Applications
			Wear	Impact	Scratch		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Thick materials of high performance for special use in horizontal and vertical applications requiring particularly high impact and moisture resistance.	Compact S or Compact F	3	2	3	CGS (Compact general purpose standard) CGF (Compact general purpose flame retardant)	Doors, partitions, walls, various self-supporting components, construction and transportation
ii)	Very high resistance to surface wear High impact resistance Very high resistance to scratching	S or F	4	3	4	HDS (Horizontal heavy duty standard) HDF (Horizontal heavy duty flame retardant)	Countertops, flooring on special substrate
iii)	High resistance to surface wear High resistance to impact High resistance to scratching	S, F or F	3	3	3	HGS (Horizontal general purpose standard) HGP (Horizontal general purpose fire retardant)	Kitchen working surfaces, restaurants and hotel tables, heavy duty doors and wall coverings, interior walls of public transport vehicles.
iv)	High resistance to surface wear Moderate resistance to impact High resistance to scratching	S, F or P	3	2	3	—	Horizontal applications for office (Computer tables) and bathroom furniture
v)	Moderate resistance to surface wear High resistance to impact Moderate resistance to scratching	S or F	2	3	2	VGS (Vertical general purpose standard) VGF (Vertical general purpose flame retardant)	—
vi)	Post forming material with moderate resistance to impact	P	2	2	2	VGP (Vertical general purpose post forming)	Front panels for kitchen, office and bathroom furniture, wall coverings, shelves
vii)	Low resistance to surface wear Moderate resistance to impact and scratching	S, F or P	1	2	2	—	Special decorative surface effects for vertical use in kitchen, showroom, etc.
viii)	Low resistance to surface wear and scratching Moderate resistance to impact	S	1	2	1	VLS (Vertical light duty standard)	Exposed side components of cupboards

3.5 Other Properties – Shall satisfy the requirements given below –

- | | |
|---|---|
| i) Resistance to surface wear | ix) Resistance to scratching. |
| ii) Resistance to immersion in boiling water. | x) Resistance to staining. |
| iii) Resistance to dry heat at 180°C. | xi) Resistance to colour change in xenon arc light. |
| iv) Dimensional stability at elevated temperatures | xii) Resistance to cigarette burns |
| v) Dimensional stability at 20°C. | xiii) Formability |
| vi) Resistance to impact by small diameter ball. | xiv) Resistance to blistering |
| vii) Resistance to impact by large diameter ball
(self supporting compact laminates) | xv) Resistance to steam. |
| viii) Resistance to cracking (thin laminates) | xvi) Resistance to crazing (thick laminates) |
| | xvii) Resistance to moisture (Double faced compact laminates) |
| | xviii) Flexural modulus |
| | xix) Flexural strength |
| | xx) Tensile strength |

Note – For details refer to Table 7 of the standard.

Note – For method of tests refer to Appendices A to Y of the standard, IS 8543 (Part 4/ Sec 1) : 1984 Methods of testing plastics: Part 4 Short term mechanical properties, Section 1 Determination of tensile properties and IS 13411 : 1992 Glass reinforced polyester dough moulding compounds (DMC).

For detailed information, refer to IS 2046 : 1995 Decorative thermosetting synthetic resin bonded laminated sheets (second revision).

SUMMARY OF
IS 2508 : 1984 LOW DENSITY POLYTHYLENE FILMS
(Second Revision)

1. Scope

1.1 Requirements and methods of sampling and test for natural and black colour (carbon black pigment) low density polyethylene films intended for packaging, canal lining, agricultural operations and post harvest uses, construction work and allied purposes.

1.2 This standard cover flexible, unsupported flat or tubular films 12.5 to 250 mm in thickness and width 175 to 7 500 mm (350 to 15 000 mm slit open width in the case of tubular films), made from polyethylene materials having a density between 0.913 to 0.937 g/ml at 27°C (0.915 to 0.939 g/ml 23°C)

1.3 Coloured film other than black shall be as agreed to between the supplier and the purchaser.

2. Grades – Film shall be classified according to the optical properties, impact strength and slip. Each grade shall be designated by a set of 3 numerals : first one for optical property, second for impact strength and third for slip property. Numeral 0 shall mean the material has not been tested for that particular property. For clarity, impact strength and slip property, numerals 1, 2, 3 and 4 shall mean the following

<i>Numeral</i>	<i>Clarity</i>	<i>Impact</i>	<i>Slip Property</i>
1	Low	Low	Low
2	Normal	Normal	Medium
3	High	High	High
4	–	–	Extra High

2.1 For example, Grade 210 shall mean that the film is of normal clarity, low impact strength and slip has not been tested.

3. Requirements**3.1 General**

3.1.1 Appearance – Shall be uniform in colour, texture and finish and free from pin-holes and substantially free from undispersed raw materials, streaks and particles of foreign matters. Shall have no other defects, such as holes, tears, or blisters. The edges shall be free from

nicks and cuts visible to unaided eye. The natural films shall be free from pin holes.

3.1.2 Film form – Shall be in the form of flat sheet or rolls or flat tubing or as agreed.

3.1.3 Odour – Shall be free from objectionable odours.

3.1.4 Density – Shall be as prescribed

3.1.5 Melt flow index – Shall be as prescribed

3.1.6 Black film – Percentage of carbon black in the material shall be 2.5 ± 0.5 percent by mass and its dispersion shall be satisfactory.

3.2 Dimensional Requirements**3.2.1 Tolerance on thickness**

<i>Nominal Thickness</i>	<i>Tolerance, percent</i>
Up to and including 40 μm	± 25
Above 40 μm	± 20

3.2.2 Tolerance on width

<i>Nominal Width</i>	<i>Tolerance, mm</i>
Up to 500	± 5
Above 500 and up to 1250	± 8
Above 1 250 and up to 2500	± 20
Above 2 500 and up to 3000	± 40
Above 3 000 and up to 7500	+150-65
Above 7 500 and up to 15000	+200-100.

3.2.3 Yield Tolerance

One roll	± 10 percent
Lots of 250 kg	± 10 percent
Lots over 250 kg and upto 1 250 kg	± 5 percent
Lots over 1 250 kg	± 3 percent

3.3 Tensile Strength at Break – Not less than 11.77MN/m² (120 kgf/cm²) in length wise direction and 8.33 Mn/m² (85 kgf/cm²) in crosswise direction.

3.4 Elongation at Break

Thickness of the Film	Elongation at Break, Min.	
	Lengthwise, Percent	Crosswise, Percent
From 12.5 µm up to but not including 75 µm	100	350
75 µm and above	200	400

3.5 Optical Properties – 45° gloss and haze of the film shall conform to requirements given below

Grade	45° Gloss	Haze
Low clarity film	Below 30	Greater than 15 Per.
Normal clarity film	30 to 55	10 to 15 percent
High clarity film	Greater	6 to 10 percent than 55

Note – These two measurement do not always correlate and this clause is not relevant to black films.

3.6 Impact Resistance

3.6.1 Low impact resistance film

Average thickness of film, µm	Impact Failure Load, Min N(gf)
12.5	0.4 (40)
20	0.6 (60)
25	0.8 (80)
40	1.25 (125)

3.6.2 Normal impact resistance film

Average thickness µm	Impact failure load, Min N (gf)
40	0.55 (55)
50	0.70 (70)
75	1.00 (100)
100	1.20 (120)
125	1.60 (160)
150	1.85 (185)
175	2.10 (210)
200	2.35 (235)
225	2.60 (260)
250	3.00 (300)

3.6.3 High impact resistance film

Average Thickness µm	Impact Failure Load, Min. N(gf)
50	90
75	125
100	165
125	210
150	255
175	295
200	340
225	380
250	425

3.7 Slip – Kinetic coefficient of friction shall be as follows:

- | | |
|-------------------------|--|
| a) Low slip film | Greater than 0.40 |
| b) Medium slip film | Greater than 0.30 and up to and including 0.40 |
| c) High slip film | Greater than 0.20 and up to and including 0.30 |
| d) Extra high slip film | upto and including 0.20 |

Note – For special requirements refer to 4.9 of the standard.

Note – For method of tests, refer to A of the standard and IS 2530 : 1963 Methods of test for polyethylene moulding materials and polyethylene compounds.

For detailed information, refer to IS 2508 : 1984 Specifications for low density polyethylene films (second revision).

SUMMARY OF
IS 6307 : 1985 RIGID PVC SHEETS
(First Revision)

1. Scope – Requirements and methods of sampling and test for rigid PVC sheets of 0.10 to 12.5 mm in thickness, manufactured by calendering, extrusion or calendering followed by lamination.

2. Types

Type 1 – General purpose,

Type 2 – With specified impact strength, and

Type 3 – Suitable for deep draw vacuum forming.

3. Requirements

3.1 Appearance — Sheet shall be uniform in colour and finish, transparent or opaque, and shall be reasonably free from detrimental scratches, creases, streaks, pinholes, pimples and inclusions.

3.2 Thickness

Nominal Thickness mm	Tolerance on Thickness, Percent		
	Extruded	Calendered	Calender and Laminated
0.10 to 0.24	± 20	± 12	—
0.25 to 0.49	± 15	± 10	—
0.50 to 0.74	± 12	± 10	—
0.75 to 1.24	± 10	—	± 20
1.25 to 1.49	± 10	—	± 18
1.50 to 1.99	± 10	—	± 18
2.00 to 4.99	± 10	—	± 15
5.00 to 9.99	± 10	—	± 10
10.00 to 12.50	± 10	—	± 10

3.3 Length and Width – The length and width of rectangular sheets shall be within the tolerance $\begin{smallmatrix} -0 \\ +5 \end{smallmatrix}$ mm of the nominal size. For other shapes, the tolerances on linear dimensions shall be as agreed.

3.4 Squareness – Cut sheets shall not deviate more than 10 mm from a true rectangle of the same dimensions.

3.5 Other Requirements

Sl. Characteristic No.	Requirement		
	Type1	Type2	Type3
i) Vicat softening temperature, °C, <i>Min</i>	75	65	50
ii) Impact strength, number of failures	—	No failure	—
iii) Tensile stress at yield, kg/cm ² , <i>Min</i>	450	380	380
iv) Dimensional change at 120°C, percent, <i>Max</i> :			
a) Extruded or calendered	20	20	*
b) Calendered and laminated	5	5	15

* Limits shall be as agreed to between the purchaser and the supplier.

3.5.1 Delamination (for calendered and laminated sheet) – The material shall show no signs of delamination.

3.5.2 Horizontal burning characteristics – Shall also be tested for horizontal burning characteristics according to the test method prescribed if agreed to.

Note – For method of tests refer to Appendices A to G of the standard.

For detailed information, refer to IS 6307 : 1995 Specifications for rigid PVC sheets (first revision).

SUMMARY OF

IS 10889 : 1984 HIGH DENSITY POLYETHYLENE FILM

1. Scope – Requirements and the methods of sampling and test for natural and black colour (carbon black pigment) high density polyethylene films. Coloured films other than black shall be as agreed to between the purchaser and the supplier.

2. Grades

Grade 1 – High molecular mass, high density polyethylene (HM HDPE); and

Grade 2 – Medium molecular mass, high density polyethylene (MM HDPE).

3. Requirements

3.1 General

3.1.1 Appearance – Shall be uniform in colour, texture and finish. The material shall be substantially free from pinholes and reasonably free from undispersed raw materials, streaks and particles of foreign matter. There shall be no other visible defects, such as holes, tears or blisters. The edges shall be free from nicks and cuts visible to unaided eye.

3.1.2 Film Form – Shall be furnished in the form of flat sheet or rolls or in the form of flat tubing or in any other form as agreed.

3.1.3 Odour – Shall be free from any objectionable odour.

3.1.4 Density – Shall be as prescribed.

3.1.5 Melt flow index (i_5) – The melt flow index (i_5) of the film shall be as prescribed for the appropriate grade.

3.1.6 Black Film

a) The percentage of carbon black in the material shall be 2.5 ± 0.5 percent by mass; and

b) The dispersion of the carbon black shall be satisfactory.

3.2 Dimensional Requirements

3.2.1 Nominal Thickness – Is the theoretically desired thickness of a film for a particular application.

3.2.1.1 Tolerance on Thickness – At any given point and the average thickness of polyethylene films for various thicknesses shall be as follows

Nominal Thickness	Tolerance, percent	
	Grade 1 film	Grade 2 film
Up to and including 40 μm	± 25	± 25
Above 40 μm	± 20	± 20

3.2.2 Nominal Width – The theoretically desired width of a film for a particular application.

3.2.2.1 Tolerance on Width – Shall be as given below:

Nominal Width cm	Tolerance, mm	
	Grade 1 film	Grade 2 film
Up to to 50	± 5	± 5
Above 50 and up to 125	± 8	± 8
Above 125 and up to 250	± 20	± 20
Above 250 and up to 300	± 40	± 40
Above 300	± 65	± 65

3.3 Yield Tolerance – The actual yield shall be within the following tolerance limits of the nominal yields:

	Grade 1 film	Grade 2 film
One roll	± 10 percent	± 10 percent
Lots of 250 kg	± 10 percent	± 10 percent
Lots over 250 kg and upto 1 250 kg	± 5 percent	± 5 percent
Lots over 1 250 kg	± 3 percent	± 3 percent

3.4 Physical Properties

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3.4.1 Tensile Strength at Break – The minimum tensile strength at break for all thickness of polyethylene film shall be as under:

	Grade 1 film	Grade 2 film
Machine direction, kgf/cm ²	300	250
Transverse direction, kgf/cm ²	250	200

3.4.2 Elongation at Break – The elongation at break for all thickness of polyethylene film shall be as under:

	Elongation at Break, Min	
	Grade 1 film	Grade 2 film
Machine direction	300	300
Transverse direction	300	300

3.4.3 Impact Resistance (Falling Dart) : The impact failure load obtained from the drop of 66 cm shall not be less than that given below for appropriate average thickness of film:

Average Thickness of Film	Impact Failure Load, N(gf), Min	
μm	Grade 1 film	Grade 2 film
12.5	35	—
25.0	70	25
50.0	140	50
100.0	280	100

Note – Values for impact failure loads for intermediate thickness may be obtained by interpolation.,

Note – For methods of tests, refer to Appendix A of the standard.

For detailed information, refer to IS 10889 : 1984 Specifications for high density polyethylene films.

SUMMARY OF

IS 12830 : 1989 RUBBER BASED ADHESIVE FOR FIXING PVC TILES TO CEMENT

1. Scope – Requirements and the methods of sampling and test for rubber based adhesives used for bonding PVC tiles to cement, floors and walls of buildings.

2. Requirements

2.1 Description – The material shall be manufactured from rubber, compounding ingredients, resins and appropriate solvents. The colour of the material shall be compatible with the application of the material as may be agreed to between the purchaser and the supplier.

2.2 Consistency – The material shall be of a consistency suitable for its mode of application.

2.3 Open Assembly Time – The open assembly time shall be as agreed to between the purchaser and the supplier depending upon the application and shall not vary from batch to batch.

2.4 Adhesion Strength – The adhesion strength shall be as follows.

2.4.1 Strength of joint in shear – The material shall have shear strength not less than 8 kg/cm² after conditioning in standard atmospheric condition and not less than 6 kg/cm² after heat ageing and immersion in water.

2.5 Keeping Quality – The material shall comply with the requirements specified in 2.1 to 2.4 when it has been stored in the original closed containers according to the manufacturer's instructions for a minimum period of one year from the date of manufacture.

Note – For method of test refer to Appendices A to C of the standard.

For detailed information, refer to IS 12830 : 1989 Specifications for Rubber based adhesives for fixing PVC tiles to cement.

SUMMARY OF

IS 12994 : 1990 EPOXY ADHESIVES, ROOM TEMPERATURE CURING, GENERAL PURPOSE

1. Scope – Requirements and methods of sampling and test for liquid and paste type epoxy adhesives for performance : (a) up to 50°C, and (b) up to 100°C.

2. Types – There shall be four types of epoxy adhesives:

Type L 50 – Liquid adhesives for performance up to 50°C.

Type P 50 – Paste adhesives for performance up to 50°C.

Type L 100 – Liquid adhesives for performance up to 100°C.

Type P 100 – Paste adhesives for performance up to 100°C.

3. Requirements –

3.1 Properties of Uncured Components

3.1.1 Solids Content – Each component of the adhesive shall be free from volatile solvents, and the non-volatilise in each component shall be not less than 99.5 percent.

3.1.2 Viscosity – The viscosity of the individual components shall comply with the following requirements:

Type L 50 and L 100 – 10 000 mPas *Max*

Type P 50 and P 100 – 10 000 000 mPas *Max*

3.2 Properties of Uncured Mixture

3.2.1 Gelation Time of Liquid Adhesives – The gelation time of the mix of resin and hardener of Type L 50 and L 100 prepared in the ratio recommended by the manufacturer shall not be less than 30 minutes at a bath temperature of $27 \pm 1^\circ\text{C}$.

3.2.2 Spreadability of paste adhesives – A mass of 25 g of the adhesive of Type P 50 and P 100, when uniformly mixed with the prescribed hardener in the ratio recommended by the manufacturers, shall remain spreadable at a temperature of $27 \pm 1^\circ\text{C}$ for a minimum of 15 minutes.

3.2.3 Sagging – The uncured adhesive of Type P 50 and P 100, when uniformly mixed in the ratio recommended by the manufactures, shall not run, drip or sag.

3.3 Properties of Cured Adhesive Joints – The tensile shear strength of joints shall be not less than the following minimum values, after curing the joints for 24 hours at $27 \pm 1^\circ\text{C}$.

	<i>Types L 50 Types L 100 and P 50 and P 100</i>	
At 27°C (N/mm ²)	14	14
At 50°C (N/mm ²)	10	14
At 100°C (N/mm ²) –	12	

Note – For methods of tests refer to Appendices A to E of the standard.

For detailed information, refer to IS 12994 : 1990 Specifications for epoxy adhesives, room temperature curing, general purpose.

SUMMARY OF

IS 14182 : 1994 SOLVENT CEMENT FOR USE WITH UNPLASTICIZED POLYVINYL CHLORIDE PLASTIC PIPE AND FITTINGS

1. Scope – Requirements and methods of sampling and test for solvent cements to be used in joining unplasticized polyvinyl chloride pipe and fittings intended for use in carrying potable water. The pipes may be pressure or non-pressure type.

2. Requirements

2.1 The solvent cement shall be a solution of unplasticized polyvinyl chloride moulding or extrusion compound or PVC resin. The requirements for rigid PVC compound are given in Table 1 for information only.

2.2 The solvent cement shall be thixotropic and consist substantially of solvents that will swell plasticized PVC polymers and stabilizers. Fillers may be incorporated provided the resulting cement meets all the requirements of specification.

2.3 The solvent cement shall be capable of application by brush and shall contain no lumps or foreign matter or macroscopic undissolved particles that will adversely

affect the ultimate joint strength or chemical resistance of the material.

2.4 The cement shall show no gelation. It shall show no evidence of stratification or separation that cannot be removed by stirring.

2.5 When used for bonding pipes and fittings coming in contact with potable water, the cement, after evaporation of the solvent, shall conform to the requirements, when tested in accordance with relevant Indian Standards, as prescribed in 10.3 of IS 4985*.

2.6 The particular solvent system to be used in the formulation of this solvent cement is not specified, since several adequate solvent system for PVC are known. Solvent systems consisting of blends of tetrahydrofuran and cyclohexanone have been found to be acceptable under the requirements of this specification.

* Unplasticized PVC pipes for potable water supplies (*third revision*)

TABLE 1 REQUIREMENTS FOR RIGID PVC COMPOUND

Sl.No.Characteristic	Requirement
i) Tensile strength, MPa, <i>Min</i>	48.3
ii) Impact strength (Izod), J/m, <i>Min</i>	34.7
iii) Modulus of elasticity in tension, MPa, <i>Min</i>	2.758
iv) Deflection temperature under load, °C, <i>Min</i>	70
v) Chemical resistance	To pass the test
a) Change in mass	
Increase, percent by mass, <i>Max</i>	5.0
Decrease, percent by mass, <i>Max</i>	0.1
b) Change in flexural yield strength	
Increase, percent by mass, <i>Max</i>	5.0
Decrease, percent by mass, <i>Max</i>	25.0
vi) Resistance to oil change in mass	To pass the test
Increase, percent by mass, <i>Max</i>	1.0
Decrease, percent by mass, <i>Max</i>	1.0

2.7 Vinyl Chloride Polymer Content – The PVC resin content shall be minimum 10 percent by mass.

2.8 Dissolution – The cement shall be capable of dissolving an additional 3 percent by mass of unplasticized PVC granular, powder compound or resin at $27 \pm 2^\circ\text{C}$ without evidence of gelation.

2.9 Viscosity – Cements are classified as regular, medium or heavy bodied types, based on their minimum viscosity.

- i) Regular-bodied cement shall have a minimum viscosity of 90 mPa.s;

- ii) Medium-bodied cement shall have a minimum viscosity of 500 mPa.s; and

- iii) Heavy-bodied cement shall have a minimum viscosity of 1 600 mPa.s.

2.10 Lap Shear Strength – The minimum average lap shear strength, shall be 1.7 MPa after 2 h curing time, 3.4 MPa after 10 h curing time and 6.2 MPa after 72 h curing time.

2.11 Hydrostatic Burst Strength – The minimum average hydrostatic burst strength test, shall be 2.8 MPa after 2 h curing time.

2.12 Shelf Life – The manufacturer shall declare the shelf life of the product on the container.

Note 1– A guide for PVC solvent cement selection is given at Annex D of the standard.

Note 2– For methods of tests, refer to Appendices A to C of the standard, IS 2267 : 1995 Polystyrene moulding and extrusion materials (*second revision*), IS 5210 : 1995 High impact polystyrene sheet (*first revision*), IS 6746 : 1994. Unsaturated polyester resin systems (*first revision*) and IS 8543 (Part 4/Sec 1) : 1984 Methods of testing plastics : Part 4 Short term mechanical properties, Section 1 Determination of tensile properties.

For detailed information, refer to IS 14182 : 1994 Specifications for solvent cement for use with unplasticized polyvinyl chloride plastic pipes and fittings.

SUMMARY OF

IS 14443 : 1997 POLYCARBONATE SHEETS

1. Scope

1.1 Requirements and methods of sampling and tests for polycarbonate sheets of solid section as well as multi-wall variety and also thinner gauge sheets (films), multi-layer composite laminates of polycarbonate compact sheets and composites of polycarbonate compact sheets and glass sheets. Sheets containing glass fibre or any other reinforcement are, however, not covered by this standard.

1.2 This standard establishes a system for designating various possible polycarbonate sheets and films. Since the system is not based on application, end use condition and performance requirement, it cannot be used for selection of any sheet or film for specific end use. For specific end use and type of sheet or film expert opinion should be sought for fabrication details.

2. Designation/Classification System

2.1 This standard adopts a data block system consisting of five blocks – each block, describing specific information about the product. Each block is separated from the other by an asterisk mark. In case a block is not used, the skipped block will be indicated by an additional asterisk mark.

Block 1* Block 2* Block 3* Block 4* Block 5*

Block 1 – Contains this IS specification number to indicate that the classification is according to this standard.

Block 2 – This block is used to describe the product in general. This block consists of four letters and one digit. The first two letters are invariably 'PC' to denote that the product under specification is made out of polycarbonate. The digit that comes next indicates the number of layers or walls (in case of hollow sheets). The letter following the digit indicates whether the product under consideration has a solid or hollow cross-section and the type of profile in case of hollow product. And the last letter indicates the surface texture of the product. Codes for Block 2 are described in Table 1.

TABLE 1 CODES FOR BLOCK 2

3rd Position Code	No. of Layers/Walls	4th Position Code	Profile	5th Position Code	Texture
(1)	(2)	(3)	(4)	(5)	(6)
1	One	S	Solid section	R	Ribbed
2	Two	N	Hollow N profile	F	Fine grain
3	Three	R	Hollow rectangular profile	C	Coarse grain
4	Four	T	Hollow tunnel profile	P	Polished
0	Not specified	O	Not specified	O	Not specified

Example:

For a twin wall hollow sheet with N profile and polished surface texture the Block 2 will be represented by PC 2 NP.

Block 3 – This block accommodates four letters. The first letter indicates whether the material used to manufacture the sheet is light stabilized or not. The next letter indicates whether any special coating has been applied on the sheet or not. Third letter is to indicate whether the sheets is transparent, translucent or opaque and the last letter takes care of colour. Table 2 describes the codes for Block 3.

Example:

An opaque coloured sheet made out of polycarbonate grade containing UV stabilizer and having a hard abrasion resistance surface coating is designated by LHQC in Block 3.

Block 4 – Combination of four digits form this block. Each digit indicates the following properties in order:

- Weight per sq. metre of the sheet/film as per the codes given in Table 3.
- Dart drop impact strength at 27°C.
- Light transmission.
- Flammability rating codes listed in Table 3.

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Example :

For a sheet with 1.3 kg/m², dart drop impact value of 12J, light transmission of 55 percent and flammability rating not specified, the block 4 will be represented by 1530.

Block 5 – This block is provided for any additional specific performance requirements, if required to be specified. These specific performances include resistance to vandalism, resistance to forced entry, resistance to bullet and resistance to explosion. In case, there is no specific requirement for the sheet the designation ends at Block 4 with an asterisk mark.

Each requirement is codified by a combination of one letter and one digit. The letter indicates the type of resistance under consideration and the digit indicates the level of resistance. The scheme is elaborated below:

V = Resistance to vandalism

F = Resistance to forced entry

B = Resistance to bullet

E = Resistance to explosion

Table 4 to 7 of the standard give the condition under the above categories.

TABLE 2 CODES FOR BLOCK 3

1st Position		2nd Position		3rd Position		4th Position	
Code	Light Stabilization	Code	Coating	Code	Transparency	Code	Colour
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L	Yes	H	Hard	T	Transparent	C	Coloured
X	No	U	UV	R	Transparent	N	Natural
O	Not specified	O	Not specified	Q	Opaque	O	Not specified
				O	Not specified		

TABLE 3 CODES FOR BLOCK 4

1st Position		2nd Position		3rd Position		4th Position	
Code	Wt./Sq. metre (kg/m ²)	Code	Dart Drop Impact	Code	Light Transmission Percent	Code	Flame Retardancy
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Up to 1.5	1	Above 150	1	Above 85	1	UL 94 HB
2	Above 1.5 up to and including 3.0	2	Above 100 up to and including 150	2	Above 70 up to and including 85	2	UL 94 V2
3	Above 3.0 up to and including 4.5	3	Above 60 up to and including 100	3	Above 50 up to and including 70	3	UL 94 V1
4	Above 4.5 up to and including 6.5	4	Above 15 up to and including 60	4	Above 35 up to and including 50	4	UL 94 V0
5	Above 6.5 up to and including 8.5	5	Up to 15	5	Up to 35	5	UL 94 5V
6	Above 8.5 up to and including 12.0	0	Not specified	0	Not specified	0	Not specified
7	Above 12.0 up to and including 15.0						
8	Above 15.0						
9	Not specified						

Note 1 – Code of good fabricating practices is given at Annex A of the standards.

Note 2 – For method of tests, refer to Appendices B to F of the standard.

For detailed information, refer to IS 14443 : 1997 Specifications for polycarbonate sheets.

SUMMARY OF

IS 14643 : 1999 UNSINTERED POLYTETRAFLUOROETHYLENE (PTFE) TAPE FOR THREADS SEALING APPLICATIONS

1. Scope – Requirements, methods of sampling and tests for unsintered polytetrafluoroethylene (PTFE) tapes for use as a thread sealing material and in similar applications.

This tape is suitable for applications under ambient conditions with all common fluids and gases up to 80 bar gauge for pipes. This tape is suitable for applications in the range —20°C to 200°C for pipe sizes up to 50 mm.

2. Requirements

2.1 Composition

2.1.1 Manufacture – Shall be manufactured from a suitable grade of virgin PTFE material. The tape shall not contain fillers or additives other than residual lubricant. The residual lubricant content shall not exceed 0.1 percent by mass.

2.1.2 The lubricant used in the manufacture of the tape shall be such that any residue left in the tape shall be entirely removed under the conditions of test for the determination of residual lubricant content.

2.2 Appearance and Finish

2.2.1 The unsintered PTFE tape, when viewed by reflected light, shall appear white.

2.2.2 It shall be free from any inclusions visible to the naked eye and shall be free from any surface or edge defects which may affect its suitability for use.

2.3 Tolerance and Dimensions

2.3.1 Length – The actual length of the tape on a spool shall not be less than that marked on the spool.

2.3.2 Width – The mean width of the tape on a spool shall not differ from that marked on the spool by more than ± 0.5 mm.

2.3.3 Thickness – The thickness of the tape at any measured point shall not differ from the mean of the readings by more than ± 10 percent.

2.4 Thread Wrapping Properties – Any sample of the tape shall conform to and hold the thread form, shall not break and the finishing end of the tape shall remain in position with no tendency to unwind.

2.5 Sealing – Any sample of the tape shall form a leak free seal.

Note – For methods of tests and method of measurements, refer to Appendices A to D of the standard.

For detailed information, refer to IS 14643 : 1999 Specifications for unsintered polytetrafluoroethylene (PTFE) tape for threads sealing applications.

SUMMARY OF

IS 14753 : 1999 POLYMETHYL METHACRYLATE (PMMA) (ACRYLIC) SHEETS

1. Scope – Requirements, methods of sampling and tests for polymethyl methacrylate (acrylic) sheets.

2. Requirements

2.1 Protection of Surface – Unless otherwise agreed between the supplier and the purchaser, the surface of the sheet, as delivered, shall be protected by suitable material, for example, kraft paper pasted with a water soluble or pressure-sensitive adhesive or a polyethylene or any other suitable film; readily removable without surface contamination or damage.

2.2 Appearance

2.2.1 Surface Defects – The sheets shall have a smooth surface. There shall be no surface defects, scratches or marks larger than 5 mm² each anywhere in the sheet.

2.2.2 Inclusion Defects – There shall be no bubbles, large inclusions, cracks or other defects that could adversely affect the performance of the sheet in its intended application. There shall be no foreign matter inclusions larger than 4 mm² each anywhere in the sheet.

2.2.3 Classification of Defects

Classification	Surface Defects	Inclusion Defects
(1)	(2)	(3)
Negligible	Less than 2 mm ²	Less than 1 mm ²
Acceptable	2 to 5 mm ²	1 to 4 mm ²

2.2.4 Distribution of Defects

2.2.4.1 There shall not be a significant (for the application) amount of fine defects, each of which is defined as negligible in above, within 1 mm² each anywhere in the sheet.

2.2.4.2 No defect defined as acceptable above shall be within 500 mm of another acceptable defect anywhere in or on the sheet.

2.3 Colour – The colour distribution shall be homogenous, unless otherwise specified. Variations in colours shall be agreed between the purchaser and the supplier.

2.4 Visual Examination – The sheets shall be visually examined for scratch, air bubbles, foreign material or any other marks except such special marks which have been specified by the purchaser.

2.5 Dimensions

2.5.1 The preferred dimensions, after trimming, for the supply of cast acrylic sheets shall be as follows.

2.5.1.1 Size I – The sheets up to 2 m² surface area –

- a) 765 × 610 mm
- b) 1 220 × 915 mm
- c) 1 220 × 1 525 mm
- d) 1 375 × 915 mm
- e) 1 750 × 1 140 mm
- f) 1 830 × 915 mm

2.5.1.2 Size II – The sheets offering more than 2 m² surface area

- a) 1 220 × 1 830 mm
- b) 1 780 × 1 180 mm
- c) 1 800 × 1 200 mm
- d) 2 170 × 1 050 mm

2.5.1.3 The tolerance for the dimensions shall be
+ 5 mm.
- 0

2.5.2 Thickness – The preferred thickness and permissible thickness variation for the acrylic sheets be as given below :

Thickness	Tolerance (mm)	
	Size I	Size II
(1)	(2)	(3)
2.0	± 0.43	± 0.6
2.5	± 0.43	± 0.6
3.0	± 0.5	± 0.6
4.0	± 0.5	± 0.7
5.0	± 0.6	± 0.8
6.0	± 0.8	± 0.9
8.0	± 0.9	± 1.0
10.0	± 1.0	± 1.1
12.0 - 13.0	± 1.1	± 1.3
15.0	± 1.4	± 1.4
18.0	± 1.4	± 1.4
20.0 - 25.0	± 1.4	± 1.4
30.0	± 1.8	± 1.8

2.6 Specific Gravity – Shall not be less than 1.18 and more than 1.20.

2.7 Water Absorption – Shall not be more than 0.4 percent of the dry mass of the sample after 24 h immersion.

2.8 Tensile Strength and Elongation – Shall show a tensile strength of 570 kg/cm², *Min* and elongation at rupture shall not be less than 4.0 percent.

2.9 Impact Strength – Shall not be less than 1.6 kg cm/cm of the notch.

2.10 Rockwell Hardness – Shall be RHM 100 ± 5.

2.11 Effect of Heat on Rigidity, that is Temperature of Deflection Under Load – Shall not show a deflection of 0.25 mm until it reaches a temperature in excess of 85°C.

2.12 Vicat Softening Temperature – Shall not be less than 100°C.

2.13 Burning Rate – Shall show a burning rate of not more than 40 mm per minute.

2.14 Refractive Index – Shall show a refractive index not more than 1.49.

2.15 Haze and Luminous Transmittance – Shall show minimum transmittance of 91 percent and haze percent shall not exceed 3.

2.16 Stability Towards Yellowing

2.16.1 Yellowness Index Method – Yellowness index values of PMMA sheets produced from virgin monomer MMA, colour code 001-clear transparent shall be as given below :

Thickness, <i>t</i> (mm)	YI for Sheet	YI/ <i>t</i> Sheet
2	3.6 to 4.2	1.80 to 2.10
2.5	3.7 to 4.3	1.8 to 1.72
3	3.8 to 4.4	1.27 to 1.47

2.17 Diffusion Factor and Uniformity of Diffusion –

2.17.1 Diffusion Factor – The diffusion factor shall be

calculated as : Diffusion factor = $\frac{L_{20} + L_{70}}{2L_5}$ where

L_5 , L_{20} and L_{70} are the luminance values of the surface when viewed at 5°, 20° and 70° to the normal.

2.17.2 The test sheet for uniformity of diffusion (applicable for diffusion factors between 0.85 and 0.9 shall appear to be uniformly bright.

2.18 Residual Monomer Test – Shall not exceed by more than 2 percent by mass.

Note – For methods of tests, refer to Appendix A to F of the standard and relevant parts of IS 13360 Plastics Methods of testing.

For detailed information, refer to IS 14753 : 1999 Specifications for polymethyl methacrylate (PMMA) (acrylic) sheets.

SECTION 25

CONDUCTORS AND CABLES

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SUMMARY OF
IS 694 : 1990 PVC INSULATED CABLE FOR WORKING VOLTAGES
UP TO AND INCLUDING 1100 VOLTS
(Third Revision)

1. Scope

1.1 Requirements and tests for the following types of unarmoured PVC insulated cables with copper or aluminium conductors and flexible cords with copper conductors for electric power and lighting (including cables for outdoor use and cables for low temperature conditions) for voltages up to and including 1100 Volts.

Note 1 For out door use, the cables shall meet the requirements of additional ageing test. [see 15.4 of the standard]

Note 2 The cables intended for low-temperature conditions shall meet the requirements of cold bend or cold impact test whichever is applicable. [see 15.4 of the standard]

1.1.1 Types of Cables

- a) Cables for fixed wiring:
 - i) Single core (unsheathed);
 - ii) Single core (sheathed);
 - iii) Circular twin, three and four core (sheathed);
 - iv) Flat twin with or without ECC (sheathed); and
 - v) Flat three core (sheathed).
- b) Flexible cables, single core (unsheathed).
- c) Flexible cords:
 - i) Single core (unsheathed);
 - ii) Single core (sheathed);
 - iii) Parallel twin (unsheathed);
 - iv) Twisted twin (unsheathed);
 - v) Circular twin, three , four and five core (sheathed); and
 - vi) Flat twin (sheathed).

1.2 The cables covered in this standard are suitable for use on ac single phase or three phase (earthed or unearthed) systems for rated voltages up to and including 1100 volts. These cables may be used on dc systems for rated voltage up to and including 1500 volts.

1.3 The cables covered in this standard are suitable for use where the combination of ambient temperature and temperature rise due to load results in a continuous

conductor temperature not exceeding 70°C.

1.4 The cables covered in this standard are also suitable for use under outdoor or low temperature conditions provided these meet the additional requirements as given under type tests. For still lower temperature, the purchaser may specify the additional requirements.

2. Requirements**2.1 Material**

2.1.1 Conductor – The conductor shall be composed of plain annealed high conductivity copper wires and aluminium wires in case of copper and aluminium conductors respectively.

2.1.2 Insulation/ Sheath – Shall be composed of PVC compound.

2.1.3 Filters – It shall consist of vulcanized / unvulcanized rubber, thermoplastic compound or textile materials.

2.1.4 Binder Tape – It shall consist of plastic or proofed textile material.

2.2 Construction

2.2.1 Conductor – Conductors for cables for fixed wiring shall be solid and / or stranded type depending upon nominal cross-sectional area of conductors. For cables having nominal area less than 16 mm² shall be circular only and for nominal area 16 mm² and above, these may be circular or shaped.

2.2.2 Insulation – It shall be of PVC compound.

2.2.3 Laying-up of cores

- a) Flat twin and three-core cables (without ECC)– Two or three cores shall be laid side by side.
- b) Flat-twin cables (with ECC)–Two cores in a bare ECC (in centre) shall be laid side by side.
- c) Circular twin, three and four core cables– Two, three or four cores shall be laid together with a suitable right-hand lay. The interstices

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between cores may be filled with fillers. A binder tape may be applied over laid-up cores.

- d) Circular twin, three, four and five core flexible cords—Two, three, four or five cords shall be twisted together with a suitable right-hand lay. The interstices may be filled with sheathing material fillers or strengthening cords of textile or any other suitable material.
- e) Parallel twin (unsheathed) flexible cords—Two conductors shall be laid parallel and insulated simultaneously such that the cores can be separated readily without damage.
- f) Twisted twin (unsheathed) flexible cords—Two cores shall be twisted together with a suitable right hand lay.
- g) Flat twin (sheathed) flexible cords—Two cores shall be laid side by side.

2.2.4 Sheathing – Shall be applied by extrusion.

2.2.5 Thickness of insulation and sheath – Range of average thickness shall not be less than the nominal values specified in Table 1.

2.3 Cable Code – The following code shall be used for designating the cable:

<i>Constituent</i>	<i>Code Letter</i>
Aluminum conductor	A
PVC insulation	Y
PVC sheath	Y
Earth continuity conductor	(ECC)
Suitable for outdoor use	OU
Suitable for low temperature	SZ

Note – No code letter is required when the conductors material is copper.

3. Tests

3.1 Type Tests

- a) Annealing test (for copper),
- b) Tensile test (for aluminium),
- c) Wrapping test (for aluminum),
- d) Resistance test,
- e) Test for overall dimensions and thickness of insulation and sheath
- f) Physical tests for insulation and sheath
- g) Insulation test, and
- h) High voltage test (water immersion test) and
- j) Flammability test.

TABLE 1 RANGE OF AVERAGE THICKNESS

<i>Sl. No.</i>	<i>Type</i>	<i>Range of Nominal Sectional Area of Conductor mm²</i>	<i>Range of Nominal Thickness of Insulation mm²</i>	<i>Range of Nominal Thickness of Sheath mm²</i>
i)	Single-core PVC insulated cables (unsheathed)	1-630	0.7-2.8	-
ii)	Flexible PVC insulated cords (unsheathed)	0.5-40	0.6-0.8	-
iii)	Single core unsheathed Flexible cables	6.50	0.8-1.4	-
iv)	PVC insulated and sheathed cables	1-50	0.6-1.4	0.8-1.8
v)	Flexible PVC insulated and sheathed cords	0.5-4.0	0.6-0.8	0.9-1.1

Note 1 – Nominal cross-sectional area of conductor- 1, 1.5, 2.5, 4, 6, 10, 16, 25, 35, 50, 70, 95, 120, 150, 185, 240, 300, 400, 500 and 630 mm².

Note 2 – For detailed dimensions, refer to Tables 2 to 6 of the standard.

3.2 Acceptance Tests – Tests specified in (a) to (d), (h) and (j) of 3.1 and following:

- a) Test for thickness of insulation and sheath
- b) Tensile strength and elongation at break of insulation and sheath.
- c) Insulation resistance test

3.3 Routine Tests

- a) Conductor resistance test, and
- b) High voltage test

3.4 Optional Tests

- a) Cold bend test,
- b) Cold impact test, and
- c) Additional ageing test
- d) Flexing test

Note – For test details, refer to IS 5831 : 1984 PVC insulation and sheath of electric cables, (*first Revision*) IS 8130 : 1984 Conductors for insulated electric cables and flexible cords (*first revision*) and the standard.

For details information, refer to IS 694 : 1990 Specification for PVC insulated cables for working voltages upto and including 1 100 volts (third revision).

SUMMARY OF

IS 1554 (PART 1) : 1988 PVC INSULATED (HEAVY DUTY) ELECTRIC CABLES

PART 1 – FOR WORKING VOLTAGES UPTO AND INCLUDING 1 100 VOLTS

(Third Revision)

1. Scope – Requirements and tests for armoured and unarmoured single-core, twin-core, three-core and multi-core PVC insulated and sheathed cables for electric supply and control purposes.

1.2 This standard also covers cables with improved fire performance Categories C₁ and C₂ for which additional requirements have been included.

1.3 The cables covered in this standard are suitable for use on ac single phase or three phase (earthed or unearthed) systems for rated voltages up to and including 1 100 V. These cables may be used on d.c. systems for rated voltages up to and including 1 500 V to earth.

Note – The cables conforming to this standard may be operated continuously at a power frequency voltage up to 10 percent higher than the rated voltage.

1.4 The cables covered in this standard are suitable for use where the combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding the following:

Type of Insulation	Normal Continuous Operation	Short Circuit Condition
General purpose	70°C	160°C
Heat resisting	85°C	160°C

The selection of type of insulation rests with the purchaser.

1.5 Armoured cables specified in this standard are suitable for use in mines also. However, for such cables, additional requirements have been included wherever necessary.

2. Requirements

2.1 Materials

2.1.1 Conductor – Shall be composed of plain copper or aluminium wires complying with IS 8130 : 1984*. Mining cables to be used in gassy mines shall be of copper conductor only.

* Conductors for insulated electric cables and flexible cords (first revision).

2.1.2 Insulation – The general purpose and heat resisting insulation of Type A and Type C PVC compound respectively conforming to the requirements of IS 5831:1984[†]

2.1.3 Filler and Inner Sheath

- a) Unvulcanized rubber, or
- b) Thermoplastic materials, or
- c) Proofed tape (for inner sheath only)

2.1.4 Armouring

- a) Galvanized round steel wire,
- b) Galvanized steel strip, or
- c) Any metallic non-magnetic wire/strip.

2.1.5 Outer Sheath – Shall be of Type ST1 & ST2 PVC compound conforming to IS 5831: 1984[†] for Cables with general purpose insulation and with heat resisting insulation respectively.

2.2 Construction

2.2.1 Conductor

– Shall be as follows :

NOMINAL CROSS SECTIONAL AREA

Copper mm ²	Aluminium mm ²	Solid/ Stranded	Flexibility Class
–	1.5	Solid	Class 1
1.5 to 6	2.5 to 10	Solid/ Stranded	Class1 for Solid Class2 for Stranded
10 and above	16 and above	Stranded	Class 2

Cables with reduced neutral conductors shall have sizes as given in Table 1 of the stranded.

2.2.2 Insulation – Shall be provided with PVC insulation applied by extrusion. The average thickness of insulation shall be not less than the nominal value specified in Table 2 of the standard.

[†]PVC insulation and sheath of electric cables (first revision).

2.2.3 Core Identification – Shall be identified by different colouring of PVC insulation.

- (a) 1 core:red, black, yellow, blue or natural (non-pigmented)
- (b) 2 cores – red and black
- (c) 3 cores – red , yellow and blue
- (d) 4 cores – red, yellow and blue and black
- (e) 5 cores – red,yellow, blue, black,and grey
- (f) 6 cores and above – Two adjacent cores (counting and direction core) in each layer,blue and yellow, remaining Cores grey

Note1– For reduced neutral conductors, the insulation colour shall be black.

Note 2 – For cables of more than 5 cores, the core identification may be done by numbers.

2.2.4 Laying up of cores – Shall be laid together with a suitable lay; the outermost having right hand lay and successive layers with opposite lay. Recommended plan up to 100 is given in Table 3 of the standard.

2.2.5 Inner Sheath – Shall be applied either by extrusion or by wrapping. Thickness of inner sheath shall be as given in Table 4 of the standard.

2.2.6 Armouring – Shall be applied over the insulation in case of single core cables and over the inner sheath in case of twin, three and multi core cables.

2.2.7 Outer Sheath – Shall be applied by extrusion as below:

- a) Over the insulation in case of unarmoured single core cables
- b) Over the inner sheath in case of unarmoured twin, three and multi-core cables, and
- c) Over the armouring in case of armoured cables

thickness shall be as given in Table 7 of the standard

3. Tests

3.1 Type Tests

- a) Tests on conductor:
 - 1) Annealing test (for copper),

Note – For method of tests, refer to the relevant parts of IS 10810. Methods of tests for cables.

For detailed information, refer to IS 1554 (Part I) : 1988 Specification for PVC insulated (heavy duty) electric cable: Part I For working voltages up to and including 1 100 volts (third revision).

- 2) Tensile test (for aluminium), and
- 3) Wrapping test (for aluminium), and
- 4) Conductor resistance test.
- b) Test for armouring wire/strips
- c) Test for thickness of insulation and sheath.
- d) Physical tests for insulation and outer sheath:
 - 1) Tensile strength and elongation at break
 - 2) Ageing in air oven,
 - 3) Shrinkage test,
 - 4) Hot deformation,
 - 5) Loss of mass in air oven,
 - 6) Heat shock test, and
 - 7) Thermal stability,
- e) Insulation resistance test.
- f) High voltage test (water immersion test).
- g) High voltage test at room temperature.
- h) Flammability test.

Note1 – For acceptance, routine optional tests and additional tests for Cables with improved fire performance refer to 15 Of the standard.

4. Identification

4.1 Cable Code – The following code shall be used for designating the cable :

<i>Constituent</i>	<i>Code Letter</i>
Aluminium conductor	A
PVC insulation	Y
Steel round wire armour	W
Steel strip armour	F
Steel double round wire armour	WW
Steel double strip armour	FF
PVC outer sheath	Y

Note – No code letter for conductor is required when the conductor material is copper.

SUMMARY OF

IS 7098 (PART 1) : 1988 CROSSLINKED POLYETHYLENE INSULATED THERMOPLASTIC SHEATHED CABLES

PART-1 FOR WORKING VOLTAGES UP TO AND INCLUDING 1 100 VOLTS

(First Revision)

1. Scope

1.1 Requirements for both armoured and unarmoured single, twin, three, four and multi-core cross-linked polyethylene (XLPE) insulated and PVC sheathed cables for electric supply and control purpose.

1.2 The cables covered in this standard are suitable for use on ac single phase or three phase (earthed or unearthed) systems for rated voltages up to and including 1 100 volts. These cables may be used on dc systems for rated voltage up to and including 1 500 volts to earth.

Note –The cables conforming to this standard may be operated continuously at a power frequency voltage 10 percent higher than rated voltage.

1.3 Armoured cables specified in this standard are suitable for use in mines also. However, for such cables, additional requirements have been included.

1.4 These cables are suitable for use where combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding 90°C under normal operation and 250°C under short circuit condition.

1.5 This standard also covers cables with improved fire performance categories C1 and C2 for which additional requirements have been included.

2. Requirements

2.1 Materials

2.1.1 Conductor – Shall be composed of plain copper or aluminium wires complying with IS 8130: 1984[†]. Mining cables to be used in gassy mines shall be of copper conductor only.

2.1.2 Insulation – Shall be of cross linked polyethylene conforming to the requirements given in Table 1 of the standard.

2.1.3 Filler and Inner Sheath – Shall be of the following:

- Vulcanized or unvulcanized rubber, or
- Thermoplastic materials.

2.1.4 Armouring – Shall be of the following :

- Galvanized round steel wire, or
- Galvanized steel strip, or
- Any metallic non-magnetic wire/strip.

2.1.5 Outer Sheath – Shall be of polyvinyl chloride (PVC) compound conforming to the requirements of type ST 2 compound of IS 5831 : 1984*.

2.2 Construction

2.2.1 Conductor – Shall be as follows :

Nominal Cross Sectional Area		Solid / stranded	Flexibility class
Copper mm ²	Aluminium mm ²		
--	1.5	Solid	1
1.5- 6	2.5-10	Solid/ Stranded	1 for solid 2 for stranded
10 and above	16 and above	Stranded	2

Cables with reduced neutral conductor shall have size as given in Table 2 of the standard.

2.2.2 Insulation – Shall be provided with cross linked polyethylene insulation applied by extrusion. The average thickness of insulation shall be not less than the nominal value specified in Table 3 of the standard.

2.2.3 Core identification – Cores shall be identified as specified below :

[†]Conductors for insulated electric cables and flexible cords (first revision).

* PVC insulation and sheath of electric cables (first revision)

- a) Coloured strip applied on the core
- b) Colouring of XLPE insulation as follows :

- 1 Core—Red, black, yellow, blue or natural;
- 2 Core—Red and black;
- 3 Core—Red, yellow and blue;
- 4 Core—Red, yellow, blue and black;
- 5 Core—Red, yellow, blue, black and grey;
- 6 Core—

and above—Two adjacent cores
(counting and direction core) in each
layer, blue and yellow, remaining cores,
grey; or

- c) By numerals either by applying numbered
strips or by printing on the cores as follows

- 2 Core – 0, 1
- 3 Core – 0, 1, 2, 3
- 4 Core – 0, 1, 2 and 3

Note 1— For reduced neutral conductors, the core shall be black.

Note 2 – For cables of more than 5 cores, the core identification may be done by numbers

2.2.4 Laying of core – Shall be laid up together with a suitable lay, the outermost layer having right hand lay and successive layers with opposite layers. Recommended plan up to 100 be is given in Table 4 of the standard.

2.2.5 Inner Sheath – Shall be applied either by extrusion or by wrapping. Thickness of inner sheath shall be as given in Table 5 of the standard.

2.2.6 Armouring – Shall be applied over the insulation in case of single core cables and over the inner sheath in case of twin, three and multicore cables

2.2.7 Outer sheath – Shall be applied by extrusion as below:

- a) Over the insulation in case of unarmoured single core cables,
- b) Over the inner sheath in case of unarmoured twin, three and multi-core cables; and
- c) Over the armouring in case of armoured cables.

Thickness shall be as given in Table 8 of the standard

3. Tests

3.1 Types Tests –

- a) Tests on conductor:
 - i) Annealing test (for copper)
 - ii) Tensile test (for aluminium)
 - iii) Wrapping test (for aluminium)
 - iv) Resistance test
- b) Test for armouring wires/strips.
- c) Test for thickness of insulation and sheath
- d) Physical tests for insulation :
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Shrinkage test
 - iv) Hot set test
 - v) Water absorption (gravimetric)
- e) Physical tests for outer sheath
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven,
 - iii) Loss of mass in air oven
 - iv) Shrinkage test, and
 - v) Hot deformation
 - vi) Heat shock test
 - vii) Thermal stability
- f) Insulation resistance (Volume resistivity Test)
- g) High voltage test,
- h) Flammability test,

Note – For acceptance, routine, optional tests and additional tests for cables with improved fine performance refer to 15 of the standard.

4. Identification

4.1 The following code shall be used for designating the cable:

Sl. No.	Constituent	Code Letter
i)	Aluminium conductor	A
ii)	XLPE insulation	2X
iii)	Steel round wire armour	W
iv)	Non-magnetic round wire armour	Wa
v)	Steel strip armour	F
vi)	Non-magnetic strip armour	Fa
vii)	Double steel strip armour	FF
viii)	Double steel round wire armour	WW
ix)	PVC outer sheath	Y

Note – No code letter for conductor is required when the conductor material is copper. Cables with heat resisting insulation suitable for 85°C conductor temperature shall be identified by the letters ‘HR 85’ marked on it.

Note – For methods tests, refer to relevant parts of IS 10810 Methods of test for cables.

For detailed information, refer to IS 7098 (Part I) : 1988 Specification for cross-linked polyethylene insulated thermoplastic sheathed cables: Part I For working voltages upto and including 1100 volts (first revision).

SUMMARY OF

IS 9968 (PART 1) : 1998 ELASTOMER INSULATED CABLES,
PART1 FOR WORKING VOLTAGES UPTO AND INCLUDING 1 100 VOLTS

(First Revision)

1. Scope – Requirements of elastomeric insulated cables for fixed wiring, flexible cables and flexible cords for electric power and lighting for operation at voltages up to and including 1100 volts.

1.1 The following types of cables and cords are covered in this standard.

1.1.1 Cables for fixed wiring

- a) Braided and compounded/varnished,
- b) Elastomer sheathed (normal duty), and
- c) Elastomer sheathed (normal duty) with earth continuity conductor.

1.1.2 Flexible cables

- a) Braided and varnished, and
- b) Elastomer sheathed (heavy duty).

1.1.3 Flexible cords

- a) Braided
- b) Elastomer sheathed (normal duty),
- c) Unkinkable flexible cords – braided and compounded (workshop type), and
- d) Unkinkable flexible cords – braided and compounded.

1.2 The cables covered in this standard are suitable for use on single-phase or three-phase (earthed or unearthed) system for rated voltages up to and including 1 100 volts. These cables may be used on dc system for rated voltages up to and including 1500 volts to earth.

1.3 The cables covered in this standard are suitable for use where the combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding the following.

<i>Type of Insulation</i>	<i>Normal Continuous Operation</i>	<i>Short-Circuit Condition</i>
Insulation for general service	60°C	200°C
Heat resisting insulation	90°C	250°C
Silicone rubber insulation	150°C	350°C

2. Materials**2.1 Conductor**

2.1.1 Copper conductor – Shall be tinned annealed copper wires complying with the requirement of IS 8130 : 1984*.

2.1.2 Aluminium Conductor – The conductor shall be composed of aluminium wires complying with the requirements of IS 8130: 1984*.

2.2. Insulation

2.2.1 Insulation for general services – The insulation shall be of elastomer compound conforming to Type IE 2 of IS 6380 : 1984†.

2.2.2 Heat resisting insulation – Shall be of elastomer compound conforming to Type IE 2 of IS 6380 : 1984.

2.2.3 Silicone Rubber Insulation – The insulation shall be of silicone rubber conforming to Type IE 5 of IS 6380 : 1984.

2.3 Tape

- a) Proofed tape.
- b) Polyethylene terephthalate (PETP) tape or Plastic tape or any other suitable tape, and
- c) Glass tape.

2.4 Fillers – Shall be of natural or synthetic fibres or elastomer.

2.5 Braid

- a) Textile Braid, and
- b) Grass braid

2.6 Sheath

*Conductors for insulated electric cables and flexible cords (first revision).

† Elastomeric insulation and sheath of electric cables (first revision).

2.6.1 General service insulated cables and flexible cords – Cables for fixed wiring and flexible cords shall consist sheath of elastomeric compounds of type SE1 of IS 6380 : 1984 Flexible cables sheath shall also be of elastomeric compound of type SE2 of IS 6380 : 1984.

2.6.2 Heat resisting insulated cables – Cables for fixed wiring and flexible cords shall consist sheath of elastomeric compounds of Type SE3 of IS 6380 : 1984. Flexible cables sheath shall also be of elastomeric compound of Type SE4 of IS 6380: 1984.

3. Construction

3.1 Conductors

3.1.1 Cables for fixed wiring – Shall be as follows:

Nominal Cross Sectional Area ,mm ²	Solid / Stranded	Flexiblility class
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Copper 1 and 1.5 2.5 to 6 10 and above </div> <div style="text-align: center;"> Alluminium 1.5 2.5 to 10 16 and above </div> </div>		
	solid	Class 1
	solid/ stranded	Class1 for solid
	stranded	Class2 for stranded
		Class 2

3.1.2 Flexible cables and cords – Shall be according to class 5 of IS 8130 : 1984.

3.2 Insulation – Shall have the average thickness not less than nominal value specified in respective tables of the standard.

3.3 Core identification – Shall be identified either by colours or numbers using any one of the following methods:

- Numbered tapes,
- Coloured insulation,
- Coloured tape, and
- Numbered printed on cores.

Note— For details see 13 of the standard.

3.4 Laying Up of Cores – Shall be laid together with a suitable right hand lay. The value of lay for flexible cables and cords shall be maximum 18 times the pitch circle diameter.

3.5 Sheath – Shall be applied by extrusion. The average thickness shall be not less than the nominal value specified in the respective tables in the standard.

4. Tests

4.1 Type Tests

- Tensile strength and elongation at break,
- Ageing in air oven ,
- Ageing in air bomb,
- Ageing in oxygen bomb,
- Hot set,
- Oil resistance, and
- Tear resistance,

Insulation resistance

High voltage (water immersion) test
 Flammability test (applicable to cables finished with SE 3 and SE 4 sheaths only)
 Water absorption test (for insulation as applicable)
 Persulphate test (for copper)
 Annealing test (for copper)
 Tensile test (for aluminium)
 Wrapping test (for aluminium)
 Conductor resistance test
 Test for thickness of insulation and sheath and overall diameter (where specified)

Note – For acceptance, routine and optional tests, refer to the standard.

5. Identification – Cables or cords shall be identified throughout the length of the cable or cords by the legends shown below, either printed or indented or embossed on the cable.

Type of Cable Insulation	Legend
Heat resisting rubber	HR 90
Silicon rubber	HR 150

The following code shall be used for designating the cable :

Constituent	Code Letter
Aluminium conductor	A
Elastomer insulation	R
Braiding, compounding or varnishing	B
Elastomer sheath	R
Earth continuity conductor	ECC

Note – For method of test refer to IS 6380 : 1984 Elastomeric insulation and sheath of electric cables (first revision) and IS 8130 : 1984 Conductors for insulated electric cables and flexible cords (first revision)

For detailed information, refer to IS 9968 (Part I) : 1988 Specification for elastomer insulated cables Part I - For working voltages up to and including 1 100 volts (first revision).

SECTION 26

WIRING ACCESSORIES

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SUMMARY OF
IS 371: 1999 CEILING ROSES
(Third Revision)

1. Scope

1.1 This standard covers ceiling roses of surface and semi-recessed types for use with simple or multiple pendant lighting fitting and for the use in circuits in which the nominal voltage does not exceed 250V and the current does not exceed 6A and intended to be used in final circuits with rated current 16A maximum for ceiling roses with screw type supply terminals or 10 A maximum for ceiling roses with screwless supply terminals. The requirements specified in this standard have particular reference to safety in use.

1.2 The ceiling roses are intended for use with cables complying with IS 694 : 1990.

1.3 The ceiling roses incorporating means other than rewirable terminals to facilitate the connection and disconnection of lampholders or luminaries, are not covered by this standard.

2. Conditions of Use – Shall be suitable for use under the following conditions:

- a) An ambient temperature having a peak value not exceeding 45°C with an average value not exceeding 40°C in a period of 24 h, but not subject to exposure to direct radiation from the sun or any other source of heat likely to raise the temperature above the specified ambient temperature.
- b) An ambient temperature having a value not less than – 5°C; and
- c) An atmosphere not subject to excessive pollution by smoke chemical fumes, salt laden spray, prolonged periods of high humidity or other abnormal conditions.

3. General requirements – Shall be so design and constructed that when installed in the proper manner and in normal use they function reliable and cause no danger to person or surrounding ceiling roses shall be capable of meeting all the relevant requirements and tests specified in the standard.

4. Ratings – Shall have a rated voltage of not exceeding 250 V and rated current not exceeding 6A.

5. Classification

- a) According to the method of mounting :
 - i) Surface type, and
 - ii) Semi-recessed or flush type
- b) According to load support :
 - i) Intended to support mechanical load by means or a flexible cord complying with IS 694, and
 - ii) Intended to support mechanical loads as nominated by the manufacturer in addition to those specified in 5 (b) (i), by means other than a flexible cord.
- c) According to current carrying terminal arrangement :
 - i) Having provision for the connection of switch wiring, and
 - ii) Having no provision for the connection of switch wiring.
- d) According to terminal type :
 - i) Having screw type terminals,
 - ii) Having screw-less terminals, and
 - iii) Having a combination of both terminals

7. Construction – Where protection against electric shock is provided by a cover screwing on to a base or by similar attachments, such parts shall withstand the forces likely to be applied in normal use. Provision shall be made for entry and connection of a circular flexible cord having three conductors of 1.0 mm². A device or means of unsulating materials, shall be provided to prevent strain upon flexible conductors connected to the ceiling rose, being transmitted to the terminal.

8. Tests

- a) Marking,
- b) Dimensions,
- c) Accessibility of live parts,
- d) Provision of earthing,
- e) Terminals,

* Pvc insulated cables for working voltages up to and including 1100V (third revision).

- | | |
|--|--|
| f) Construction, | k) Resistance to heat, |
| g) Resistance to moisture and humidity, insulation resistance and electric strength, | l) Resistance to abnormal heat fire and tracking, |
| h) Temperature rise, | m) Screws, current carrying parts and connector, |
| j) Mechanical strength, | n) Creepage distances and clearances, and |
| | o) Resistance to excessive residual stress and to rusting. |

Note – For detailed requirements and methods of tests refer to the standard

For detailed information, refer to IS 371 : 1999 Specification for ceiling roses (third revision).

SUMMARY OF

IS 1293 : 1988 PLUGS AND SOCKET-OUTLETS – RATED

VOLTAGE UPTO AND INCLUDING 250 VOLTS AND RATED

CURRENT UPTO AND INCLUDING 16 AMPERES

(Second Revision)

1. Scope – Requirements and tests for three-pin two-pole and earthing plugs and socket-outlets (shuttered and non-shuttered) including multi-socket-outlet (shuttered and non-shuttered) suitable for ac circuits with a rated voltage above 50 V but not exceeding 250 volts and a rated current of 6 A or 16 A.

Note 1– 2 pin plugs and socket outlets are considered non-standard.

Note 2– Fused plugs are not covered under the scope of this standard.

2. General Requirements – Accessories shall be so designed and constructed that in normal use their performance is reliable and without danger to the user or the surroundings.

3. Ratings

3.1 Rated Voltage – The rated voltage shall not exceed 250 V. The preferred voltage shall be 240 V.

3.2 Rated Current – Shall be 6 or 16 A in line with international practice. However, for the convenience of manufacturers and users used to the present series of 5 and 15 A and in order to facilitate a smooth change over, both the series shall be used con-currently.

4. Classification – Shall be classified according to:

- a) Absence or presence of enclosures:
 - i) Unenclosed, and
 - ii) Enclosed.
- b) Absence or the presence of shutters:
 - i) Without shutters, and
 - ii) With shutters
- c) The method of application:
 - i) Surface-type socket-outlets,
 - ii) Flush-type socket-outlets,
 - iii) Portable type socket-outlets.

5. Dimensions

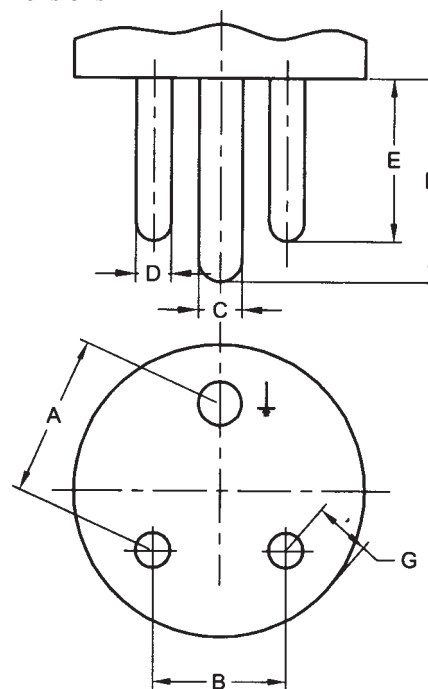


Fig.1

Reference to Fig 1	Rating	
	6A mm	16A mm
A	22.2	28.6
B	19.1	25.4
	+0.025	+0.025
C	7.06	8.71
	– 0.050	– 0.050
	+0.025	+0.025
D	5.08	7.06
	– 0.050	– 0.050
	+1.04	+1.04
E	15.9	20.6
	– 0.13	– 0.13
	+1.04	+1.04
F	20.06	28.6
	– 0.13	– 0.13
G.min.	7.94	9.52
H	5.16 to 7.54	6.76 to 9.12

6. Materials

<i>Part</i>	<i>Material</i>
a) Plug base, plug cover, socket-outlet cover shutter	Tough, non-ignitable insulating material
b) Socket base	Tough, non-ignitable insulating material or vitrified ceramic material
c) Pins, terminals and current-carrying parts, including earthing-pin and earthing contact	Phosphor-bronze, brass aluminium alloy or suitable material
d) Noncurrent carrying parts	Mild steel, aluminium alloy, brass or similar alloys, or insulating material.

7. Tests

- a) Visual examination,
- b) Checking of dimensions,
- c) Protection against electric shock,
- d) Construction,
- e) Interchangability,
- f) Resistance to ageing and moisture,
- g) Insulation resistance and electric strength,
- h) Effectiveness of contact,
- j) Temperature rise,
- k) Breaking capacity,
- m) Endurance test for shutters,
- n) Withdrawal pull,
- p) Cord grip,
- q) Mechanical strength,
- r) Resistance to heat,
- s) Screws and connections,
- t) Water absorption,
- u) Resistance to rusting,
- v) Resistance to abnormal heat and fire,

Note 1– For constructional requirements with regard to aspect such as protection against electric shocks, provisions for earthing, terminal and screw, construction of fixed socket-outlets and construction of plugs and portable socket outlets refer to **9** to **13** of the standard.

Note 2 – For detailed requirements and methods of tests refer to the standard

For detailed requirements refer to IS 1293 : 1988 Specification for plugs and socket-outlets-rated voltage up to and including of 250 volts and rated current up to and including 16 amperes (second revision).

SUMMARY OF

IS 2086 : 1993 CARRIERS AND BASES USED IN REWIRABLE TYPE
ELECTRIC FUSES FOR VOLTAGES UP TO 650 VOLTS

(Third Revision)

1. Scope – Performance requirements and tests as well as dimensions of carriers and bases used in rewirable type electric fuses having a rated current up to and including 100 A meant for alternating current systems of voltages not exceeding 650V between lines. The specification does not cover fuse-wire used in rewirable type fuses.

2. Electrical Requirements

2.1 Preferred Voltages – Fuses shall be rated for one of the following voltages – For ac systems – 240 V single-phase and 415 V three phase.

Note – A 240 V grade fuse shall not be used in a three-phase 4 wire 415 V systems.

2.2 Rated Currents – The preferred values shall be 16, 32, 63 and 100 A

2.2.1 The fuse-carrier and base shall be so designed and proportioned, that when they are carrying their rated current continuously in an ambient temperature not exceeding 40°C, the temperature rise of the carrier and base contacts does not exceed 55°C.

2.3 Rated Breaking Capacity – When tested as prescribed the fuse carriers and the fuse base shall be deemed to have failed if one or more of the following occur :

- a) Any part of the carrier or the base ignites
- b) The fuse carrier is rejected,
- c) Any part of the fuse except the fuse element and its covering is damaged to such an extent to render it unserviceable,
- d) Melting of the fire-wire fuse, indicating arching to metal core, and
- e) Arcing between fuses on tests involving 2 or more fuses.

2.3.1 The values of rated breaking / capacity recognized for the purpose of this standard are 2 kA in the case of fuses of rating up to and including 16 A, and 4 kA in the case of higher current ratings at a power factor not exceeding 0.4 (lag).

2.4 Fuse-Wire – The fuse-wire, specified by the manufacturer for use with the fuse-carrier, shall conform to the requirements in IS 9926 : 1981*. In addition, the fuse – wire shall be capable of blowing – off within 30 minutes when carrying a current of 1.9 times the rated current of the fuse-wire and be capable of carrying 1.6 times the current rating continuously without blowing for at least 30 minutes.

3. Physical Requirements**3.1 Mechanical Robustness**

3.1.1 Mechanical Endurance – At the end of the prescribed test, the fuse base and fuse carrier shall be examined for the following :

- a) The contacts shall not work loose.
- b) No damage shall be caused to any part of fuse carrier of fuse-base.
- c) There shall be no displacement of any of the component parts, and
- d) The serviceability of the fuse shall not have been impaired.

3.1.2 Mechanical Strength – Fuse base and fuse carrier shall show neither cracks nor permanent deformation.

3.2 Withdrawal Force

<i>Rated Current</i> A	<i>Withdrawal Force</i> N
16	5 to 35
32	15 to 55
63	30 to 100
100	40 to 160

3.3 Requirements for ceramic material

3.3.1 The ceramic material shall be sound, thoroughly vitrified, smoothly glazed except in the case of steatite, and shall be free from defects, such as, dents and projections. The mounting surface may be left unglazed

*Fuse wires used in rewirable type electric fuses up to 650 volts.

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3.3.1.1 The glaze, which shall show no signs of crazing, shall be leadless and shall cover at least those surface which are exposed when the fuse has been mounted in the intended manner.

3.3.2 Temperature cycle – When fuse-bases and fuse-carrier are subjected to the temperature cycle test the ceramic material shall withstand the series of tests without breaking, cracking or crazing. In addition, the fuse-base and fuse-carrier shall comply with the requirements of the standard when subjected to high voltage test at the end of the temperature cycle tests.

3.3.3. Water absorption – Shall not absorb more than 2 percent of its weight of water, when broken and tested.

3.4 Requirements for Non-ceramic Material

3.4.1 Water absorption (for non – ceramic material) – materials other than ceramics, required to be non-hygroscopic shall be incapable of taking up water in sufficient quantity to cause appreciable swelling, laminating, warping or changing of the material.

3.5 Non Flammability – Materials required to be non-inflammable shall be incapable of burning or giving off inflammable vapours in sufficient quantity to ignite at a pilot flame when heated for 5 minutes in an oven at 300°C.

3.6 High Voltage Test – Shall withstand without puncture or flash over when ac voltage given below is applied between the parts specified and maintained for one minute.

Rated Voltage of Fuse (V)	Test Voltage (rms)(V)
240 single-phase	2 000
415 three-phase	2 500

3.7 Insulation Resistance – Shall be not less than 10MΩ

3.8 Ignition Test – Specimen shall not inflame or give off inflammable vapours in sufficient quantities to ignite at the pilot flame when tested as prescribed.

Note – For design and construction of fuse carrier and fuse base with regard to aspects such as material, protection, handle or grip etc. refer to 6 of the standard.

4. Dimensions of Carriers and Bases – The dimensions of carriers and bases used in rewirable type electric fuses shall conform to Type A dimensions given in Annex-A of the standard.

5. Tests

5.1 Type Tests

- a) Mechanical test sequence :
 - i) Visual examination
 - ii) Test for dimensions
 - iii) Test for mechanical endurance
 - iv) Test for mechanical strength
 - v) Test for withdrawal force
- b) Electrical test sequence :
 - i) Test for temperature rise
 - ii) Insulation resistance test
 - iii) High voltage test
 - iv) Test for breaking capacity
- c) Test for proving material properties:
 - i) Test for water absorption (non-ceramic)
 - ii) Test on ceramic material
 - iii) Ignition test

5.2 Acceptance Test – Tests specified in [(a) – (i), (ii), (iii), (iv)] [(b) – (i), (ii), (iii)] [(c) – (i)] of 5.1 and Temperature cycle test (for ceramic materials).

5.3 Routine Test – High voltage test.

Note – For detailed requirements and method of tests refer to the standard

For detailed information, refer to : IS 2086: 1993. Specification for carriers and bases used in rewirable type electric fuses for voltages up to 650 volts (third revision).

SUMMARY OF
IS 2412 : 1975 LINK CLIPS FOR ELECTRICAL WIRING
(First Revision)

1. Scope – Requirements and tests for link clips (both joint link clips and link clips with separate linking eyes) for general wiring purpose.

2. Requirements

2.1 Material – Aluminium sheet or strip in the annealed condition.

2.2 Construction – Shall be smooth, free from dents or burrs, and shall have corners rounded off smoothly.

2.2.1 One fixing hole for sizes up to 40 mm and two for size over 40 mm. Size of hole 2.6 mm clear diameter and tolerance on hole +0.25, – 0 mm.

2.3 Finish – Shall be free from any mark of corrosion.

3. Dimensions (in mm)

3.1 Link Clip with Separate Eyes

<i>Size (Length)</i>	25	32	40	50	63	80
<i>Thickness</i>	0.32	0.32	0.32	0.40	0.40	0.40
<i>Width</i>	8	8	8	8	8	8

Note – Values of thickness are minimum values. Tolerance on other dimensions shall be ± 5 percent

3.1.1 Linking Eye – Size 15×6.5 mm and hole 10×2 mm.

3.2 Joint Link Clips

<i>Size (Length)</i>	16	25	32	40	50	63	80
<i>Thickness</i>	0.32	0.32	0.32	0.32	0.4	0.4	0.4
<i>Width</i>	8	8	8	8	8	8	8
<i>Distance of fixing hole</i>	5	10	10	12.5	12.5	20	25
<i>Spacing of fixing hole</i>	—	—	—	—	12.5	12.5	12.5

Note 1 – For details, see Fig. 1 and 2 of the standard.

Note 2 – Values of thickness are minimum values. Tolerance on other dimensions shall be + 5 percent.

4. Tests

4.1 Type Tests

4.1.1 General examination

4.1.2 Dimensions

4.1.3 Flexibility – Clips shall be wound round a mandrel 5 mm dia, and fixed with linking eye. It shall then be opened out, flattened by hand and again wound and fixed. At the end of 5 such operations, clip shall retain its flexibility and shall be fit for use.

For detailed information, Refer to IS 2412 : 1975 Specification for link clips for electrical wiring (first revision).

SUMMARY OF
IS 2667 : 1988 FITTINGS FOR RIGID STEEL CONDUITS FOR
ELECTRICAL WIRING
(First Revision)

1. Scope – Material, dimensions and other requirements of screwed type fittings for use with rigid steel conduits for electrical wiring purposes conforming to IS 9537 (Part 2) : 1981*

1.2 The fittings covered by this standard are – (a) couplers, (b) elbows, (c) tees, (d) bends, and (e) boxes.

Note – Screw reducers which are generally tailor-made items are not covered by this standard.

2. Requirements

2.1 Material – Shall be made of steel, cast iron or malleable cast iron.

2.2 Fittings shall be fabricated or cast to shape. The interior and the ends of fittings shall be free from burrs, dents, fins sharp edges or projection and the like which may cause damage to the cables.

2.3 Screwed couples shall be screwed inside throughout their entire length.

2.4 Elbow – The axis of any elbow shall be a quadrant of a circle plus a straight portion at each end (tangential to the arc at the end).

2.5 Bend

2.5.1 Normal bend – Shall be large sweep bend giving a diversion of 90° (degrees) in turn of the conduit.

2.5.2 Half-normal bend – Shall be similar to normal bend except that the diversion in the run of conduit shall be 45° (degrees).

2.6 Circular Boxes – Small circular boxes shall be provided with two lugs of thickness not less than 2.8 mm for fixing the covers. Large circular boxes shall have four lugs of thickness not less than 4 mm for fixing the covers.

2.7 Rectangular Boxes – Those used in conjunction with 16 and 20 mm conduits are recognised as standard and shall be provided with two lugs of thickness not less than 2.8 mm.

2.8 Covers for Boxes – Shall be steel, malleable cast iron or other suitable material. Thickness shall not be less than 1.2 mm for steel covers; and not less than minimum thickness of box for malleable cast iron.

2.9 Protection Against Corrosion – Shall be treated both outside and inside excluding machined surfaces and screw threads. Each fitting shall be supplied with a medium or heavy protective coating as agreed. Example of protection are:

a) *Medium Protection* – Stove enamelling, Air drying paint and electrolytic deposits.

b) *Heavy protection* – Hot -dip galvanized coating

2.10 Screw Threads – ISO metric threads.

3. Dimensions – The nominal sizes of outlets of the fittings shall correspond to the nominal outside diameter of the conduits covered by IS 9537 (Part 2) : 1981

3.1 For all cast fittings (other than boxes), the minimum thickness of the machined part measured at the root of the thread shall be as follows :

Thickness

	mm
For sizes equal to 16, 20, and 25 mm dia	1.5
For sizes equal to 32, 40, and 50 mm dia	2.5
For sizes equal to 63 mm dia	3.0

3.2 All dimensions except those for which tolerance are specifically stated herein or which are definitely stated as being maximum or minimum, shall be taken as nominal dimensions and subject to a tolerance of ±5 percent.

3.3 Couplers – Sizes (*Min*) Nominal 16, 20, 25, 32, 40, 50 and 63.

3.4 Elbows – Nominal Size in mm 16, 20, 25, 32, 40, 50 and 63

3.5 Normal Bends and Half Normal Bends – Nominal size in mm 16, 20, 25, 32, 40, 50 and 63.

*Conduits for electrical installations, Part 2. Rigid steel conduits.

3.6 Tees – Nominal Size in mm 16, 20, 25, 32, 40, 50 and 63.

75.0	100	100
	150	75

3.7 Circular Boxes – Size of conduits

a) *Small circular* – 16, 20, 25mm

	150	100
100.0	150	150

b) *Large circular boxes* – 20, 25, 32mm

150.0	100	100
	150	150

3.8 Rectangular Boxes – Preferred internal dimensions:

Height	Length	Breadth
37.5	75	75
	100	75
	100	100
	150	75
	150	100
50.0	150	150
	75	75
	100	75
	100	100
	150	75
	150	100
	150	150

3.9 Circular Looping Boxes – Nominal size 16 and 20 mm.

Note – For detailed dimensions refer to Tables 1 to 7 of the standard.

4. Tests

- Tests for visual examination,
- Dimensional check,
- Test for protective coatings, and
- Test for resistance to impact.

Note – For method of tests refer to 4 and Appendix C of the standard and IS 9537 (Part 2) : 1981 Conduits for electrical installations Part 2 Rigid steel conduits.

For detailed information, refer to IS 2667 : 1988 Specification for fitting for rigid steel conduits for electrical wiring (second revision).

SUMMARY OF

IS 3419 : 1989 FITTINGS FOR RIGID NON-METALLIC CONDUITS

(Second Revision)

1. Scope – Requirements and methods of test for rigid conduit fittings manufactured from insulating materials for use with circular, rigid, non-flame propagating and non-threadable plain conduits of insulating materials. This standard covers conduit fittings suitable for temperature between -5°C and $+60^{\circ}\text{C}$. Only plain type fittings are covered in this standard. The fittings covered by this standard are—couplers, bends, elbows, tees, inspection sleeves, and boxes.

2. Requirements

2.1 Shall be homogenous and non-porous.

2.2 Inside and outside surfaces shall be smooth, clean and uniform and free from projections, grooving and other defects.

2.3 Elbows – Area of the opening in case of inspection elbow shall not be less than two and a half times the internal cross-sectional area of the corresponding conduits.

2.4 Tees – Area of the opening for inspection tees shall not be less than three times the internal cross sectional area of the corresponding cover.

2.5 Cover of Circular Box – Minimum thickness of 1.6 mm.

3. Dimensions (in mm) – Nominal size of the outlets of the fittings shall correspond to the nominal outside diameter of the conduits covered by IS 9537 (Part 3) : 1983*.

Note – For detailed dimensions of slip type couplers, socketed type couplers, clamp type couplers, normal type bends, slip type coupling bends, normal type elbows, normal type tees, socketed type tees and spout type circular boxes refer to Tables 1 to 9 of the standard.

* Conduits for electrical insulations, Part 3, Rigid plain conduits of insulating materials.

4. Tests

4.1 Type Tests

4.1.1 Visual examination

4.1.2 Checking of dimensions

4.1.3 Resistance to heat – Diameter of the impression shall not exceed 2 mm when tested as prescribed.

4.1.4 Resistance to burning – When tested as prescribed, if the sample burns, it shall do so slowly that the burning shall not spread. Any flame shall die out in less than 30s after removal of the burner.

4.1.5 Moisture absorption test – Shall not exceed 1.0 per cent.

4.1.6 Resistance to chemical action – There shall be no visible sign of deterioration of the specimen when tested as prescribed. Slight changes in colour shall however be allowed.

4.1.7 Copper test – There shall be no visible evidence of copper salts or the sample.

4.1.8 Resistance to oil – Shall not show any sign of penetration of oil, cracking or splitting when tested as prescribed.

4.1.9 Resistance to impact – Shall show no damage or cracks visible to the naked eye.

4.1.10 Tests for electric characteristic.

4.2 Acceptance tests – Tests specified in 4.1.1, 4.1.2, 4.1.3 and 4.1.10.

4.3 Routine tests – Tests specified in 4.1.1 and 4.1.2.

Note – For methods of tests refer to the standard.

For detailed information, refer to IS 3419 : 1989 Specification for fittings for rigid non-metallic conduits (second revision).

SUMMARY OF

IS 3480 : 1966 FLEXIBLE STEEL CONDUITS FOR ELECTRICAL WIRING

1. Scope – Requirements for flexible steel conduits for protection of cables in electrical installations. Such conduits shall not be used as an earth continuity conductor.

2. Requirements

2.1 Strip steel used in manufacture shall be of mild steel, bright, cold-rolled and annealed. Shall be electro-galvanized or electro-tinned to a minimum thickness of 0.0025 mm, or otherwise provided with equally effective protective coating.

2.2 Conduit shall be wound tightly and the strip so overlapped in subsequent helices that no openings are seen in normal position.

2.3 Internal surfaces shall be free from burrs and sharp edges.

3. Dimensions (See Table 1)

4. Tests

4.1 Tests for Dimensions

4.2 Linear Breaking Test – Shall show no indication of yielding under a load less than that specified in above table maintained for 3 minutes when undergone the prescribed test.

4.3 Test for Flexibility – Shall show no crack or flaws and shall return to normal position without damage to its outer or inner diameter.

4.4 Bend Fracture Test – Radius of bend shall be decreased until the yield point is reached under a load, not less than that specified in Table given in 3.

4.5 Crushing Test – There shall be no permanent distortion.

Note – For test details, refer to 8 of the standard.

TABLE 1 REQUIREMENTS FOR FLEXIBLE STEEL CONDUITS

NOMINAL INTERNAL DIAMETER	INTERNAL DIAMETER	TOLERANCE ON INTERNAL DIAMETER	EXTERNAL DIAMETER IN NORMAL POSITION	TURNS METRE IN NORMAL POSITION	*BENDING DIAMETRE	+LINEAR BREAKING LOAD	BENDING FRACTURE LOAD
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
m m	m m	m m	m m	m m	m m	m m	m m
6.5	6.5	±0.5	9.0	315	55	35	11.5
10	10.0		13.0	235	63	60	18.0
16	16.0		20.0	200	90	110	35
25	25.0		31.0	160	150	210	45
40	40.0	+1.0	46.0	100	225	330	70
63	63.0		70.0	100	350	430	125
100	100.0		108.0	100	450	500	190

* Inner diameter of bend without straining conduit.

+ Linear breaking load – load at which coils pull off adjacent beading.

For detailed information, refer to IS 3480 : 1966 Specification for flexible steel conduits for electrical wiring

SUMMARY OF
IS 3837 : 1976 ACCESSORIES FOR RIGID STEEL CONDUITS FOR
ELECTRICAL WIRING
(First Revision)

1. Scope – Material, dimensions and other requirements of accessories (other than fittings) used with rigid steel conduits conforming of IS : 9537 (Part 2) 1981*. Accessories include clips (ordinary), saddles (single and multiple), pipe hooks and crampets, plugs, lock nuts and bushes (externally screwed hexagonal and internally screwed circular).

2. Requirements

2.1 Saddles shall be ribbed for reinforcement at crown.

2.2 Plug may be recessed to the thickness of the head, thickness of wall being not less than 3 mm.

2.3 The inside edges of entry bushes shall be smoothly rounded in order to prevent abrasion of cables.

Note – For constructional details in respect of screw thread, spacing plates, plug, lock nuts and entry bush, refer to 3 of the standard.

2.4 Shall be protected against corrosion both inside and outside, excluding machined surfaces and screw threads. Example of protections are:

- a) Medium protection– Stove enamelling; Air drying paint, Electrolytic deposits, etc.
- b) Heavy protection– Hot-dip galvanized coating; Sherardizing, etc.

3. Dimensions (in mm)

<i>Size of Conduit/Bush</i>	16	20	25	32	40	50	63
Minimum thickness (ordinary clips, single and multiple saddles)	0.6	1.0	1.0	1.25	1.25	1.25	1.25
Minimum width (ordinary clips, single and multiple saddles)	15	20	20	25	25	25	25
Maximum width across flats (plugs)	22	26	31	38	46	56	69
Maximum width across flats (lock nuts)	22	27	36	41	50	65	80
Maximum width across flats (hexagonal bushes)	17	22	30	36	41	55	—
Bore (hexagonal bushes)	10	13.5	19	26.2	31	44.4	—
Circular bushes, external dia	20	24	29	36	44	56	—
Circular bushes, bore	11.1	14.3	19	26.2	31.8	44.4	—

Note 1 – Tolerance shall be ± 5 percent on nominal dimensions.

Note 2 – The material shall be mild steel for clips, saddles, plugs and lock nuts, mild steel forgings for pipe hooks and crampets, and shall be moulded insulating for bushes.

Note 3 – For detailed dimensions of accessories, refer to Table 1 to 8 of the standard.

4. Tests

- a) Visual examination,
- b) Dimensional check, and
- c) Test for protective coating (for medium and heavy protection).

* Conduits for electrical wiring Part 2 Rigid steel conduits

For detailed information, refer to IS 3837 : 1976 Specification for accessories for rigid steel conduits for electrical wiring (first revision).

SUMMARY OF
IS 3854 : 1997 SWITCHES FOR DOMESTIC AND SIMILAR
PURPOSES
(Second Revision)

1. Scope

1.1 Applies to manually operated general purpose switches with a rated voltage not exceeding 440 Volts and a rated current not exceeding 63A. intended for household and similar fixed electrical installations either indoors or outdoors.

1.1.1 The rated current is limited to 16 A for switches provided with screwless terminals.

1.2 The standard applies to boxes for switches which are an integral part of it. It does not however apply to mounting boxes for flush type switches.

1.3 This standard also applies to switches such as–

- Switches incorporating pilot lights.
- Electromagnetic remote control switches
- Switches incorporating a time delay device.
- Combinations of switches and other functions (with the exception of switches combined with fuses).
- Electronic switches

1.4 Switches complying with this standard are suitable for use at ambient temperatures not normally exceeding 35°C, but occasionally reaching 45°C.

1.5 It does not cover switches for location where special conditions prevail, as in ships, vehicles and the like and in hazardous locations, for instance where explosions are liable to occur, special constructions may be required.

1.6 This standard does not apply to circuit-breakers for household and similar installations, to switches for appliances, to (in-line) cord switches and switches incorporated in cable reels.

1.7 This standard does not include requirements and tests for switches with protection against solid foreign with their titles and insert the following IS No. at the end:

2. General Requirements– Switches and boxes shall be so designed and constructed, that in normal use, their performance is reliable and without danger to the

user or surroundings.

3. Ratings– Switches shall preferably have rated voltage of 110 V, 230V, 240V and 250V, 400V, 415V. For momentary contact switches intended to operate bells, electromagnetic remote control switches or time-delay switches, the standard rated voltages are 110V and 250V.

3.1 Switches shall preferably have rated currents of 6 A, 10 A, 16 A, 20 A, 25 A, 32 A, 40 A, and 63 A. The rated current shall be not less than 6A, except that rated current of 1 A, 2 A and 4 A are allowed for push-button switches intended to operate bells, electromagnetic remote control switches or time-delay switches.

4. Classification –

a) *According to the possible connections –*

	Pattern No.
– Single-pole switches	1
– Double-pole switches	2
– Three-pole switches	3
– Three-pole plus switched neutral switches	03
– Two-way switches	6
– Two-circuit switches with a common incoming	5
– Two-way switches with one off position	4
– Two-way double-pole switches	6/2
– Two-way double-pole reversing switches	7

b) *According to the contact opening –*

- Switches of normal gap constructions.
- Switches of mini-gap construction (only for a.c.)

c) *According to the degree of protection against electric shock –*

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- Unenclosed switches.
- Enclosed switches.
- d) *According to the degree of protection against harmful ingress of water –*
 - Ordinary switches having no special protection against harmful ingress of water; IPX0
 - Splash-proof switches with degree of protection IPX4.
 - Jet-proof switches with degree of protection IPX5
- e) *According to the method of activating the switch –*
 - Rotary
 - Tumbler
 - Rocker
 - Push-button
 - Cord-operated
- f) *According to the method of application :*
 - Surface type
 - Flush type
 - Semi flush type
 - Panel type
 - Architrave type
- g) *According to the method of Installation, as a consequence of the design :*
 - Switches with screw the cover or cover plate can be removed without displacement of the conductors (Design A)
 - Switches where the cover or cover plate cannot be removed without displacement of the conductors (Design B)
- h) *According to type of terminal–*
 - Switches with screw type terminals
 - Switches with screwless terminals for rigid conductors only
 - Switches with screwless terminals for rigid and flexible conductors only

5. Protection Against Electric Shock – Switches shall be so designed that when they are mounted and wired as in normal use, live parts are not accessible even after removal of parts which can be removed without the use of a tool.

6. Provision for Earthing – Accessible metal parts, which may become live in the event of an insulation fault, shall be provided with, or permanently and reliably connected to, an earthing terminal.

7. Terminals – Switches shall be provided with terminals having screw clamping or with screwless terminals. The means for clamping the conductors shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.

8. Tests

8.1 Type tests –

- a) Rating
- b) Classification
- c) Marking
- d) Checking of dimensions
- e) Protection against electric shock
- f) Provision for earthing
- g) Terminals
- h) Constructional requirements
- j) Mechanism
- k) Resistance to ageing, to harmful ingress of water and to humidity
- m) Insulation resistance and electric strength
- n) Temperature rise
- p) Making and breaking capacity
- q) Normal operation
- r) Mechanical strength
- s) Resistance to heat
- t) Screws, current carrying parts and connections
- u) Creepage distance, clearance and distance through sealing compound
- v) Normal operation for fluorescent lamp circuits
- w) Resistance to abnormal heat and fire
- x) Resistance to tracking
- y) Resistance to rusting.

8.2 Acceptance Tests – Tests specified in 8.1c,) k), n), p), r) and t).

8.3 Routine Tests – Tests specified in 8.1c) and electric strength.

Note – For details requirements and method of tests refer to *the standard*

For detailed information, refer to IS 3854 : 1997 Specification for switches for domestic and similar purposes (second revision).

SUMMARY OF

IS 4160 : 1967 INTERLOCKING SWITCH SOCKET OUTLET

1. Scope – Requirements for interlocking type switch socket outlets, rating up to 30A, suitable for use in ac and dc circuits at rated voltages up to 250 V.

2. Standard Current Ratings – 5, 15 and 30 A

3. Requirements

3.1 Material – Part manufactured with following materials :

- Base* – of vitrified ceramic material or tough non-ignitable moulded insulating material.
- Cover, cover plates and actuating member* – of tough, non-ignitable insulating material.
- Current carrying parts* – of brass, copper, phosphor, bronze, aluminium alloy, or other suitable material.
- Springs* – of corrosion resistant metal.
- Attachment fittings, screws, noncurrent carrying parts* – of mild steel, aluminium alloy or insulating material.

3.2 Terminals – Shall allow a conductor to be connected without special preparation such as soldering of strands, use of cable lugs and formation of eyelets. Shall be designed to clamp the conductor between metal surfaces with sufficient contact pressure and without damage to conductor.

3.2.1 Dimensions of pillar type terminals (in mm):

Rated current, A	5	15	30
Nominal thread dia, <i>Min</i>	3.5	4	6
Dia of hole for conductor, <i>Min</i>	3.5	4.5	7
Length of thread in pillar, <i>Min</i>	2.5	3	4
Difference between dia of hole and nominal dia of screw, <i>Max</i>	0.6	0.6	1.2

3.2.2 Dimensions of screw type terminals (in mm):

Rated current, A	5	15	30
Nominal thread dia, <i>Min</i>	3.5	5	5
Length of screw under head, <i>Min</i>	4	7	8.5
Length of thread in nut, <i>Min</i>	1.5	3	3
Nominal difference between dia of head and thread part, <i>Min</i>	3.5	5	5
Height of head, <i>Min</i>	2	3	3.5

3.3 Interlocking Mechanism – Moving member which locks the plug into the socket outlet shall not be more than 2 mm thick and shall not protrude more than 1.5 mm into the earthing pin of the plug.

3.4 Creepage Distance and Clearance – Not less than 3mm

Note 1 – For constructional details in respect of enclosures, covers and cover plates, mounting of switch socket outlet, carrying parts, precaution against electrical contact, socket contacts, prevention against charring of base, sealing and holes, refer to 5 of the standard.

Note 2 – For requirements regarding terminals and screws, and switch actuating mechanism, refer to 6 and 7 of the standard.

4. Tests

4.1 Type Tests

- Visual Examination
- Dimensional Check
- Interlocking Action
- Insulation resistance (dry)* – Shall not be less than 100 megohms.
- High voltage* – Shall withstand AC voltage of 1500 V rms for a period of one minute under the specified test.
- Moisture resistance* – Insulation resistance shall not be less than 2 megohms.
- Contact resistance and temperature raise* – Shall be capable of carrying rated current for half an hour without voltage drop in a switched pole of switch socket outlet measured from the terminal of the switch to the corresponding plug pin exceeding 0.1 volt and without temperature rise exceeding 25°C.
- Overvoltage and overcurrent capacity* – 130 percent of rated current at 110 percent of rated voltage 10 times in succession at intervals of 30 seconds.
- Endurance* – 15 000 switch cycles for 5 and 15 A and 10 000 for 30 A.
- Test for switch socket outlets for AC inductive

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- circuits
 - l) Screws and connections.
 - m) Mechanical strength
 - n) *Water absorption* – Shall not exceed 0.5 percent for ceramic material and 1 percent for moulded insulating material.
 - o) Resistance to heat
 - p) Resistance to rusting – Shall show no sign of rust after the prescribed ammonium chloride test.
- 4.2 Acceptance Tests** – Tests specified in 4.1 (a) 4.1 (k) and 4.1 (n)
- 4.3 Routine Tests** – Tests specified in 4.1 (a) to 4.1 (e).

Note 1 – Test for tracking shall be applicable to mould insulating materials only and be carried out by manufacturer for proper selection of raw materials.

Note 2 – For detailed requirements and methods of test, refer to **11** of the standard.

For detailed information, refer to IS 4160 : 1967 Specification for interlocking switch socket outlet.

SUMMARY OF

IS 4615 : 1968 SWITCH SOCKET-OUTLETS (NON-INTERLOCKING TYPE)

1. Scope – Requirements for switch socket-outlets of the non-interlocking type of the surface and flush type (shuttered and non-shuttered) having ratings up to 30 A and suitable for use on ac and dc circuits at rated voltage not exceeding 250 V.

2. Standard Current Ratings – 5, 15, and 30 A.

3. Requirements:

3.1 Materials – Parts shall be manufactured with following materials –

- Base* – Vitrified ceramic material or tough non-ignitable moulded insulating material.
- Covers, cover plates and actuating member* – Tough, non ignitable insulating material –
- Current-carrying parts* – Brass, copper, phosphor bronze, aluminium alloy, etc.
- Springs* – Corrosion resistant material
- Attachment fittings, screws, non current carrying parts* – Mild steel, aluminium alloy or insulating material.

3.2 Terminals – Shall allow a conductor to be connected without special preparation such as soldering of stands, use of cable lugs and formation of eyelets. Shall be designed to clamp the conductor between metal surfaces with sufficient contact pressure and without damage to the conductor.

3.2.1 Dimensions of pillar type terminals (in mm):

Rated current, A	5	15	30
Nominal thread dia, <i>Min</i>	3.5	4	6
Dia of hole for conductor, <i>Min</i>	3.5	4.5	7
Length of thread in pillar <i>Min</i>	2.5	3	4
Difference between dia of hole and nominal dia of screw, <i>Max</i>	0.6	0.6	1.2

3.2.2 Dimensions of pillar type terminals (in mm):

Rated current, A	5	15	30
Nominal thread dia, <i>Min</i>	3.5	5	5
Length of screw under the head <i>Min</i>	4	7	8.5
Length of thread in nut, <i>Min</i>	1.5	3	3

Normal differences between dia of head and thread part, <i>Min</i>	3.5	5	5
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Height of head, <i>Min</i>	2	3	3.5
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3.3 Clearances and Creepage Distances – Not less than 3mm

Note 1 – For constructional details in respect of enclosures, covers, cover plates, mounting of switch socket outlet, current carrying parts, precautions against electrical contact, earthing, socket contacts, prevention against charring of base sealing and holes, refer **5** of the standard.

Note 2 – For requirements regarding terminals and screws, and switch actuating mechanism, refer **6** and **7** of the standard.

4. Tests

4.1 Type Tests

- Visual examination*
- Dimensional check*
- Effectiveness of contact* – Voltage drop between terminals of switch socket outlet and corresponding plug pin shall not exceed 25 and 60 millivolts in unswitched neutral pole and switched pole respectively.
- Withdrawal pull* – Between 3 to 60, 4 to 80 and 7 to 100 Newtons for 5, 15, and 30A rating respectively.
- Insulation resistance (dry)* – Shall not be less than 100 megohms.
- High voltage* – Shall withstand ac voltage of 1500 V rms for a period of one minute under specified test conditions.
- Moisture resistance* – Insulation resistance shall not be less than 2 megohms after moisture treatment.
- Contact resistance and temperature Rise* – Not more than 25°C
- Overvoltage and overcurrent capacity* – 130 percent of rated current at 110 percent of rated voltage, 10 times in succession at intervals of 30 seconds.
- Endurance* – 15 000 switch cycles for 5 and 15 A and 10 000 for 30 A.

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- m) *Switch socket* – outlets for ac inductive circuits 125 percent or rated current at 110 percent of rated voltage at 0.3 power factor, 100 times, at a rate approximate 7.5 switch cycles per minute.
 - n) *Screws and connections* –
 - o) *Mechanical strength* –
 - p) *Water absorption*
 - q) *Resistance to heat*
 - s) *Resistance to rusting* – Shall show no sign of rust after the prescribed ammonium chloride test.
 - t) *Endurance of shutters* – 5 000 operations
- 4.2 Acceptance tests** – Tests specified in 4.1(a) to (p) and (s)
- 4.3 Routine tests** – Tests specified in 4.1(a), (b) (e), and (f)

Note 1 – Test for tracking shall be applicable to mould insulating materials only and be carried out by manufacturer for proper selection of raw materials.

Note 2– For detailed requirement and methods of tests, refer to **10** of the standard.

For detailed information, refer to IS 4615 : 1968 Specification for switch socket- outlets (non-interlocking type)

SUMMARY OF

IS 4649 : 1968 ADAPTORS FOR FLEXIBLE STEEL CONDUITS

1. Scope – Requirements for adaptors of clamp and solid types for flexible steel conduits intended for the protection of cables in electrical installations. Adaptors are used for connecting flexible metallic conduits to a rigid conduits or its fitting. Flexible steel conduits shall not be used as earth continuity conductor.

2. Requirements

2.1 Material – Malleable iron.

2.2 Shall be protected against corrosion, both inside and outside, excluding machined surfaces and screw threads.

Examples

- a) *Medium protection* – Stoved enamel; Airdrying paint; and Electrolytic deposits.
- b) *Heavy protection* – Hot-dip galvanized coating; Sherardizing

2.3 Shall be fitted with external earthing lug with hole to accommodate not less than 4 mm² earthing wire. The lug shall be tapped and fitted with a headed clamping screw. Alternately, a headed earthing screw and washer shall be fitted to the solid portion.

2.4 Workmanship – Shall be free from burrs or sharp edges and edges of turns of fins shall be well-formed.

2.5 Dimensions (in mm)

Nominal internal dia of flexible conduit	6.5	10	16	25	40	63	100
External dia in normal position, <i>Max</i>	9	13	20	31	46	70	108
Turns per metre in normal position <i>Min</i>	315	235	200	160	100	100	100
Depth of engagement between conduit and adaptor, <i>Min</i>	10	15	15	25	30	35	45

Note – Tolerances on internal dia shall be +0.5 and 0.0 and +1.0 and – 0.0 for nominal dia range 6.5 to 25 and 40 to 100 respectively.

3. Tests

3.1 Type Tests

- a) Visual examination,
- b) Dimension check, and
- c) Test for protective-coating (for medium and heavy protection)

3.2 Acceptation Tests

- a) Visual examination, and
- b) Dimension check

Note – For test details, refer to **10** of the standard.

For detailed information, refer to IS 4649 : 1968 Specification for adaptors for flexible steel conduits

SUMMARY OF

IS 6538 : 1971 THREE-PIN PLUGS MADE OF RESILIENT MATERIAL

1. Scope – Requirements and tests for three-pin (two - pole and earthing-pin) plugs having the base and cover, or either of these components, constructed of rubber or other suitable resilient material and suitable for use in ac and dc circuits having voltage up to 250 V.

Note – These are intended to be used with socket outlet conforming to IS 1293:1988*

2. Standard Ratings – 5 and 15 A

3. Requirements

3.1 Materials

- a) *Plug base and cover* – of rubber (hardness < 85 IRHD) or tough non-ignitable insulating material.
- b) *Pins, terminals, current-carrying parts* – of phosphor-bronze, brass, aluminium alloy, etc.
- c) *Non-current-carrying parts* – of mild steel, aluminium alloy, or insulating material.

3.2 Construction

3.2.1 During insertion of plug into socket-outlet, it shall not be possible to touch a live pin after contact has been established between pins and socket contacts. Earthing pin shall make and break contact respectively before and after the associated current-carrying pins make and break contact with corresponding contacts.

3.2.2 *Dimensions of plugs (in mm)* – See Table 1.

3.2.3 *Terminals and screws* – The design shall allow a conductor to be connected without special preparations, such as soldering, use of cable lugs and formation of eyelets. When pillar type terminals are used, their dimensions shall be as follows

Current rating	6A	16A
Nom thread dia, <i>Min</i>	3.5 mm	4.0 mm
Dia of hole for conductor, <i>Min</i>	3.5 mm	4.0 mm
Length of thread in pillar, <i>Min</i>	2.5 mm	3.0 mm
Difference between dia of hole and nominal dia of screw, <i>Max</i>	0.6 mm	0.6 mm

Plugs and socket outlets of 250 volts and rated current up to 16 amperes (*second revision*)

TABLE 1 DIMENSIONS OF PLUGS

	Current Rating	
	6A	16A
i) Distance between earthing-pin and current-carrying pin (centre to centre)	22.2	28.6
ii) Distance between current-carrying pins (centre to centre)	19.1	25.4
iii) Dia of earthing pin	7.06	8.71
iv) Dia of current -carrying pin	5.08	7.06
v) Projection of current-carrying pins from plug face	15.9	20.6
vi) Projection of earthing-pin from plug face	20.6	28.6

Note – For detailed dimensions and tolerances refer to Table 1 of the standard.

3.3 Ageing – Plugs shall be resistant to ageing.

3.4 Clearances and Creepage Distances – Not less than 3.0 mm.

Note – For constructional requirements of three-pin plugs with regard to aspects such as earthing, plug cover and base, pins, cord entry and cord grip, current-carrying parts, finger grip, plugs with integral flexible cord, and terminals and screws, refer to 5 of the standard.

4. Tests

4.1 Type Tests

- a) Visual examination,
- b) Test for interchangeability,
- c) Test for effectiveness of contact
- d) Test for insulation resistance (dry),
- e) High voltage test,
- f) Test for moisture resistance,
- g) Temperature-rise test,
- h) Breaking capacity test,
- j) Test for mechanical strength,
- k) Test for mechanical strength,
- m) Ageing test,
- n) Plug pin deflection test,

- | | |
|---|--|
| p) Test for water absorption | 4.2 Acceptance Test – Tests specified in (a) to (m) of 4.1 |
| q) Test for screws and connections
(not applicable for moulded-on type plugs), | 4.3 Routine Tests—Tests specified in (a), (b) and (e) of 4.1 |
| r) Test for cord grip, | |
| s) Test for resistance to heat, and | |
| t) Test for resistance to rust. | |

Note – For test details, refer to 9 of the standard and IS : 1293-1988 Three-pin plugs and socket-outlets (*second revision*)

For detailed information, refer to IS 6538: 1971 Specification for three-pin plugs made of resilient material.

SUMMARY OF
IS 8828 : 1996/IEC 898 (1995) CIRCUIT BREAKERS FOR
OVER CURRENT PROTECTION FOR HOUSEHOLD
AND SIMILAR INSTALLATIONS
(Second Revision)

1. Scope—Applies to A.C. air-break circuit-breakers for operation at 50 Hz or 60 Hz, having a rated voltage not exceeding 440 V (between phases), a rated current not exceeding 125 A and a rated short-circuit capacity not exceeding 25 000 A.

1.2 These circuit-breakers are intended for the protection against overcurrents of wiring installations of buildings and similar applications; they are designed for use by uninstructed people and for not being maintained.

1.3 This standard also applies to circuit-breakers having more than one rated current, provided that the means for changing from one discrete rating to another is not accessible in normal service and that the rating cannot be changed without the use of a tool.

1.4 This standard does not apply to:

- circuit-breakers intended to protect motors.
- circuit-breakers, the current setting of which is adjustable by means accessible to the user.

1.5 For circuit-breakers having a degree of protection higher than IP 20 according to IEC 529, for use in locations where arduous environmental conditions prevail (for example excessive humidity, heat or cold or deposition of dust) and in hazardous locations (for example where explosions are liable to occur) special constructions may be required.

1.6 This standard states :

- i) the characteristics of circuit-breakers;
- ii) the conditions with which circuit-breakers shall comply, with reference to –
 - a) their operation and behaviour in normal service;
 - b) their operation and behaviour in case of overload;
 - c) their operation and behaviour in case of short-circuits up to their rated short-circuit capacity;

- d) their dielectric properties;
- iii) the tests intended for confirming that these conditions have been met and the methods to be adopted for the tests;
- iv) the data to be marked on the devices;
- v) the test sequences to be carried out and the number of samples to be submitted for certification purposes (*see* Annex C of the standard).
- vi) the coordination with separate fuses associated in the same circuit (*see* Annex D of the standard).

2. Classification

2.1 According to the number of poles:

- single-pole circuit-breakers
- two-pole-circuit-breakers with one protected pole;
- two-pole circuit-breakers with two protected poles;
- three-pole circuit-breakers with three protected poles;
- four-pole circuit-breakers with three protected poles;
- four-pole circuit-breakers with four protected poles.

2.2 According to the protection against external influences :

- enclosed-type (not requiring an appropriate enclosure);
- unenclosed-type (for use with an appropriate enclosure);

2.3 According to the method of mounting :

- surface-type;
- flush-type;
- panel board type, also referred to as distribution board type.

2.4 According to the method of connection :

- circuit-breakers the electrical connections of which are not associated with the mechanical mounting;
- circuit-breakers the electrical connections of which are associated with the mechanical mounting; enclosed-type (not requiring an appropriate enclosure);

Note – Examples of this type are :

- plug-in type;
- bolt-on type;
- screw-in type.

2.5 According to the instantaneous tripping current:

- B - type;
- C - type;
- D - type.

2.6 According to the I^2t characteristic – In addition to the I^2t characteristic provided by the manufacturer, circuit-breakers may be classified according to their I^2t characteristic.

3. Standard and preferred values – See Table 1**TABLE 1 PREFERRED VALUES OF RATED VOLTAGE**

Circuit-breakers	Circuit Supplying the Circuit-Breaker	Rated Voltage
	Single phase (phase to neutral)	230 V
Single-pole	Single phase (Phase to earthed middle conductor, or phase to neutral)	120 V
	Single phase (phase to neutral) or three phase (3 single-pole circuit-breaker) (3-wire or 4-wire)	230/400 V
Two-pole	Single phase (phase to neutral)	230 V
	Single phase (phase to phase)	400 V
	Single phase (phase to phase, 3-wire)	120/240 V
Three-pole	Three phase	240 V
Four-pole	(3-wire or 4-wire)	400 V

3.1 Preferred Values of Rated Current are – 6 A, 8 A, 10 A, 13 A, 16 A, 20 A, 25 A, 32 A, 40 A, 50 A, 63 A, 80 A, 100 A and 125 A.

3.2 Standard Values of Rated Frequency – Standard values of rated frequency are 50 Hz and 60 Hz.

3.3 Standard Values of Rated Short-Circuit capacities:

- (a) up to and including 10 000 A are 1 500 A, 3 000 A, 4 500 A, 6 000 A, and 10 000 A.
- (b) Above 10 000 A, up to and including 20,000 A and 25,000 A

4. Standard Condition for Operation in Service

- The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C.
- The lower limit of the ambient air temperature is -5 °C.
- In general the altitude of the site of installation does not exceed 2000 m (6600 ft).
- The air is clean and its relative humidity does not exceed 50% at a maximum temperature of +40 °C

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5. Tests

- | | |
|--|--|
| a) Indelibility of marketing, | g) 28 days test, |
| b) Reliability of screws,current-carrying, Parts and connections | h) Tripping characteristic |
| c) Reliability of terminals for external conductors | j) Mechanical and electrical strength, |
| d) Protection against electric shock | k) Short-circuit*, |
| e) Di-electric properties | m) Resistance to mechanical shock and impact |
| f) Temperature-rise test, | n) Resistance to heat |
| | p) Resistance to a abnormal heat and to fire |
| | q) Resistance to rusting. |

* This test comprises several type tests.

Note – For detailed requirements and methods of tests refer to the standard.

For detailed information, refer to IS 8828 : 1996 Specification for circuit breakers for over current protection for house-hold and similar installations (second revision).

SUMMARY OF
IS 9537 (PART 1) : 1980 CONDUITS FOR ELECTRICAL
INSTALLATIONS
PART 1 - GENERAL REQUIREMENTS

1. Scope – This standard (Part I) applies to conduits of circular cross section for the protection of conductors and/or cables in electrical installations.

Note – Cover conduits suitable for -5°C to $+60^{\circ}\text{C}$.

2. General Requirements – Conduits shall be so designed and constructed that they ensure reliable mechanical protection to the conductors and/or cables contained therein. Furthermore the conduit shall withstand stresses likely to occur during transport, storage, recommended practice and usage.

3. Classification

a) *According to material :*

- 1) Metal conduits and
- 2) Insulating conduits, and
- 3) Composite conduits.

b) *According to the method of connection :*

- 1) Threadable conduits (only plain conduits).
- 2) Non-threadable conduits:
 - i) Plain conduits, and
 - ii) Corrugated conduits.

c) *According to mechanical properties :*

- 1) Conduits for very light mechanical stresses
- 2) Conduits for light mechanical stresses,
- 3) Conduits for medium mechanical stresses,
- 4) Conduits for heavy mechanical stresses and
- 5) Conduits for very heavy mechanical stresses

Note – Conduits which are designed for higher mechanical stresses can be used for lower mechanical stresses. For example – conduits of classification (c) (5) can be used for any of the conditions covered in (c) (1) to (c) (4).

d) *According to suitability for bending :*

- 1) Rigid conduits,
- 2) Flexible conduits,
- 3) Self-recovering conduits, and
- 4) Pliable conduits.

e) *According to resistance to flame propagation :*

- 1) Non-flame propagating conduits, and
- 2) Flame propagating conduits.

f) *According to electrical characteristics :*

- 1) With electrical insulating characteristics, and
- 2) Without electrical insulating characteristics.

g) *According to resistance to external influences–*

- 1) Resistance against ingress of water:
 - i) Unprotected conduits,
 - ii) Conduits with protection against sprays, splashes and jets,
 - iii) Conduits with protection against waves and immersion, and
 - iv) Conduits with protection against submersion:

2) Resistance against corrosive or polluting substances.

- i) Conduits with the same protection on the outside and the inside, Conduits with low protection, Conduits with medium protection, and Conduits with high protection, and
- ii) Conduits with greater protection on the outside than the inside, Conduits with medium protection outside and low protection inside, Conduits with high protection outside and low protection inside, and Conduits with high protection outside and medium protection inside.

h) *According to resistance to solar radiation:*

- 1) Conduits without protection against solar radiation.
- 2) Conduits with protection against solar radiation.
 - i) Conduits with low protection against radiation.
 - ii) Conduits with medium protection against radiation.

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- iii) Conduits with high protection against radiation.

4. Mechanical Properties

- a) Conduits shall have adequate mechanical strength.
- b) Bend Test – Values as per relevant conduit specifications.
- c) *Compression Test* – when tested as prescribed, the difference between the initial diameter and diameter of flattened sample shall not exceed a specified percentage of the outside diameter measured before the test.
- d) *Impact Test* – There shall be no sign of disintegration, neither shall there be any cracks visible to the naked eye when tested as prescribed.

- e) *Collapse Test* – Values of minimum internal diameter as per relevant conduits specifications)
- f) *Resistance to Heat* – (As per relevant conduit specifications).
- g) *Resistance to Burning* – Time of exposure as per relevant conduit specifications. If the sample burns it shall do so slowly and the flame shall not spread appreciably; any flame shall have died out in less than 30 seconds after removal of the burner.

5. Electrical Characteristics

- a) Electrical Strength.
- b) Insulation Resistance.

6. External Influences – Conduits shall have adequate protection against external influences. The influences included here are ingress of water or oil or building materials, low or high temperatures and polluting substances and solar radiation.

Note — For methods of Test, refer to the standard.

For detailed information, refer to IS 9537 (Part I) : 1980 Specification for conduits for electrical installations : Part I General requirements.

SUMMARY OF
IS 9537(PART II) : 1981 CONDUITS FOR ELECTRICAL WIRING
PART 2 RIGID STEEL CONDUITS

1. Scope—Requirements and methods of test of threaded/threadable plain rigid steel conduits.

2. General Requirements – Conduits shall be so designed and constructed that they ensure reliable mechanical protection to conductors and/or cables contained therein. Conduit shall withstand stresses likely to occur during transport, storage, recommended practice and usage.

3. Classification

3.1 According to Resistance against Corrosive or Polluting substances :

- a) Conduits with low protection,
- b) Conduits with medium protection,
- c) Conduits with high protection,
- d) Conduits with high protection on the outside and low protection inside,
- e) Conduits with medium protection outside and low protection inside, and
- f) Conduits with high protection outside and medium protection inside.

Note 1 – Normally, protection mentioned at (b) and (c) are commonly used.

Note 2 – Typical examples of medium protection are stove enamelling, air drying paint and electrolytic deposits.

Note 3 – Typical examples of high protection are hot-dip galvanized coating and sherardizing.

3.2 According to Mechanical Properties:

- a) Conduits for very light mechanical stresses,
- b) Conduits for light mechanical stresses,
- c) conduits for medium mechanical stresses,
- d) Conduits for heavy mechanical stresses, and
- e) Conduits for very heavy mechanical stresses.

4. Dimensions

<i>Nominal Size of Conduit (Outside Diameter)</i>	<i>Tolerance Wall on Outside</i>	<i>Thickness of Conduits</i>
mm	mm	mm
16	0 -0.3	1.4 to 1.8
20	0 -0.3	1.4 to 1.8
25	0 -0.4	1.4 to 1.8
32	0 -0.4	1.4 to 1.8
40	0 -0.4	1.6 to 2.2
50	0 -0.5	1.6 to 2.2
63	0 -0.6	1.6 to 2.2

4.1 Length – Conduits shall be supplied in straight lengths of 3 to 5 metres.

5. Construction –The inside and outside surfaces of conduits shall be reasonably smooth and free from burrs, flash and similar defects. The conduits shall be solid drawn or seam joined by welding.

6. Mechanical Properties

6.1 Bending Test – After the test, basic material or protective coating of conduits shall not show any cracks visible by normal or corrected vision without magnification. Seams, if any, shall not have opened, and section of conduit shall not have distorted unduly.

6.2 Compression Test – The difference between the initial diameter and diameter of flattened samples shall not exceed **10** percent of outside diameter measured before the test.

Note 1 – For requirement regarding gauge for checking minimum and maximum outside diameter of conduits, measurement of thickness and screw threads, refer to *the standard*.

Note 2 – For test details and provisions regarding external influences, refer to the standard and IS 9537 (Part 1) : 1980 Conduits for electrical installations – Part I General requirements.

For detailed information, refer to IS 9537 (Part 2) : 1981 Specification for conduits for electrical wiring: Part 2 Rigid steel conduits.

SUMMARY OF
IS 9537 (PART 3) : 1983 CONDUITS FOR ELECTRICAL
INSTALLATIONS
PART 3 – RIGID PLAIN CONDUITS OF INSULATING MATERIALS

1. Scope – Requirements and methods of tests for circular rigid non-flame propagating and non-threadable plain conduits of insulating materials ended and socket ended.

2. General Requirements—Provision of IS 9537 (Part:1) 1980 shall apply

3. Classification – According to mechanical properties as :

- a) Conduits for light mechanical stresses.
- b) Conduits for medium mechanical stresses.
- c) Conduits for heavy mechanical stresses.

4. Dimensions - See Table 1

TABLE 1 DIMENSIONS OF CONDUITS

Nominal Size Diameter	Outside Diameter	All dimensions in millimetres Tolerance on Outside Diameter	Inside Diameter, Min		
			Light	Medium	Heavy
(1)	(2)	(3)	(4)	(5)	(6)
16	16	- 0.3	13.7	13.0	12.2
20	20	- 0.3	17.4	16.9	15.8
25	25	- 0.4	22.1	21.4	20.6
32	32	-0.4	28.6	27.8	26.6
40	40	- 0.4	35.8	35.4	34.4
50	50	- 0.5	45.1	44.3	43.2
63	63	- 0.6	57.0	-	-

5. Test

- a) *Bend Test* – Only conduits of sizes 16, 20 and 25 shall be subjected to the bending test. After the test, the sample shall show no cracks visible to normal or corrected vision without magnification.
- b) *Compression Test* – The difference between the initial diameter and the diameter of the flattened sample shall not exceed 25 percent of the initial diameter while the compression force is still applied.

- c) *Impact Test* – As given in IS 9537 (Part I) : 1980
- d) *Collapse Test* – It shall be possible to pass the appropriate gauge, through the conduit fixed to support under its own weight and without any initial speed. Applicable for conduit of sizes 16, 20 and 25 only
- e) *Resistance to Heat*
- f) *Resistance to Burning*
- g) *Electrical Characteristics*
- h) *External Influences*

Note – For detail requirements refer to the standard

For detailed information, refer to IS 9537 (Part 3): 1983. Specification for conduits for electric installations - Part 3 Rigid plain conduits of insulation materials.

SUMMARY OF
IS 9537 (PART 4) : 1983 CONDUITS FOR ELECTRICAL
INSTALLATIONS
PART 4 – PLIABLE SELF RECOVERING CONDUITS OF
INSULATING MATERIALS

1. Scope – Requirements and methods of tests for pliable self-recovering plain and corrugated conduits of insulating materials.

2. General Requirements – Provisions of IS 9537 (Part 1):1980 shall apply.

3. Classification – According to mechanical properties:

- a) Conduits for very light mechanical stresses,
- b) Conduits for light mechanical stresses, and
- c) Conduits for medium mechanical stresses.

4. Dimensions – See Table 1.

TABLE 1 DIMENSIONS OF THE CONDUITS

<i>Nominal size of Conduit</i>	<i>Outside Diameter of the Conduit</i>	<i>Tolerance on Outside Diameter</i>	<i>Inside Diameter, Min</i>	<i>Preferred Length when Delivered as Coil</i>
(1)	(2)	(3)	(4)	(5)
mm	mm	mm	mm	mm
16	16	- 0.3	10.7	50 and 100
20	20	- 0.3	14.1	
25	25	- 0.4	18.3	50
32	32	- 0.4	24.3	
40	40	- 0.4	31.2	
50	50	- 0.5	39.6	25
63	63	- 0.6	52.6	

5. Tests

- a) *Bending Test* – After the test, the samples shall show no cracks visible to normal or corrected vision without magnification.
- b) *Compression Test* – After the test, the samples shall show no cracks visible to normal or corrected vision without magnification:
- c) *Impact test* – As given in IS 9537 (Part 1): 1980

- d) *Collapse Test* – It shall be possible to pass the appropriate gauge, through the conduit fixed to support under its own weight and without any initial speed.
- e) *Resistance to Heat.*
- f) *Resistance to Burning.*
- g) *Electrical Characteristics.*
- h) *External Influences.*

Note – For details requirements refer to the standard

For detailed information, refer to IS 9537 (Part 4) : 1983 Specification for conduits for electrical installations :Part 4 Pliable self-recovering conduits of insulating materials.

SUMMARY OF
IS 9537 (PART 5) : 2000 CONDUITS FOR ELECTRICAL
INSTALLATIONS
PART 5 – PLIABLE CONDUITS OF INSULATING MATERIAL

1. Scope – This clause of Part 1 of the Standard is applicable except as follows:

Addition:

This Indian Standard (Part 5) specifies requirements for pliable non-flame propagating plain and corrugated conduits of insulating material. It does not include self-recovering or flexible conduits.

This standard also applies to corrugated conduits with a smooth exterior surface.

2. General Requirements – This clause of Part 1 is applicable

3. General Notes on tests – This clause of Part 1 is applicable except as follows:

Replacement:

The minimum total length of conduit to be submitted for all tests is 36 m.

4. Classification – This clause of Part 1 is applicable except as follows: **5.1** (a), (1), **5.1** (a), (3), **5.1** (b), (1), **5.1** (d), (1) **5.1** (d), (2), **5.1** (d), (3), **5.1** (c), (2), **5.1** (f), (2) and **5.1** (g), (1) (i), not applicable.

Additional Sub-clause

5.101 According to temperature, given as follows:

5. Classification of tests –

5.1 Types Tests

The following shall constitute the type tests:

- a) Checking of admissions
- b) Bending test
- c) Compression
- d) Impact test
- e) Collapse test
- f) Resistance to heat
- g) Resistance to burning
- h) Electrical characteristics, and
- j) External influences

5.1.1 Acceptance Tests

The following shall constitute the acceptance tests:

- a) Checking of dimensions
- b) Bending test (at room temperature only)
- c) Compression test
- d) Collapse test
- e) Resistance to burning
- f) Electrical characteristics

Temperature Classification	Temperature not Normally less Than		Permanent Application Temperature Range °C
	Storage and Transport °C	Use and Installation °C	
– 45	– 45	– 15	– 15 to + 60
– 25	– 25	– 15	– 15 to + 60
– 5	– 5	– 5	– 5 to + 60
+ 90	– 5	– 5	– 5 to 60 ¹
+ 90/–25	– 25	– 15	– 15 to + 60 ¹

¹ These types, for use in prefabricated concrete, will temporarily withstand temperatures up to + 90°C.

Note : Conduits of insulating materials for temperature up to 200°C are under consideration.

Note – For detail requirements refer to the standard

For detailed information, refer to IS 9537 (Part 5): 1983. Specification for conduits for electric installations - Part 3 Rigid plain conduits of insulation materials.

SUMMARY OF

IS 14772 : 2000 GENERAL REQUIREMENTS FOR ENCLOSURES FOR ACCESSORIES FOR HOUSEHOLD AND SIMILAR FIXED ELECTRICAL INSTALLATIONS – SPECIFICATION

1. Scope – This standard applies to enclosures or parts of enclosures or parts for accessories with a rated voltage not exceeding 440 V intended for household or similar fixed electrical installations, either indoors or outdoors.

This standard may be used as a guide for enclosures having a rated voltage up to 100 V.

Enclosures complying with this standard are suitable for use, after installation, at ambient temperatures not normally exceeding 35°C, but occasionally reaching 45°C.

For the purpose of this standard the enclosures include surface, flush and semi-flush mounting boxes provided, for electrical accessories, where the cover or cover plate may or may not be part of the accessory. This standard does not apply to enclosures for assemblies containing overcurrent protective devices, not to enclosures of the busbar trunking of luminaires.

This standard also applies to boxes intended for the mounting or suspension of luminaires.

This standard is intended to apply to enclosures for electrical accessories but is also intended to serve as a reference document for other Indian Standards.

As enclosures which is an integral part of an electrical accessory and provides protection for that accessory against external influences (for example mechanical impact, ingress of solid objects or water etc) is covered by the relevant standard for such an accessory.

(AQL) for lot-by-lot inspection (*second revision*)

2824 : 1975 Method for determining the comparative tracking index of solid insulating material under moist condition (*first revision*)

11000 (Part 2/ Fire hazard testing: Part 2 Test method, Sec 1) : 1984 method, Section I Glow wire test and guidance

12063 : 1987 Classification of degree of protection provided by enclosures of electrical equipment.

13588 : 1993/ Spring operated impact test apparatus
IEC 817:1984 and calibration

14763 : 2000 conduits for electrical purposes, inside diameters of conduits for electrical installations and thread for conduits and fittings

2. General Requirements

2.1 Enclosures shall be so designed and constructed that, when mounted as for normal use, they ensure adequate electrical and mechanical protection to the parts so enclosed and prevent danger to the user or surroundings.

Compliance is checked by carrying out all the relevant tests specified.

3. Classification – Enclosures are classified according to:

3.1 The nature of their material

3.1.1 Insulating material

3.1.2 Metallic

3.1.3 Composite

3.2 The method of installation

3.2.1 Flush - type

3.2.2 Semi-flush type

3.2.3 Surface - type

3.3 The Nature of installation

3.3.1 Enclosures flush mounted in :

3.3.1.1 Solid non - combustible walls and ceilings:

- a) Suitable to be placed before the building process (for example not suitable for casting into concrete)
- b) Suitable to be placed after the building process (for example not suitable for casting into concrete).

3.3.1.2 Solid combustible walls and ceilings

3.3.1.3 Hollow walls, hollow ceilings, furniture, architraves

3.3.1.4 Trunking and ducting

3.3.2 Enclosures surface mounted on :

3.3.2.1 Non-combustible walls and ceilings

3.3.2.2 Combustible walls and/or ceilings and/or

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furniture

3.4 The temperature range during installation

3.4.1 from -5°C to $+60^{\circ}\text{C}$

3.4.2 from -15°C to $+60^{\circ}\text{C}$

3.4.3 from -25°C to $+60^{\circ}\text{C}$ (see Note)

Note – These types are intended for enclosures to be used outdoor conditions with a cold climate.

3.5 The maximum temperature during the building process.

3.5.1 $+60^{\circ}\text{C}$

3.5.2 $+60^{\circ}\text{C}$ (see Note)

Note – These types are intended for enclosures to be used outdoor conditions with a cold climate.

3.3 The degree of protection against direct contact and harmful ingress of solid objects and harmful ingress of water.

According to IP given in IS 12063.

3.7 The provision for suspension means

3.7.1 Without suspension means

3.7.2 With suspension means

Enclosures intended to provide double or reinforced insulation are under consideration. The time interval between one drop and the next is $30 \pm 5\text{s}$.

No flashover or breakdown between electrodes shall occur before a total of 50 drops has fallen.

Note– 1. Care is taken that the electrodes are clean, correctly shaped and correctly positioned before each test is started.

2. In case of doubt the test is repeated, if necessary, on a new set of samples.

4. Tests –

4.1 Category of Test – Tests are classified as type, acceptance and routine test.

Table 3 Scheduled of Test

(Clause 18.1)

Sl. No.	Test
i)	Making
ii)	Dimensions
iii)	Protection against electric shock
iv)	Provision for earthing
v)	Construction
vi)	Resistance to ageing, to humid conditions, ingress of solid objects and to harmful ingress of water
vii)	Mechanical strengths
viii)	Resistance to heat
ix)	Resistance of insulating material to abnormal heat and fire
x)	Resistance to rusting
xi)	Resistance of tracking

4.2 Acceptance test – The following shall constitute the acceptance test:

Test

Making
Protection against electric shock
Provision for earthing
Construction
Resistance to ageing, to humid condition, to ingress of solid objects and to harmful ingress of water
Mechanical Strength

4.3 Routine Test

Test

Protection against electric shock
Provision for earthing

Note – For detail requirements refer to the standard

For detailed information, refer to IS 14772 : 2000. Specification for conduits for electric installations - Part 3 Rigid plain conduits of insulation materials.

SECTION 27

GENERAL

CONTENTS

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IS 875 :	Code of practice for Design loads (Other than Earthquake)for Buildings and Structures	
(Part-1): 1987	Dead loads — Unit Weights of Building Materials and stored materials	.27.2

SUMMARY OF

**IS 875 (PART 1) : 1987 CODE OF PRACTICE FOR DESIGN LOADS
(OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES,
PART-1 DEAD LOADS – UNIT WEIGHTS OF BUILDING
MATERIALS AND STORED MATERIALS.**

1. Scope – Covers unit weight mass of materials, and parts or components in a building that apply to the determination of dead loads in the design of buildings. The unit weight mass of materials that are likely to be stored in a building are also specified in the standard for the purpose of load calculations along with angles internal friction as appropriate.

2. Building Materials – Table 1 of *the standard* gives the unit weight mass of the following materials used in building construction:

Acoustical materials
Aggregate, coarse
Aggregate, organic
Asbestos
Asbestos cement building pipes
Asbestos cement gutters
Asbestos cement pressure pipes
Asbestos cement sheeting
Bitumen
Blocks
Boards
Bricks
Brick chips and broken bricks
Brick dust (*SURKHI*)
Cast iron, manhole covers
Cast iron, manhole frames
Cast iron pipes
Cement
Cement concrete, plain
Cement concrete, reinforced
Cement concrete pipes
Cement concrete, prestressed
Cement mortar
Cement plaster
Cork
Expanded metal

Felt, bituminous for water-proofing and damp-proofing
Foam slag, foundry pumice
Glass
Gutter, asbestos cement
Gypsum
Iron
Lime
Linoleum
Mastic asphalt.
Masonry brick
Masonry stone
Metal sheeting, protected galvanized steel sheets and plain.
Mortar
Pipes
Plaster
Sheeting
Slagwool
Soil and gravels
Steel sections
Stones
Tar, coal
Thermal Insulation
Terra cotta
Terrazzo
Tiles
Timber
Water
Wood-wool building slabs

3. Building Parts and Components – Table 2 of *the standard* gives the unit weights of the following building parts or components:

Ceilings	Finishing
Cement concrete, plain	Flooring
Cement concrete, reinforced	Roofing
Damp-proofing	Walling
Earth filling	

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4. Store and Miscellaneous Materials – Unit weights of the following store and miscellaneous materials are given in Appendix A of the standard.

Fuels	Metals and alloys and allied materials	Ores	Textiles paper
Manures	Miscellaneous materials		

Agricultural and food products	Chemicals and allied materials
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For detailed information, refer to IS 875 (Part 1) : 1987 Code of practice for design loads (other than earthquake) for building and structures. Part 1 Dead codes - Unit weight of building materials and stored materials.



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