

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 650

RELATIVE DENSITY 60/60 °F HYDROMETERS
FOR GENERAL PURPOSES

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BRIEF HISTORY

The ISO Recommendation R 650, *Relative density 60/60 °F hydrometers for general purposes*, was drawn up by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1954 and led, in 1959, to the adoption of a Draft ISO Recommendation.

In November 1963, this Draft ISO Recommendation (No. 687) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Argentina	Greece	Switzerland
Australia	Hungary	Turkey
Austria	India	U.A.R.
Belgium	Israel	United Kingdom
Brazil	Korea, Rep. of	U.S.A.
Bulgaria	Netherlands	U.S.S.R.
Chile	New Zealand	Yugoslavia
Colombia	Poland	
Czechoslovakia	Spain	

Two Member Bodies opposed the approval of the Draft:

France
Germany

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in February 1968, to accept it as an ISO RECOMMENDATION.

RELATIVE DENSITY 60/60 °F HYDROMETERS FOR GENERAL PURPOSES

1. SCOPE

This ISO Recommendation specifies requirements for five basic series of glass hydrometers of constant mass which indicate relative density 60/60 °F with reference to water and comply with ISO Recommendation R 387, *Principles of construction and adjustment of hydrometers*. The dimensions of the hydrometers have been chosen in such a way as to lead to convenience in use and economy in manufacture.

2. BASIS OF SCALE

2.1 The scale should indicate relative density * 60/60 °F with reference to water.

NOTE. — The relative density 60/60 °F of a liquid with reference to water is the ratio

$$\frac{\text{density of the liquid at 60 °F}}{\text{density of water at 60 °F}}$$

2.2 The use of a scale other than one based on density (mass per unit volume) is not in general recommended but, in view of its importance in trade between various countries, the scale based on relative density with reference to water is accepted.

3. REFERENCE TEMPERATURE

The standard reference temperature for the hydrometers should be 60 °F. When used in a liquid at this temperature, the hydrometer should indicate the relative density of the liquid at 60 °F with reference to water at 60 °F.

NOTE. — For the purposes of this ISO Recommendation, the standard reference temperature 60 °F can be taken as equal to 15.56 °C.

4. SURFACE TENSION

The adjustment should be related to specific capillary conditions as follows:

4.1 When the hydrometer is slightly displaced from its equilibrium position in a liquid, the stem should pass through the liquid surface without causing any apparent alteration in the shape of the meniscus.

4.2 The hydrometer should be adjusted with regard to surface tension. Except where the highest precision is required, one of the standard categories of surface tension given in Annex A should be used.

For hydrometers of the highest precision, intended for use in particular liquids (e.g. alcohol solutions), the surface tension values appropriate to clean surfaces of these liquids and to the actual indications of the hydrometer should be used (see clause 13 (b) (iii)).

* The expression "relative density" complies with ISO Recommendation R 31, Part III, *Quantities and units of mechanics*. The term "specific gravity" is often used in English instead of "relative density", when the reference substance is water.

5. REFERENCE LEVELS FOR ADJUSTMENT AND READING

- 5.1 Hydrometers should preferably be adjusted for readings taken at the level of the horizontal liquid surface. If a hydrometer so adjusted is used in an opaque liquid, readings may be taken at the top of the meniscus where it appears to meet the stem, but appropriate correction to the level of the horizontal liquid surface should then be made.

To avoid the necessity for making such corrections, hydrometers intended for use in opaque liquids may alternatively be adjusted for readings taken at the top of the meniscus where it appears to meet the stem. If a hydrometer is so adjusted, this should be clearly indicated on the scale (see clause 13 (c)).

NOTE. — Appropriate corrections are given in Annex C.

- 5.2 The middle of the thickness of a scale line should be taken as its definitive position.

6. IMMERSION

In order that the readings of the hydrometer should be correct, the emergent stem should be dry except in the immediate vicinity of the meniscus.

7. MATERIALS AND WORKMANSHIP

- 7.1 The bulb and the stem should be made of transparent glass as free as possible from strain and visible defects.

NOTE. — Various measurement tables for liquids have been drawn up on the basis of using hydrometers made of glass having a particular thermal expansion coefficient. When the actual expansion of the hydrometer departs significantly from the particular value which underlies the measurement tables, an appropriate correction should be made.

- 7.2 Where the loading material is solid, it should be fixed in the bottom part of the hydrometer and should not in general soften if heated to 80 °C; if, however, a hydrometer is likely to be used at a temperature higher than 70 °C, the loading material should have a softening point which is higher than 80 °C. The material should not deteriorate in use. Where mercury is the loading material, it should be confined in the bottom part of the hydrometer.
- 7.3 There should be no loose material elsewhere in the instrument.
- 7.4 The scale lines and inscriptions should preferably be black and should be clearly and permanently marked.
- 7.5 The strip on which the scale and inscriptions are marked should have a smooth surface. The scale should show no evidence of charring. When the stem is exposed to a temperature of 80 °C, or such higher temperature at which the hydrometer will be used, for the time necessary to carry out a determination, the strip bearing the scale should not become discoloured or distorted.

8. FORM

- 8.1 The outer surface should be symmetrical about the main axis.