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BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

Draft Indian Standard

GLASS ALCOHOLOMETERS — SPECIFICATION
PART 2 GLASS ALCOHOLOMETERS WITH THERMOMETER (THERMO-ALCOHOLOMETERS)

(*Second Revision*)

भारतीय मानक मसौदा

ग्लास अल्कोहलमीटर – विशिष्टि
भाग 2 ग्लास अल्कोहलमीटर थर्मोमीटर के साथ (थर्मो-अल्कोहलोमीटर)

(दूसरा पुनरीक्षण)

ICS 17.060

Glass, Glassware & Laboratoryware Sectional Committee, CHD 10

Last date for Comments: 11 November 2024

FOREWORD

(*Formal clause may be added later*)

This Indian Standard was originally published in 1987 as IS 3608 covering alcoholometers with and without thermometer. Later in 1987, the standard was revised in two parts: Part 1 glass alcoholometers without thermometer; and Part 2 glass alcoholometers with thermometer.

In the first revision, the alcoholometers having 0.2° graduation (type B) were omitted as the same were not in use. Instead, two classes of accuracy were introduced for glass alcoholometers without thermometer; class A for more accurate work and class B for normal work. However, in the case of alcoholometer with thermometer only one type of accuracy, namely, class B, was prescribed. Modifications in dimensions of alcoholometers were made. Reference temperature was also changed from 15°C to 20°C in order to align with the international practice.

This second revision has been taken up to update the ICS No and several other editorial changes in order to bring out the standard in the latest style and format of the Indian standards.

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, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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GLASS ALCOHOLOMETERS — SPECIFICATION

PART 2 Glass Alcoholometers with Thermometer (Thermo-Alcoholometers)

(*Second Revision*)

1 SCOPE

1.1 This standard (Part 2) prescribes the requirements and the methods of sampling and test for thermo-alcoholometers meant for determining the ethanol content in ethanol-water mixtures at 20°C.

1.2 The basis of graduations of these alcoholometers are the values of density versus composition of ethanol solutions by volume as given in Table 1 of this standard and are based on values adopted by the International Organization of Legal Metrology (OIML).

2 REFERENCE

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

IS No.	*Title*
1382: 1981	Glossary of terms relating to glass and glassware (*first revision*)
4905: 2015	Random sampling and randomization procedures (*first revision*)
5717: 2003	Laboratory glassware - Pyknometers (*second revision*)
6274: 1971	Method of calibrating liquid-In-Glass thermometers
8787: 2018	Principles of design, construction and use of liquid - In - Glass thermometers (*first revision*)
9621: 1980	Principles of construction and adjustment of glass hydrometers

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1382 in addition to the following shall apply.

3.2 Alcoholometer

An instrument which indicates the alcoholic strength by volume of a mixture of water and ethanol.

3.3 Bulb

The wider portion of the alcoholometer containing the loading material.

3.4 Ethanol Content (at Temperature t °C)

The number of parts by volume of ethanol at 20°C contained in 100 parts by volume of the liquid at temperature t °C.

3.5 Stem

The thin tubing attached to the upper part of the bulb containing the indicating scale.

3.6 Thermo-alcoholometer

An instrument which indicates the alcoholic strength by volume of a mixture of water and ethanol and is provided with a built in thermometer.

3.7 Observed Degree

The temperature other than 20°C. The observed degree shall always be given with the temperature of the liquid.

3.8 Observed Volume

The volume of the liquid at the temperature at which it actually is. The observed volume shall be expressed in litres at that particular temperature, for example, 1.0253 litres at 25°C.

4 TEMPERATURE OF CALIBRATION OF SCALES

4.1 Temperature of Calibration

The alcoholometers shall be calibrated at 20°C.

4.2 Range of Scale

The thermo-alcoholometers shall cover the entire range of 0°C to 100°C in steps of 5 degrees on each thermo-alcoholometer. An additional thermo-alcoholometer may be provided to cover the range 98 °C to 103 °C.

NOTE - Alcoholic content more than 100 percent volumes are imaginary (*see* Table 1). These values are necessary for adjustment of alcoholometers in highly concentrated alcohol-water mixtures at temperature between 20 °C to 40 °C, the density of which formally corresponds to alcohol content more than 100 percent.

5 BASIS OF SCALE

The basis of scale of each type of thermo-alcoholometer shall be the values of density versus composition of ethanol solutions by volume as given in Table 1.

6 SURFACE TENSION

In marking graduation lines, the conventional values given in Table 1 shall be assumed for the surface tension at 20°C of ethanol solutions of various concentrations.

7 REFERENCE LEVEL FOR READING

The thermo-alcoholometers shall be graduated for reading at the level of the free horizontal surface of the liquid.

8 REQUIREMENTS

8.1 Thermo-alcoholometers shall conform with the general requirements given in IS 9621.

TABLE 1 ETHANOL CONTENT BY VOLUME, DENSITY AND SURFACE TENSION AT 20°C
(*Clauses* 5 and 6)

Observed Degree Percent Volume	Density kg/m^3	Surface Tension mN/m	Observed Degree Percent Volume	Density kg/m^3	Surface Tension mN/m	Observed Degree Percent Volume	Density kg/m^3	Surface Tension mN/m
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0	998.20	72.6	35	955.59	33.3	70	885.56	26.7
1	996.70	68.1	36	954.15	32.9	71	883.06	26.6
2	995.23	64.5	37	952.69	32.6	72	880.54	26.5
3	993.81	61.7	38	951.18	32.3	73	877.99	26.4
4	992.41	59.6	39	949.63	31.9	74	875.40	26.3
5	991.06	57.8	40	948.05	31.7	75	872.79	26.2
6	989.73	56.1	41	946.42	31.4	76	870.15	26.1
7	988.43	54.5	42	944.76	31.1	77	867.48	25.9
8	987.16	53.1	43	943.06	30.9	78	864.78	25.8
9	985.92	51.8	44	941.32	30.6	79	862.04	25.7
10	984.71	50.5	45	939.54	30.4	80	859.27	25.6

11	983.52	49.4	46	937.73	30.2	81	856.46	25.4
12	982.35	48.3	47	935.88	30.0	82	853.62	25.3
13	981.21	47.2	48	934.00	29.8	83	850.74	25.2
14	980.08	46.3	49	932.09	29.6	84	847.82	25.0
15	978.97	45.4	50	930.14	29.4	85	844.85	24.9
16	977.87	44.5	51	928.16	29.3	86	841.84	24.8
17	976.79	43.7	52	926.16	29.1	87	838.77	24.6
18	975.71	42.9	53	924.12	28.9	88	835.64	24.5
19	974.63	42.1	54	922.06	28.8	89	832.45	24.4
20	973.56	41.4	55	919.96	28.6	90	829.18	24.2
21	972.48	40.7	56	917.84	28.5	91	825.83	24.1
22	971.40	40.0	57	915.70	28.3	92	822.39	23.9
23	970.31	39.3	58	913.53	28.2	93	818.85	23.8
24	969.21	38.7	59	911.33	28.1	94	815.18	23.6
25	968.10	38.1	60	909.11	27.9	95	811.38	23.4
26	966.97	37.5	61	906.87	27.8	96	807.42	23.3
27	965.81	37.0	62	904.60	27.7	97	803.27	23.1
28	964.64	36.4	63	902.31	27.6	98	798.90	22.9
29	963.44	35.9	64	899.99	27.4	99	794.25	22.6
30	962.21	35.4	65	897.65	27.3	100	789.24	22.4
31	960.95	35.0	66	895.28	27.2	101	783.75	22.2
32	959.66	34.5	67	892.89	27.1	102	778.26	22.0
33	958.34	34.1	68	890.48	27.0	103	772.77	21.8
34	956.98	33.7	69	888.03	26.9			

8.2 Materials

8.2.1 *Glass*

The thermo-alcoholometers shall be made of colourless transparent glass, resistant to chemicals and thermal shock encountered in use. It shall be as free as possible from strain and visual defects.

8.2.1.1 The coefficient of cubical thermal expansion of glass shall be $(25 \pm 2) \times 10^{-6}$ per degree Celsius.

8.2.2 *Loading Material*

The loading material shall be confined to the bottom of the bulb. After the instrument has been maintained in a horizontal position for 1 h at 80°C and subsequently cooled in that position, it shall meet the requirements of clause **8.3**.

NOTE- The use of mercury as loading material is not permitted for alcoholometer.

8.2.2.1 There shall be no loose material whatsoever in any part of the instrument.

8.3 Pattern Workmanship and Finish

The thermo-alcoholometers shall be of a pattern as shown in Fig. 1.

8.3.1 It shall be circular in cross-section, robust and symmetrical about the main axis. It shall float vertically in alcoholic solutions of appropriate strength and the inclination, if any, from the vertical, shall not exceed 1.5 degrees.

8.4 Thermometer Scale

In thermo-alcoholometers, the thermometer shall conform with the design requirements given in IS 8787 and those given in Table 2.

TABLE 2 REQUIREMENTS FOR THERMOMETER FOR THERMO-ALCOHOLOMETER

(Clause 8.4)

Sl No.	CHARACTERISTIC	REQUIREMENT
(1)	(2)	(3)
i)	Range of thermometer	0 °C to 40 °C
ii)	Immersion	Total
iii)	Subdivision 1	0.5 °C
iv)	Scale error at any point	± 0.2 °C
v)	Scale length, *Min*	80 mm
vi)	Extension of scale on either side	4 graduation
vii)	Expansion chamber to with-stand temperature rise up to, *min*	80 °C

NOTE — The bulb of the construction and use of liquid-in-glass thermometers

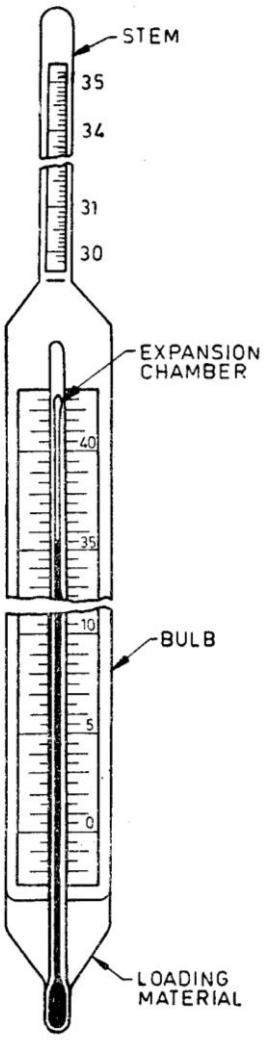

FIG. 1 GLASS ALCOHOLOMETER WITH THERMOMETER

8.5 Scale

The scales and inscriptions shall be marked on a smooth matt surface of white or off-white colour. It shall be straight and free from twist. Neither the scale nor the graduations shall distort or discolour when the alcoholometer is maintained at a temperature of 80°C for 24 hours. The thermo-alcoholometer scale shall be fully enclosed in the thermo-alcoholometer with all graduation marks clearly visible on the stem.

8.5.1 A reference mark consisting of a short horizontal straight line with a 'V' at each end, thus > – < shall be marked in the paper scale a few millimetres above the topmost graduation mark. A fine, clearly etched permanent line of uniform thickness shall be etched on the stem of the thermo-alcoholometer coincident with the horizontal portion of the reference mark and slightly longer than that portion of the reference marks so that the ends of the etched line project into the 'Vs' at the ends of the reference mark.

8.5.1.1 A suitable datum line shall be also marked for thermometer scale similar to the one given in **8.5.1**.

8.5.1.2 The figuring and graduations of thermometer shall be in accordance with IS 8787.

8.5.2 The graduation lines shall be distinct and of uniform thickness not exceeding one fifth of the distance between the centres of adjacent graduation lines or 0.2 mm, whichever is less. There shall be no evident local irregularities in their spacing. They shall be perpendicular to the axis of the thermo-alcoholometer.

8.5.3 The nominal range of each thermo-alcholometer shall not exceed 5 degrees. Each thermo-alcoholometer shall carry two to ten additional graduation lines beyond the nominal limits at both ends of the scale.

8.5.4 The long, medium and short graduation lines shall extend respectively to at least one half, one third and one fifth of the circumference of the stem.

8.5.5 *Sequence of Graduation Lines*

Every tenth graduation line shall be a long line. There shall be a medium line between two consecutive long lines and four short lines between consecutive medium and long lines.

8.5.6 *Figuring of Graduation Lines for Thermo-alcoholometer*

The highest and the lowest graduation lines referring to the nominal range of the thermo-alcoholometer shall be figured in full. At least every long graduation line shall be figured. Graduation lines within the nominal range and the inscription shall be marked in black or brown. Graduation lines outside the nominal range may be marked in colour other than black.

8.6 Dimensions

The dimensions shall be as given in Table 3.

TABLE 3 DIMENSIONS FOR THERMO-ALCOHOLOMETERS

(Clause 8.6)

Sl No.	DIMENSIONS	VALUES
(1)	(2)	(3)
		mm
i)	Overall length, *Max*	335
ii)	Length of scale, *Min*	42.5
iii)	Sub-sub-division	0.1°
iv)	Stem diameter, *Min*	3
v)	Body diameter, *Min*	21
	Body diameter, *Max*	23

8.6.1 The cross section of the stem shall remain unchanged for at least 5 mm below the lowest graduation line.

8.6.2 The stem shall extend at least 15 mm above the uppermost graduation line on the scale.

8.6.3 The volume of the bulb below the lowest graduation line shall be between 60 cm^3 and 80 cm^3.

8.7 Accuracy

8.7.1 The error at any point on the scale of thermo-alcoholometer shall not exceed ± 1 of the smallest division.

8.7.2 The accuracy of the thermo-alcoholometers shall be tested in accordance with the procedure prescribed in Annex **A**.

9 MARKING AND PACKING

9.1 Packing

The thermo-alcoholometers shall be securely packed as agreed to between the purchaser and the supplier.

9.2 Marking

9.2.1 Each thermo-alcoholometer shall be marked legibly and indelibly with the following information:

a) Maker's name or recognized trade-mark, if any;

b) The word thermo-alcoholometer;

c) Calibration temperature, that is, 20 °C;

d) Identification mark; if any.

9.2.2 *BIS Certification Mark*

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.

10 SAMPLING

10.1 The method of drawing representative samples of the thermo-alcoholometers and the criteria for conformity shall be as prescribed in Annex **B**.

ANNEX A
(*Clause* 8.7.2)

METHOD OF TESTING ACCURACY OF THERMO-ALOCOHOLOMETERS

A-1 GENERAL

A-l.1 Checking of thermo-alcoholometers shall be done by one of the following methods:

a) Comparison with a similar Standard Thermo-Alcoholometer (**A-2**); and

b) Verifying the readings of thermo-alcoholometer at 20°C by determining the density of the liquid at the same temperature by pyknometer and then finding the observed degree corresponding to particular density from Table 1.

A-2 COMPARISON METHOD

A-2.1 Readings of the liquid shall be as taken simultaneously with the thermo-alcoholometer under test and that with a similar but Standard Thermo-Alcoholometer under similar conditions. The readings shall be taken at four or five different points covering the entire range.

A-2.2 The readings by thermo-alcoholometers shall be taken in a circular or preferably a rectangular vessel suitable for the thermo-alcoholometer. Dimensions of appropriate vessels are given in Table 4.

TABLE 4 RECOMMENDED SIZES OF VESSELS
(*Clause* A-2.2)

INTERNAL SIZE OF VESSEL	
Rectangular (mm)	Circular (mm)
(135 ± 5) × (55 ± 3) × (430 ± 5)	(125 ± 5) × (430 ± 5)

A-3 VERIFICATION BY PYKNOMETER

A-3.1 A suitable pyknometer of 25 ml capacity, such as shown in Fig. 2 or pyknometer Type 3 of IS 5717 shall be used. The determination shall be carried out at 20°C.

A-3.2 Pour the liquid under test in a weighed pyknometer taking due care that no air is entrapped. Allow the level of the liquid to rise slightly above the mark on the neck of the pyknometer. Place the pyknometer in a bath so that it is immersed in the bath up to a height slightly below the mark. Maintain the bath at 20°C for about half-an-hour so that the liquid and the pyknometer acquire the temperature of the bath, Adjust the liquid level such that the meniscus just touches the mark on the neck of the pyknometer. Remove the pyknometer from the bath, wipe, dry and weigh; and determine the mass of the liquid.

A-3.3 The true mass of the liquid is calculated by adding a correction for the buoyancy effect of the air to the observed mass of the liquid. This correction is calculated using the following formula:

$$C = P(V — m/d)$$

Where,

C = correction factor,

P = density of air at the temperature of experiment,

V = volume in ml of liquid in the pyknometer at 20°C,

m = observed mass in g of the liquid, and

d = density of the material of weights at the temperature of experiment.

A-3.4 Calculate the density of the liquid at 20°C by dividing the mass (m) of the liquid as obtained above by volume (v) at 20 °C and subsequently find out corresponding degree from Table 1. Any departure from this value

in the reading of thermo-alcoholometer for the same solution at 20°C separately shall be taken as error at the corresponding point on the scale.

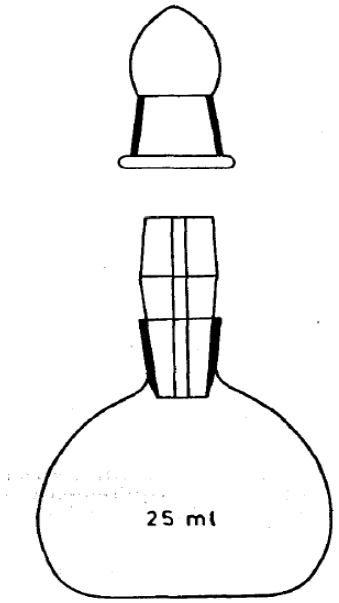

FIG. 2 PYKNOMETER

ANNEX B
(*Clause* 10.1)

SAMPLING SCHEME FOR GLASS ALCOHOLOMETERS WITH THERMOMETER

B-1 SCALE OF SAMPLING

B-1.1 Lot

All the alcoholometers with thermometers of one type and range shall constitute one lot.

B-1.2 Samples shall be taken from each lot for ascertaining the conformity to this specification and shall be according to Table 5.

TABLE 5 NUMBER OF ALCOHOLOMETERS (WITH THERMOMETER) TO BE SELECTED

(Clause B-1.2)

Sl No.	LOT SIZE	SAMPLE SIZE	ACCEPTANCE NUMBER
(1)	(2)	(3)	(4)
i.	Up to 15	2	0
ii.	16 to 25	3	0
iii.	26 to 50	5	0
iv.	51 to 100	8	1
v.	101 and above	13	2

B-1.2.1 The sample shall be selected from the lot at random and in order to ensure the randomness of selection, the method given in IS 4905 may be followed.

B-2 CRITERIA FOR CONFORMITY

B-2.1 The samples selected according to co1 3 of Table 5 shall be tested for the requirements given in **8.3**, **8.5** and **8.7**. The lot shall be declared as conforming to these requirements if all the alcoholometers with thermometers satisfy these requirements.

B-2.2 When the lot has been accepted with respect to the requirements of **8.3**, **8.5** and **8.7**, the test for other requirements given in **8** shall be done on the samples selected. If an alcoholometer with thermometers fails to satisfy any of the requirements given in **8**, it shall be declared as defective. The lot shall be declared as conforming to the requirements of **8** if the number of defectives in the lot does not exceed the corresponding acceptance numbers given in co1 4 of Table 5.