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(पहला पुनरीक्षण)

Draft Indian Standard

ADJUSTABLE RANGE THERMOMETERS — SPECIFICATION

(*First Revision*)

ICS 17.200.20

Glass, Glassware & Laboratoryware Sectional Committee, CHD 10

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FOREWORD

(*Formal clause to be added later*)

Adjustable range thermometers can be used over a wide range of temperatures in several industrial, agricultural and scientific applications where the variations around a 'datum temperature' do not exceed a span of 6°C, and where precise measurement of variations in temperature is involved. Such thermometers can be used with advantage in studies of chemical micro-reactions, combustion phenomena, fuel evaluation, germination of seeds, storage of cereals, micro-calorimetry, etc. Use of such a thermometer, however, is not recommended for measuring actual temperatures unless it is set with the help of a calibrated precision thermometer.

As adjustable range thermometers require to be first set at a datum temperature, a method for their proper setting and use, is described in Annex A.

This standard was originally published in 1977. . In relation to the Minamata Convention where mercury shall be removed from products by 2025, the committee responsible for formulating this standard decided to revise the standard by providing alternative thermometric liquids in addition to the mercury as liquid-in-glass thermometers are still in use in the country.

In this first revision, Kerosene oil has been added as an alternative thermometric liquid. Several editorial changes such as the inclusion of the Reference clause, Hindi Title, ICS no, BIS certification marking clause, etc. have also been incorporated.

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.

Draft Indian Standard

ADJUSTABLE RANGE THERMOMETERS — SPECIFICATION

(*First Revision*)

1 SCOPE

This standard prescribes the requirements for the enclosed-scale type adjustable range thermometers for measuring temperature differences up to 6 °C, in the range – 20 °C to + 150 °C.

NOTE – Thermometers having temperature spans of 5 °C as well as 6 °C are covered in this standard.

2 REFERENCE

The standards given 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.

IS No.	*Title*
IS 2627 : 1979	Glossary of terms relating to liquid - In - Glass thermometers (*first revision*)
IS 4610 : 1968	Specification for glass tubes for general purpose and reference thermometers
IS 4825 : 1982	Specification for liquid - In - Glass solid - Stem reference thermometers (*first revision*)
IS 6274 : 1971	Method of calibrating liquid - In - Glass thermometers
IS 8787 : 2018	Principles of design, construction and use of Liquid - In - Glass thermometers (*first revision*)

3 TERMINOLOGY

3.1 For the purpose of this standard the definitions given in IS 2627, in addition to the following, shall apply.

3.1.1 *Setting Temperature*

The temperature at which the main scale of the adjustable range thermometer reads zero.

3.1.2 *Setting*

The process of adjusting the adjustable range thermometer to the required temperature range; in other words, to the requisite setting temperature (*see* Annex A).

3.1.3 *Adjusting Device*

That portion of the adjustable range thermometer which can be made to act as a reservoir of thermometric liquid which becomes surplus at the setting temperature. It enables the adjustment of the thermometer to read the setting temperature.

3.1.4 *Temperature Span*

The total maximum changes of temperature on either side of the 'datum temperature' for which the thermometer is to be used. This is given directly by the range of the main scale in degrees Celsius.

3.1.5 *Immersion Level*

In the adjustable range thermometers, it is the position where the saddle (*see* Fig. 1) is fused to the sheath.

4 TYPE AND PATTERNS

4.1 Type

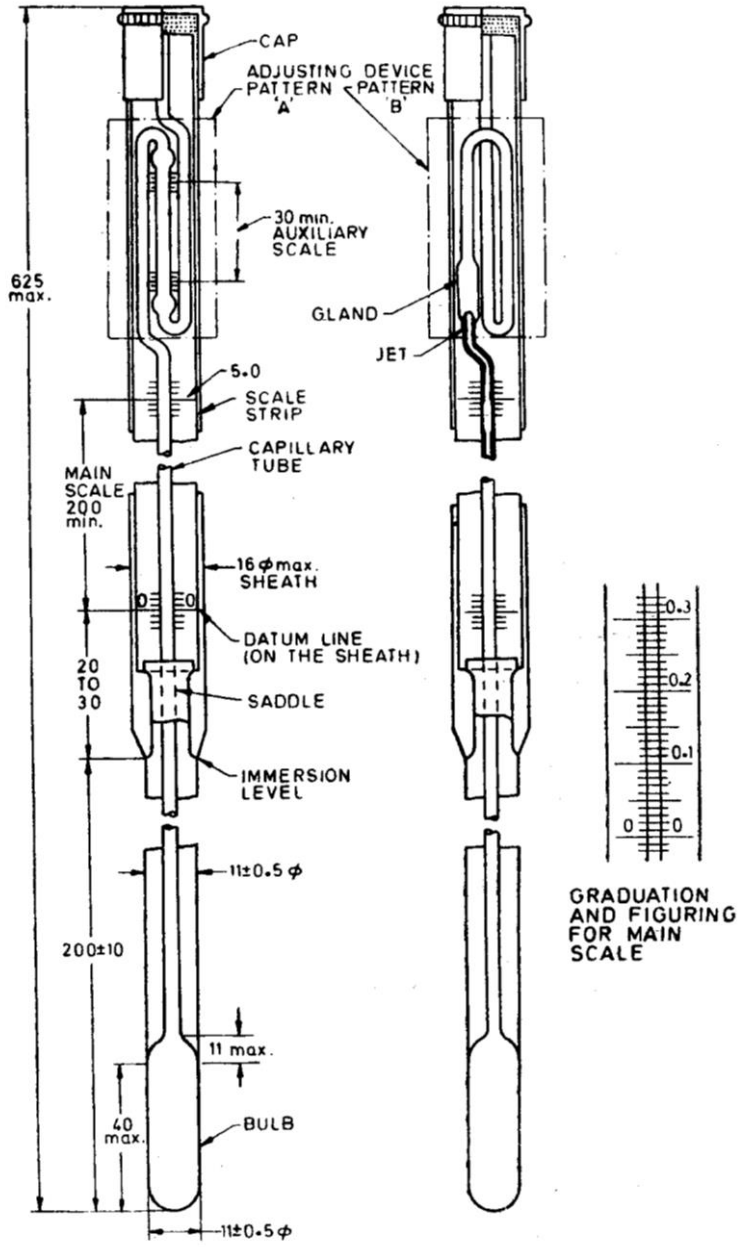
The adjustable range thermometer shall be of partial immersion, enclosed-scale, liquid-in-glass type provided with an adjusting device (*see* Fig. 1).

4.2 Patterns

The thermometers shall be of two patterns, as shown in Fig. 1. The patterns differ in the design of their adjusting device only.

5 TEMPERATURE SCALE

The thermometer shall be graduated in degrees Celsius.



All dimensions in millimetres,

FIG. 1 ENCLOSED-SCALE ADJUSTABLE-RANGE THERMOMETER

6 MATERIALS

6.1 Glass

6.1.1 The bulb and capillary tubing of the thermometer shall be made from glass which complies with IS 4610.

6.1.2 The sheath, the saddle and the adjusting device shall be made from glass compatible with that of the bulb and capillary.

6.2 Scale Strips

Scale strips shall be made of such a material as does not deteriorate by continuous use at 150 °C and is compatible with the method of fixing.

NOTE — Although opaque glass is preferable for this purpose, a thin strip of metal, suitable plastics or cardboard may also be used provided it satisfies the above requirement.

6.3 Thermometric Liquid

6.3.1 The thermometric liquid shall be entirely free from contamination particularly of solid particles or of any liquid which produces a variation of volume with time.

6.3.2 Recommended thermometric liquids and the approximate temperature ranges covered by them are given in Table 1.

TABLE 1 TEMPERATURE RANGES FOR VARIOUS THERMOMETRIC LIQUIDS

(*Clause* 6.3.2)

Sl No.	**Thermometric Liquid**	**Approximate Temperature Range,** *°C*
(1)	(2)	(3)
i.	Mercury	– 38 to + 600
ii.	Mercury-thallium alloy [8.5 percent (m/m) of thallium]	– 55 to + 600
iii.	Kerosene Oil	– 20 to + 150

6.3.3 The organic liquid used as the liquid filling shall, wherever possible, be coloured by means of light-fast dye which does not stain the glass.

6.4 Top

Top of the thermometer shall be made of glass, light metal or suitable plastics compatible with the method of fabrication and use in the temperature range of the thermometer.

7 CONSTRUCTION

7.1 Shape

The thermometer shall be straight and its sheath shall be approximately circular in cross-section.

7.2 Bulb

The bulb shall be cylindrical and in alignment with the stem.

7.3 Capillary

7.3.1 The bore of the capillary shall be identical on both sides of the immersion level (*see* Fig.1).

7.3.2 The bore of the capillary, along the main scale, shall not vary by more than 5 percent of its average value.

7.3.3 The bore of the capillary shall be wide enough to ensure that the jumping of the liquid meniscus without tapping does not exceed one half of the smallest division of main scale when observed by unaided eye, while the temperature is rising at a uniform rate of 0.1 °C per minute or less.

7.3.4 *Adjusting Device*

The top of the capillary shall be provided with an arrangement (*see* Fig. 1) called the adjusting device.

NOTE - In Fig. 1, Pattern A the adjusting device consists of a large bore U-tube joined to the capillary at one end and sealed at the other. In Fig. 1, Pattern B it consists of a truncated cylindrical gland through the bottom of which a capillary projects, ending in a jet. The other end of this gland is closed by fusing.

7.3.5 The capillary and the adjusting device assembly shall be evacuated above the mercury column to such an extent that no difficulty is experienced in rejoining the mercury column during setting.

7.3.6 The volume of mercury contained in the capillary from immersion level to the nearest graduation line on the main scale shall not exceed the equivalent of 2°C.

7.4 Saddle

A suitable saddle shall be provided inside the sheath to support the main scale strip *cum* capillary assembly. It is a good practice to fuse the saddle to the sheath at the immersion level.

7.5 Scale Strip

The scale strip shall be placed firmly against the capillary tube, inside the sheath and shall be securely fastened at the top of the thermometer.

NOTE - A suitable method of fixing the scale strip is to fuse a glass tube or rod between the sheath and the top end of the scale strip, keeping the lower end free to slide in the saddle. Alternatively, the scale strip shall be fixed inside the sheath in any other suitable manner which permits differential expansion.

7.6 Scales

The thermometer shall have two scales as follows, which shall be engraved or otherwise marked on the scale strip (*see* Fig. 1):

a) *Main Scale* – for showing the variation from the datum temperature.
b) *Auxiliary Scale* – for approximate indication of the datum temperature between - 20 °C to + 150 °C with graduation interval of 5 °C.

7.7 Top Finish

The top end of the sheath shall be closed in a suitable manner and may be provided with a cap of some light metal or plastics which can stand continuous use of the thermometer at 150 °C.

7.7.1 The cap may carry a hook or a ring for hanging the thermometer.

7.8 Calibration

The thermometer shall be graduated and calibrated for use in a vertical position, immersed up to the immersion level (*see* Fig. 1) assuming the emergent column at the standard ambient temperature, that is, (27 ± 2) °C.

NOTE - It is usual practice not to mark such thermometers with an immersion line, because a mistake of a few millimetres in locating this point hardly matters.

8 DIMENSIONS

The dimensions of the thermometers shall be as shown in Fig. 1 read with Table 2.

TABLE 2 DIMENSIONS AND GRADUATIONS OF ENCLOSED-SCALE ADJUSTABLE RANGE THERMOMETERS

(*Clause* 8)

Sl No.	**CHARACTERISTIC**	**REQUIREMENT**	
		Temperature span	**Temperature span**
		5 °C	6 °C
(1)	(2)	(3)	(4)
i)	Nominal temperature span of main scale, °C	0 to 5	0 to 6
ii)	Smallest scale division, °C	0.01	0.01
iii)	Adjustable range, °C	(- 20 to + 150)*	(- 20 to + 150)*

iv)	Overall length, *Max*, mm	625	675
v)	Depth of immersion, mm	(200 ± 10)	(200 ± 10)
vi)	Length of main scale, *Min*, mm	200	240
vii)	Length of auxiliary scale, *Min*, mm	30	30
viii)	Sheath diameter, *Max*, mm	16	16
ix)	Bulb diameter (*external*), mm	(11 ± 0.5) (but not exceeding the external diameter of the adjoining portion of the sheath)	(11 ± 0.5)
x)	Bulb length, *Max*, mm	40	50
xi)	Funnel height (*inside bulb*), *Max*, mm	11	11

*With graduation interval of 5 °C

9 GRADUATION AND FIGURING

The graduation and figuring in the thermometers shall comply with the marking provisions given in IS 8787.

10 ACCURACY

10.1 Stability

Stability of the thermometers shall be such that when adjusted to setting temperature of 100 °C and heated to 130 °C for at least 15 min and then again set and maintained at 100 °C for 24 h the reading shall not change by more than 0.01 °C during these 24 h.

10.2 Interval Error

The interval error of the thermometers shall be within the following limits:

a) In an interval of 1 °C ± 0.01 °C
b) In an interval of 2 °C ± 0.02 °C

11 MARKING AND PACKING

11.1 Packing

Thermometers shall be packed as agreed between the purchaser and the supplier.

11.2 Marking

11.2.1 The following inscriptions shall be distinctly and durably marked on each thermometer:

a) The symbol ‘C’ or ‘°C’, as an indication that the graduations are in degrees Celsius;
b) Depth of immersion, that is, ‘200 mm’;
c) The name or recognized trade-mark of the manufacturer, if any; and
d) The manufacturer’s serial number to enable the thermometer to be traced from records.

11.2.2 *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.

12 TESTING AND REPORT

12.1 Testing

Each thermometer shall individually comply with all the requirements of this specification.

12.1.1 Its main scale shall be calibrated at three different setting temperatures, almost equally spaced on its ‘adjustable range’, according to the methods prescribed in IS 6274 and using a calibrated platinum resistance

thermometer instead of a liquid-in-glass reference thermometer. Interval errors for 1 °C and 2 °C intervals shall be computed for each of these calibrations. They shall all lie within the limits prescribed in **10.2**.

12.2 Report

The report shall be in two parts. The first part shall certify the requirements actually satisfied by the individual thermometer, and the second part shall give the results of calibration of the main scale at three setting temperatures referred to in **12.1.l**.

ANNEX A

(*Clause* 3.1.2)

METHODS OF SETTING AND USE OF ADJUSTABLE RANGE THERMOMETERS

A-1 GENERAL

A-1.1 The temperature range of an adjustable range thermometer is adjusted by changing the volume of thermometric liquid.in the bulb and capillary portion. This is done by transferring a part of it to the adjusting device (*see* Fig. 1).

A-1.2 Two patterns of adjusting devices, namely, Pattern A and Pattern B are in general use (*see* Fig. 1).

A-1.3 Methods of adjusting (or setting) and use of thermometers with each of these patterns of adjusting devices are given below.

A-2 ADJUSTABLE RANGE THERMOMETERS WITH ADJUSTING DEVICE OF PATTERN A

A-2.1 Apparatus

A-2.1.1 *Comparator Bath — see* IS 6274.

A-2.1.2 *Reference Thermometer* — of the required range to cover the setting temperature (*see* IS 4825).

A-2.2 Procedure

Heat the comparator bath filled with a suitable liquid to the desired setting temperature and immerse the adjustable range thermometer in it. See whether the thermometer being set reads temperature higher or lower than the comparator bath temperature. Take the thermometer out of the bath, drain the liquid on the outside of the thermometer, wipe and then tilt to drain the mercury towards the bulb or towards the adjusting device, as necessary. After some mercury has been transferred to the required side again insert the thermometer in the bath. Repeat the process till the thermometer begins to show almost ‘zero’ on the main scale. It is now ready for exact adjustment.

A-2.2.1 *Computation of Setting Temperature*

Again put the thermometer being set in the bath, and allow it to acquire constant reading. Take the readings of this thermometer and the reference thermometer, apply corrections to reference thermometer reading and compute the temperature of the adjustable range thermometer for zero-reading on its main scale. This is the actual temperature to which the thermometer has been ‘set’.

A-2.3 Use

In order to measure a temperature near about its setting temperature place the thermometer so ‘set’ in the medium whose temperature is to be measured and note reading on its main scale. The actual temperature of the medium is then the algebraic sum of the set temperature and the reading of the main scale of the thermometer.

A-2.3.1 In order to measure temperature difference between two media put the thermometer so set first in one medium, read its main scale and then put it in the second medium and again take the main scale reading. The difference between the two readings on the main scale is the requisite temperature difference between the two media.

A-2.3.1.1 For such measurements, it is often desirable to measure the hotter medium first.

NOTE

Temperature variations in chemical reactions can also be precisely studied by suitable adaptation of the method given above.

A-3 ADJUSTABLE RANGE THERMOMETERS WITH ADJUSTING DEVICE OF PATTERN B

A-3.1 General

The adjustment/setting is done by transferring a part of the mercury from the bulb to the gland or vice-versa. Skill is needed in transferring the mercury back into the capillary through the jet. This has to be done by carefully tilting

the thermometer as the jet is a little away from the sides of the gland. Once the droplets of mercury enter the jet, they easily slide down the capillary towards the bulb under gravity.

A-3.2 Apparatus — same as given in **A-2.1**.

A-3.3 Procedure

Transfer the whole mercury in the gland into the jet by skillful manipulation. Set the bath as in **A-2.2**. Insert the thermometer into the bath. Some mercury should flow into the gland; if it does not, it indicates that the bulb does not have sufficient mercury. Again, transfer some mercury as above and again put the thermometer in the bath. Take the thermometer out of the bath when mercury stops flowing out of the jet. Cool the thermometer and repeat the process till mercury just stops flowing out.

A-3.3.1 *Fine Adjustment*

The operation given in **A-3.3** is repeated till the flow of mercury into the gland just stops after becoming extremely slow. The thermometer is now set for use.