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**Solid-stem general purpose liquid-in-
glass thermometers**

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS B 7411: 1977** is replaced with **JIS B 7411: 1997**.

Further, **JIS B 7413: 1977**, *Etched-stem mercury-in-glass thermometers (Partial immersion type)*, has been integrated into **JIS B 7411: 1997** and withdrawn.

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Solid-stem general purpose liquid-in-glass thermometers

Introduction This Japanese Industrial Standard has been prepared on a basis of the first edition of ISO 1770, *Solid-stem general purpose thermometers*, without any modification in technical content, however, the specified items (Annex 1 and Annex 2), which are not standardized in the corresponding International Standard, have been supplemented as Japanese Industrial Standard.

1 Scope This Japanese Industrial Standard specifies the solid-stem general purpose liquid-in-glass thermometers, classified into two series, which are not expensive and are suitable for industrial use, educational use, and laboratory use where highly accurate measurements are not required.

- Remarks 1 This Standard does not necessarily define all precautions for safety use, therefore, users of this thermometer shall specify appropriate prohibitions for safe and healthy treatment.
- 2 Total immersion-type thermometers and partial immersion-type thermometers are respectively shown in Annex 1 and Annex 2.
- 3 The thermometers which are called A to H in Attached Table 1 are suitable for the measurements needing a rather inferior accuracy, and the thermometers which are called J to W in Attached Table 2 are for rather high accuracy.
- 4 The International Standard corresponding to this Standard is listed as follows.

ISO 1770: 1981 *Solid-stem general purpose thermometers*

2 Normative references The following standard contains provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent edition of the standard indicated below shall be applied.

JIS B 7410 *Liquid-in-glass thermometers for testing of petroleum product*

3 Temperature scale The thermometers shall be graduated in accordance with the Celsius scale as defined in the current definition of the International Practical Temperature Scale adopted by the General Conference of Weights and Measures, and in accordance with the International System of Units (SI).

4 Immersion

4.1 General Immersion means the condition in which a thermometer is kept when temperature is measured, and classified into total immersion and partial immersion.

4.2 Total immersion The reading shall be correct when the thermometer is immersed so that the top of the liquid column is in the same plane as, or no more than two scale divisions above, the surface of the medium the temperature of which is required to be measured.

4.3 Partial immersion Keep the thermometer from the bottom of the bulb to the specified graduation at the temperature to be measured. In this case, the preferred immersion is $75\text{ mm} \pm 1\text{ mm}$, and the adjustment of such a thermometer shall be carried out at the average temperature at emergent column, which is detailed in Attached Table 1 and Attached Table 2.

Remarks 1 Adjustment at partial immersion is not permitted for the thermometers with a scale extending below $-38\text{ }^{\circ}\text{C}$, because of the large errors likely to be caused in a liquid-in-glass thermometer, containing no mercury, by variations in temperature around the emergent portions of the stem.

2 The guidance of the correction method of emergent column to be applied when the thermometer is used in situations where the average emergent liquid column temperature differs from that given in Attached Table 1 and Attached Table 2, shall follow the Annex attached in **JIS B 7410**.

5 Glass The thermometer bulb shall be made of suitable thermometric glass. The glass comprising the thermometer shall be selected and processed so that the finished thermometer shows the following characteristics.

- a) Stress in the glass of the bulb and capillary stem shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock.
- b) The bulb glass shall be stabilized by suitable heat treatment to ensure that the accuracy requirements of clause **10** are met.
- c) The legibility of the reading shall not be impaired by devitrification and/or clouding.
- d) The distortion of meniscus and/or its image caused by defects or impurities in the glass shall be made as little as possible.

6 Liquid filling Liquid filling shall be as follows.

- a) Mercury shall be used as liquid filling. In case of a thermometer with a scale extending below $-38\text{ }^{\circ}\text{C}$, however, the organic liquid, which will remain liquid throughout the nominal temperature range under the pressure prevailing inside the thermometer, shall be used.
- b) The organic liquid used as the liquid filling should preferably be colored by means of a light-fast dye which does not stain the glass.
- c) The organic liquid used as the liquid filling should preferably be toluene or an isomer of pentane or suitable mixture of isomers of pentane.

7 Gas filling Thermometers containing mercury as the liquid filling shall be filled with a dry inert gas above the liquid filling. The pressure of the gas shall be high enough to raise the boiling point of the liquid sufficiently to minimize vaporization over the nominal range of the thermometer.

8 Construction

8.1 Shape The thermometers shall be straight. Their external cross-section should be approximately circular, but if required, an external lens-shaped deviation from the circular cross-section is permitted to facilitate reading.

8.2 Top finish The top of the thermometer shall be finished with a plain top, button top, or glass ring. In any case, the diameter of the top finish of the thermometer shall not exceed that of the stem.

8.3 Capillary tube The stem bearing the capillary tube should preferably incorporate an enamel back. The inside of the capillary tube shall be smooth in order to avoid possible sticking of the liquid filling. For the thermometers listed in Attached Table 2, the cross-sectional area of the bore shall not show variations from the average greater than 10 %.

8.4 Expansion volume (safety chamber) An expansion volume shall be as follows.

- a) An expansion volume shall be provided at the top of the capillary tube. This volume may take the form either of an extension of the bore or of an expansion chamber.

Remarks: Overheating a thermometer beyond its upper nominal limit is liable to change the zero or other fiducial point of the thermometer, and redetermination of this point will therefore become necessary if it takes place.

- b) If an expansion chamber is incorporated, it shall, except when the stem is made from borosilicate glass, be pear-shaped with the hemisphere at the top.

8.5 Enlargement of bore There shall be at least 10 mm of unchanged capillary between any enlargement and the nearest scale line or immersion line.

8.6 Dimensions The dimensions of the thermometers shall be as detailed in Attached Table 1 and Attached Table 2.

The tolerance on the overall length of the thermometers of higher accuracy given in Attached Table 2 shall be ± 10 mm. The bulb diameter shall not exceed that of the stem.

9 Scale lines, immersion line, and figuring

9.1 The nominal ranges, figuring, and scale divisions of the thermometers shall be as detailed in Attached Fig. 1, Attached Table 1, and Attached Table 2.

9.2 The scale lines shall be clearly etched or otherwise durably marked and of uniform thickness not exceeding the values given in Attached Table 1 and Attached Table 2. Typical examples of graduation and figuring are shown in the Attached Fig. 2.

9.3 In the case of the thermometers listed in Attached Table 1 with 0 °C as the lower nominal limit or 100 °C as the upper nominal limit, the scale shall be extended by at least three divisions beyond each of these limits. In all other cases, the scales may also be suitably extended beyond the nominal limits.

9.4 On thermometers adjusted for partial immersion the immersion depth shall be indicated by a line on the stem at the appropriate distance from the bottom of the bulb. This line shall be marked around the back of the thermometer and shall not cross the scale line.

9.5 In the case of etched scales, the pigment filling shall not drop off from the scale lines, figures, inscriptions, and immersion line under normal conditions of use.

10 Accuracy The instrument error for the thermometer shall be as shown in Attached Table 1 and Attached Table 2.

Remarks: The scale error of thermometers shall be checked according to the method specified in Annex of **JIS B 7410**.

Informative reference: In the case of thermometers of ranges 0 °C to 360 °C and 0 °C to 500 °C, an appreciable error may develop after long exposure at temperatures in the upper part of the scaled range.

11 Marking The following markings shall be durably and legibly marked on the thermometers.

- a) Symbol for unit of temperature, "°C "
- b) The designation of the thermometer for example, "A" (see Attached Table 1 and Attached Table 2).
- c) For partial immersion thermometers, an indication of the immersion depth for which the thermometer is adjusted, for example, "75 mm". No marking is needed for total immersion thermometers.
- d) The name of vender and/or of maker, or their abbreviation
- e) The number of this Japanese Industrial Standard, or number of the corresponding International Standard
- f) Identification marking for bulb glass.

Remarks: It shall be made by a colored stripe or stripes, or an inscription on the thermometer.

- g) Manufacturer's identification or serial number, the last two digits of which may, if required, indicate the year of manufacture.