



Laboratory glassware — Density hydrometers for general purposes — Part 2 : Test methods and use

Verrerie de laboratoire — Aréomètres à masse volumique d'usage général — Partie 2 : Méthodes d'essai et d'utilisation

First edition — 1981-09-01

UDC 542.3 : 531.756

Ref. No. ISO 649/2-1981 (E)

Descriptors : glassware, laboratory glassware, measuring instruments, hydrometers, density (mass/volume), tests, utilization, interfacial tension, dimensions, specifications.



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 649/2 was developed by Technical Committee ISO/TC 48, *Laboratory glassware and related apparatus*, and was circulated to the member bodies in September 1979.

It has been approved by the member bodies of the following countries :

Australia	India	Portugal
Brazil	Italy	Romania
Canada	Korea, Rep. of	South Africa, Rep. of
Czechoslovakia	Libyan Arab Jamahiriya	Spain
France	Mexico	United Kingdom
Germany, F.R.	Netherlands	USSR
Hungary	Poland	

No member body expressed disapproval of the document.

International Standards ISO 649/1 and ISO 649/2 cancel and replace ISO Recommendation R 649-1968, of which they constitute a technical revision.

Laboratory glassware — Density hydrometers for general purposes —

Part 2 : Test methods and use

1 Scope and field of application

This part of ISO 649 specifies the test methods and use of density hydrometers for general purposes.

Part 1 of this International Standard gives the specification for density hydrometers for general purposes.

2 References

ISO 91/1, *Petroleum measurement tables — Part 1 : Tables based on reference temperatures of 15 °C and 60 °F*.¹⁾

ISO 649/1, *Laboratory glassware — Density hydrometers for general purposes — Part 1 : Specification*.

ISO 650, *Relative density 60/60 degrees F hydrometers for general purposes*.

ISO 653, *Long solid-stem thermometers for precision use*.

ISO 654, *Short solid-stem thermometers for precision use*.

ISO 655, *Long enclosed-scale thermometers for precision use*.

ISO 656, *Short enclosed-scale thermometers for precision use*.

ISO 3507, *Pyknometers*.

ISO 4788, *Laboratory glassware — Graduated measuring cylinders*.

3 Methods of determination of density by means of ISO hydrometers

3.1 General

To obtain the highest precision when using a particular hydrometer, the following general procedures should be

adhered to :

3.1.1 Read the hydrometer in the liquid at a known temperature.

3.1.2 Apply corrections (when significant) to the observed reading for :

- a) the meniscus height (if the test liquid is opaque see 3.6.1);
- b) the scale error of the hydrometer at the observed reading (see 3.6.2);
- c) the difference between the temperature of the liquid and the standard temperature of the hydrometer (see 3.6.3);
- d) the difference between the surface tension of the liquid and that for which the hydrometer is graduated (see 3.6.4).

3.2 Apparatus

3.2.1 Hydrometer

Select a hydrometer appropriate to the surface tension of the liquid to be examined. Table 3 of ISO 649/1 gives a guide to the range of liquids suitable for the appropriate hydrometer category. Surface tensions of other liquids may be obtained from appropriate tables of physical properties of substances, for example "International Critical Tables".

3.2.2 Hydrometer vessel

Select a hydrometer vessel as described in clause 6.

3.2.3 Thermometer

For high precision work, select a total immersion thermometer graduated in 0,1 °C, with a certificate of scale correction. A thermometer complying with ISO 653, ISO 654, ISO 655 or ISO 656 is suitable.

1) At present at the stage of draft. (Revision of ISO/R 91 and its Addendum 1.)

3.3 Preliminaries

3.3.1 Clean all apparatus before use.

3.3.2 Allow the liquid to attain thermal equilibrium with its surroundings and pour it into the hydrometer vessel, allowing a small quantity to overflow if an overflow vessel is used. Avoid the formation of air bubbles in the liquid by pouring down the side of the vessel. Stir the liquid vertically with a loop stirrer, again avoiding the formation of bubbles. Record the temperature of the liquid to the nearest 0,2 °C.

3.3.3 Insert the hydrometer carefully into the liquid, holding it by the top of its stem. Release the hydrometer when it is approximately in its position of equilibrium and, if an overflow vessel is used, add a further amount of sample to the vessel by way of the filling tube until a volume approximately equal to 15 % of the nominal capacity has overflowed. A little experience soon enables the user to appreciate when the hydrometer is approaching equilibrium and to release it in such a position that the hydrometer rises or falls by only a small amount when released. This is important with viscous liquids, for otherwise excess liquid will adhere to the stem and the hydrometer will thereby be weighted down.

3.3.4 When the hydrometer is steady, press the top of the stem downwards a few millimetres beyond the position of equilibrium or, if the liquid is viscous, only one scale division, gripping the stem very lightly with a finger and thumb. Withdraw the hand and observe the meniscus as the hydrometer oscillates to equilibrium. If the stem and liquid surface are clean, the meniscus shape will remain unchanged as the hydrometer rises and falls. If the meniscus shape changes, for example if it wrinkles or is distorted by the motion of the hydrometer, lack of cleanliness is indicated and the hydrometer and vessel shall be cleaned and the test repeated with a fresh sample. This precaution becomes increasingly important with increasing surface tension of the liquid.

3.4 Reading the hydrometer

When the hydrometer, which must not be touching the side of the vessel, has settled down to its equilibrium position (in the case of viscous liquids this may take some time), record the reading as follows.

3.4.1 Transparent liquids

Record the scale reading corresponding to the plane of intersection of the horizontal liquid surface and the stem. When taking the reading, view the scale through the liquid, adjusting the line of sight so that it is in the plane of the liquid surface.

3.4.2 Opaque liquids

Record the scale reading where the meniscus merges into the stem of the hydrometer.

3.5 Reading of temperature

Immediately after taking the reading, measure the temperature of the liquid to the nearest 0,2 °C. The mean of this temperature and the initial temperature referred to in 3.3.2 shall be used in the calculation of corrections (3.6).

NOTE — This is particularly important in the case of liquids having high values of coefficient of cubical thermal expansion.

The difference between the two temperatures shall not exceed 1 °C and, if a larger difference is found, lack of thermal equilibrium is indicated and the procedure shall be repeated from 3.3.2.

3.6 Application of the corrections

3.6.1 Meniscus height

In cases where a hydrometer adjusted for readings taken at the level of the horizontal liquid surface has been read in an opaque liquid (i.e. at the line where the liquid merges into the stem of the hydrometer), it is necessary to correct the reading for the meniscus height by adding the appropriate value from table 3 or 4.

3.6.2 Instrument error

By "instrument error" is meant the difference between the reading of the hydrometer and the reading of a similar but ideal hydrometer used under precisely the same conditions. If known, the corrections for instrument error may be applied with equal validity under all conditions of use. It is, however, additional to other corrections, for example those for temperature and surface tension, which vary according to conditions of use. For many purposes it is sufficient to know that the instrument error does not exceed the maximum error permitted by clause 13 of ISO 649/1. Where greater accuracy is required, the instrument error should be known and allowed for.

In this case the hydrometer shall be tested. The linear dimension shall be checked with suitable graduated metal scales and outside micrometer calipers to verify that they comply with the requirements of clause 12 of ISO 649/1.

a) The scale of a hydrometer of the L20, L50 and L50SP series shall be calibrated on at least five points within the nominal limits, which shall include at least 80 % of the graduated interval of the scale.

Neither of the extreme points shall be further from the nearest end of the graduated scale than a distance equal to 15 % of the graduated scale.

No two adjacent points shall be further apart than a distance equal to 25 % of the graduated scale.

b) The scale of hydrometers of all other series shall be calibrated in a similar way following the same order as in a) but at three points, which shall include at least 60 % of the graduated interval of the scale.