

BUREAU OF INDIAN STANDARDS

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Draft Indian Standard

**SPECIFICATION FOR GLASS TUBES FOR GENERAL PURPOSE
AND REFERENCE THERMOMETERS**

(First Revision)

ICS 17.200.20

Glass, Glassware & Laboratoryware Sectional Committee, CHD 10

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FOREWORD

(Formal clauses to be added later)

This standard was originally published in 1968 with an objective to enable manufacturers of glass thermometers to select glass tubes of the right type and thus produce quality thermometers. In this first revision, the amendments have been incorporated, references have been updated and several editorial changes such as inclusion of the Reference clause, Hindi Title, ICS no, BIS certification marking clause, etc. have also been incorporated.

Requirements and methods of sampling and test for glass tubes for medical thermometers have been prescribed in IS 4529: 1968.

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

1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for glass tubes used in the manufacture of general purpose, reference and all other types of liquid-in-glass thermometers suitable for use within a range of -200° to $+500^{\circ}\text{C}$.

2 REFERENCES

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

<i>IS No.</i>	<i>Title</i>
1382 : 1981	Glossary of terms relating to glass and glassware (<i>first revision</i>)
2303 (Part 1/Sec 1) : 2021	Grading glass: Part 1 method of test and classification: Sec 1 hydrolytic resistance of glass grains at 98°C (<i>third revision</i>)
2627 : 1979	Glossary of terms relating to liquid-in-glass thermometers (<i>first revision</i>)
4905 : 2015	Random sampling and randomization procedures (<i>first revision</i>)

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1382: 1981 and IS 2627: 1963, in addition to the following, shall apply.

3.1 Glass Tubes — capillary tubes and bulb tubes.

4 TYPES

4.1 Glass tubes for thermometers shall be of two types, namely, capillary tubes and bulb tubes.

5 MATERIAL

5.1 Appearance

Glass capillary and bulb tubes shall be of clear, transparent glass, free from occlusions, striae, stresses and other visual defects, such as bubbles, knots, reflection failures and roughness of the bore.

5.1.1 The capillary tubes shall be of a round cross-section and shall be provided with a white or yellow opal glass backing with a suitably placed oval or round bore.

NOTE 1: For thermometers having maximum range above 350°C , glass tubing without opal backing may be used.

NOTE 2: Additional coloured stripe or stripes may be provided suitably on the capillary tubes as a mark for identification.

5.1.2 The capillary tubes shall not have any double bore at the two ends as viewed through a microscope of minimum linear magnification of 250 times.

5.1.3 The bulb tubes shall be of round cross-section and shall be free from any stone or airline visible to the naked eye.

6 REQUIREMENTS

6.1 The tubes shall not devitrify during two heatings each for 3 minutes at a stretch in the oxidizing flame of a burner.

6.2 Coefficient of Linear Thermal Expansion

The average coefficient of linear thermal expansion of the tubes between 0° and 100°C shall be as under:

- a) Not more than $8.5 \pm 0.3 \times 10^{-6}$ per deg for thermometers meant for use up to 350°C, and
- b) Below 5.0×10^{-6} per deg for the thermometers meant for use between 350° and 500°C.

6.2.1 The difference in the coefficient of linear thermal expansion of capillary tubes and bulb tubes shall be not more than 0.2×10^{-6} per deg.

6.3 Stability of Bulb Tubes

The bulb tubes shall be considered stable if a thermometer made with that bulb tubing passes the following test:

Heat the thermometer to a temperature equal to its maximum nominal temperature for 5 minutes. Allow the thermometer to cool either naturally in still air or slowly in the test bath (at a specified rate) to 20°C above the ambient temperature or to 50°C, whichever is the lower, and then determine the zero point.

Repeat the above experiment about 24 hours after determining this zero point. The change in the zero shall not exceed one small scale division of the thermometers to be made out of these tubes.

NOTE 1: If rapid cooling is used, the zero point shall be determined within one hour.

NOTE 2: Thermometers having maximum nominal temperature up to or below 50°C shall be heated to about 50°C.

6.4 Limit of Alkalinity

When graded according to the method prescribed in IS 2303(Part 1/Sec 1): 2021, glass tubes shall conform to Class HGB 4 or better of the glass.

6.5 Dimensions

6.5.1 Length

The length of the glass tubes shall be as agreed to between the purchaser and the supplier.

6.5.2 Diameter

The outside diameter of the capillary tubes shall be uniform and between 5.5 and 8.0 mm when measured with a ring gauge or a micrometre or a shadow graph.

6.5.2.1 The outside diameter of the bulb tubes shall be less than that of the corresponding capillary tube as prescribed in the relevant material standard of the thermometers when measured with a ring gauge or a micrometre or a shadow graph.

6.5.3 Bore

The bore of the capillary tubes for use with mercury as thermometric liquid shall be preferably elliptical having a ratio of the major axis to the minor of not more than 2.5.

6.5.3.1 The bore of the capillary tubes meant for thermometers having minimum nominal temperature below 55°C shall be round.

NOTE: Usually the highest temperature of use is taken as about 130 deg below the strain point and there is no limitation to lower temperature.

6.5.3.2 The bore of bulb tubes shall be almost round.

6.5.3.3 The bore area at any end of the capillary tube shall not differ from the average of the bore areas of the two ends of the capillary tube by more than 10 percent.

6.5.3.4 The bore areas of the tubes shall be measured with a high power microscope having a linear magnification of not less than 250 times or any other suitable instrument.

7 PACKING AND MARKING

7.1 Packing

Glass tubes shall be packed in sealed polyethylene bags, free from moisture, dirt and dust or each tube shall be flame-sealed at both ends. The bags shall be packed in suitable corrugated card-board boxes.

7.2 Marking

7.2.1 Each bag and each box shall be marked with the following information:

- a) Name of the material;
- b) Manufacturer's name or recognized trade-mark, if any;
- c) Lot number to enable the batch of manufacture to be traced from records;
- d) Year of manufacture;
- e) Bore area and its tolerance;
- f) Accelerated ageing schedule recommended by the manufacturer; and
- g) Temperature range suitable for thermometers to be made.

7.2.2 *BIS Certification Marking*

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

8 SAMPLING

8.1 Representative samples of the glass tubes shall be drawn and adjudged for conformity to this standard as prescribed in **Annex A**.

ANNEX A
(Clause 8.1)

**SAMPLING OF GLASS TUBES FOR GENERAL PURPOSE AND
REFERENCE THERMOMETERS**

A-1 SCALE OF SAMPLING

A-1.1 Lot

In a single consignment all the capillary tubes of the same type and area of nominal bore and all the bulb tubes for the same type of thermometers produced in the same batch of manufacture shall constitute a lot.

A-1.2 Samples shall be tested from each lot separately for ascertaining conformity of the tubes in the lot to the requirements (except stability of bulb tubes) of this specification.

A-1.3 The number of sample tubes to be selected for testing shall depend on the size of the lot and shall be in accordance with Table 1 when the lot contains up to 1 000 tubes and in accordance with Table 2 when the lot contains more than 1 000 tubes.

**TABLE 1 SCALE OF SAMPLING FOR LOTS CONTAINING
UP TO 1 000 TUBES**

(Clauses A-1.3, A-2.1 and A-2.2.1)

LOT SIZE	SAMPLE SIZE	ACCEPTANCE NUMBER
(1)	(2)	(3)
Up to 300	20	0
301 to 1 000	80	1

**TABLE 2 SCALE OF SAMPLING FOR LOTS CONTAINING
MORE THAN 1 000 TUBES**

(Clauses A-1.3 and A-3.2)

SAMPLING STAGE	SAMPLE SIZE	CUMULATIVE SAMPLE	ACCEPTANCE NUMBER	REJECTION NUMBER
(1)	(2)	(3)	(4)	(5)
First	20	20	*	2
Second	20	40	*	2
Third	20	60	0	2
Fourth	20	80	0	3
Fifth	20	100	1	3
Sixth	20	120	1	3
Seventh	20	140	2	3

*Acceptance not permitted at this stage.

A-1.4 Random Selection

The tubes shall be selected at random from the lot. In order to ensure randomness of selection, procedures given in IS 4905 may be followed.

A-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY FOR LOTS CONTAINING UP TO 1 000 TUBES

A-2.1 Sample tubes, as required in col 2 of Table 1, shall be selected from the lot in two steps. In the first step at least 50 percent of the bags in the lot shall be taken at random. Then in the second step from each selected bag an approximately equal number of tubes shall be taken at random so as to give the total number of tubes in accordance with col 2 of Table 1.

A-2.2 Requirements Other Than Alkalinity

All the sample tubes shall be individually tested for all the requirements except that of alkalinity. Any tube which fails to satisfy any one or more of these requirements shall be called a defective.

A-2.2.1 If the number of defectives in the sample tubes does not exceed the acceptance number specified in col 3 of Table 1 the lot shall be declared to conform to these requirements and shall be passed on for alkalinity test (*see A-2.3*).

A-2.3 Alkalinity Requirements

The lot having been found to conform to all other requirements in **A-2.2**, it shall be tested for alkalinity. For this purpose, from the sample tubes a number of tubes shall be taken at random so as to yield after crushing an adequate quantity of glass for one alkalinity test.

If the test result for alkalinity meets the specified alkalinity requirement, the lot shall be declared as conforming to the requirements of this specification.

A-3 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY FOR LOTS CONTAINING MORE THAN 1 000 TUBES

A-3.1 The sample tubes shall be selected at random from the lot in stages at the rate of 20 per stage according to need as in **A-3.2**.

A-3.2 Requirements Other Than Alkalinity

Testing and judging for conformity to these requirements shall be done stage-by-stage as follows:

First Stage — Twenty sample tubes shall be taken at random from as many bags in the lot as possible. Each of the 20 tubes shall be tested for these requirements. A tube which fails to satisfy any one or more of these requirements shall be called a defective. If the number of defectives found in these 20 tubes equals or exceeds the rejection number corresponding to the first stage in Table 2, the lot shall be rejected without further testing, otherwise, testing shall proceed to second stage.

Second Stage — In the second stage 20 more tubes shall be taken from the lot at random from as many bags as possible and representing as many new bags as possible. Each of these 20 tubes shall be tested for these requirements. If the total number of defectives of both the stages equals or exceeds the rejection number corresponding to the second stage in Table 2, the lot shall be rejected without further testing, otherwise testing shall proceed to third stage.

Third Stage — In this stage 20 more tubes shall be taken from the lot at random from as many bags as possible and representing as many new bags as possible. Each of these 20 tubes shall be tested for these requirements. If the total number of defectives of all the stages so far

is equal to or less than the acceptance number corresponding to this stage in Table 2, the lot shall be declared to conform to these requirements; if it is equal to or greater than the rejection number corresponding to this stage in Table 2, the lot shall be rejected; if it is in between the corresponding acceptance number and the rejection number, the testing shall proceed to the next stage.

Fourth and Subsequent Stages — The procedure for the fourth and the subsequent stages, if needed, shall be the same as for the third stage till a decision to reject or to accept the lot for these requirements is reached.

A-3.3 Alkalinity Requirement

The lot having been found to conform to all other requirements in **A-3.2** shall be tested for alkalinity. For this purpose, two alkalinity determinations shall be made; one from the sample tubes of the first stage and the other from the sample tubes of the second stage. The tubes for alkalinity test shall be taken at random from the stage sample so as to yield after crushing an adequate quantity of glass for one test.

If the two test results for alkalinity separately meet the specified alkalinity requirement, the lot shall be declared as conforming to the requirements of this specification.