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SPECIFICATION FOR
**DENSITY HYDROMETERS
AND SPECIFIC
GRAVITY HYDROMETERS**



BRITISH STANDARDS INSTITUTION

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Price 10/- net

BRITISH STANDARDS INSTITUTION

INCORPORATED BY ROYAL CHARTER

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The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 3000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 15s.

This standard makes reference to the following British Standards:

B.S. 604. Graduated measuring cylinders.

B.S. 733. Density bottles.

B.S. 1797. Tables for use in the calibration of volumetric glassware.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard :
Committee reference LBC/5. Draft for comment CZ(LBC) 8552

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CO-OPERATING ORGANIZATIONS

The Laboratory Apparatus Industry Standards Committee, under whose supervision this British Standard was prepared consists of representatives from the following Government departments and scientific and industrial organizations:

Agricultural Research Council

Air Ministry

*Association of British Chemical Manufacturers

Association of Scientific Workers

Board of Trade

British Association for the Advancement of Science

British Chemical Ware Manufacturers Association

*British Laboratory Ware Association

*British Lampblown Scientific Glassware Manufacturers' Association

*British Pharmacopœia Commission

British Scientific Instrument Research Association

*Chemical Society

*D.S.I.R.—Laboratory of the Government Chemist

D.S.I.R.—National Chemical Laboratory

Glass Manufacturers' Federation

*Institute of Petroleum

Ministry of Aviation

Ministry of Health

*National Physical Laboratory (D.S.I.R.)

Oil Companies Materials Association

Pharmaceutical Society of Great Britain

*Royal Institute of Chemistry

Science Masters' Association

Society for Analytical Chemistry

*Society of Chemical Industry

*Society of Glass Technology

*Standardization of Tar Products Tests Committee

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Agricultural Education Association

British Sugar Refiners Association

Institute of Brewing

National Institute for Research in Dairying

War Office

Individual manufacturers

BRITISH STANDARD SPECIFICATION FOR DENSITY HYDROMETERS AND SPECIFIC GRAVITY HYDROMETERS

FOREWORD

The first edition of this British Standard, published in 1936, related only to density hydrometers. In the revision published in 1953, scales of specific gravity were introduced and the linear dimensions were brought more into accord with those of the majority of British hydrometers. Nine series of hydrometers of differing size and precision were then specified to satisfy normal demand and to provide an economical basis for the construction of special hydrometers.

One of the main changes in the present edition is the reduction in the number of series of specified hydrometers from nine to five. As before, these series are designated by reference to their length—long (L), medium (M) or short (S)—and by their range in g/ml or specific gravity—0.020 (20), 0.050 (50) or 0.100 (100). Of these five series (see Table 1), the M50 and L50 series are much the most in demand, the M100 and S50 series are also often used, and the L20 series, although less popular, is included on account of the high accuracy it provides. The five series also differ as regards bulb size and fragility.

The present standard incorporates various other modifications which accord with international agreements evolved during the period 1950 to 1959 by Technical Committee 48 (Laboratory Glassware and Related Apparatus) of the International Organization for Standardization and having the approval of the appropriate committees of the British Standards Institution. The dimensional changes result in more slender hydrometers which are nevertheless more robust. These instruments, while more sensitive to changes of surface tension than those previously specified, conform more closely to constructional practice in other countries, with the prospect of consequent benefit to the export trade. A further change is the adoption of a tolerance on scale error equal to plus or minus one scale division for all the general purpose hydrometers.

As in the 1953 edition, scales of specific gravity and density (g/ml) are covered by alternative provisions on hydrometers of the same dimensions. For density hydrometers intended for general use, the standard temperature is now exclusively 20°C; the provision in 1953 for density scales based on 15°C has been restricted in the present standard because the difference between the two alternatives (which depends mainly on the very small expansion of glass between 15°C and 20°C) is too small to warrant the provision of further series of instruments, except for certain special purposes. The relationship between the scales of density (20°C and 15°C) and specific gravity (S 60/60°F) are given in Appendix G.

Each of the series of hydrometers specified for general use covers the density (g/ml) or specific gravity range 0.60 to 2.00. The length of the scale of each hydrometer in a particular series is approximately the same. For economy in manufacture the volume below the scale of each hydrometer in a given series is (with few exceptions) also the same; one of these volumes is, in fact, common to two of the series. As in the 1953 edition, the mandatory requirements are as few as possible, but to accord with international recommendations these requirements now include the volume below the scale. It is hoped that the associated recommendations, which are included for the guidance of manufacturers, will not only secure the highest practicable standard in routine production, but will also aid manufacture.

Two of the five series, namely L50 and M50, include the special petroleum sub-series, designated L50SP and M50SP respectively. These are identical with the L50 and M50 ordinary series as regards all the dimensions specified, but differ in having smaller tolerances on the accuracy of indication and in being limited to the low surface tension category and to the range 0.6 to 1.1 g/ml or sp.gr. They comprise hydrometers calibrated to indicate density at 15°C or specific gravity 60/60°F.

A new section has been incorporated to help prospective buyers of hydrometers to secure the instruments best suited to their particular needs. This new section immediately follows the Foreword.

In addition to the specification this standard contains a number of appendices. These include information on the technique of using hydrometers; tables of temperature corrections; indications of the influence of surface tension on the various hydrometers; a table (included for the first time) for correcting readings taken at the top of the meniscus in opaque liquids; and tables facilitating the measurement of the volume of liquid in bulk on the basis of hydrometer observations.* Suitable vessels for use with the hydrometers are described. Information is given to enable hydrometer readings to be correlated with pycnometer observations, and the relationship between weight per millilitre in air and specific gravity is indicated. The density of distilled water between 0°C and 42°C is tabulated.

NOTE. The adoption of the term 'specific gravity' in this British Standard is based on general usage in the United Kingdom. The term adopted for this concept by the International Organization for Standardization is 'relative density'.

* Attention is drawn to the fact that in the petroleum industry a different method, of special applicability, is in use for the measurement of oil in bulk.

GUIDE TO INTENDING PURCHASERS OF BRITISH STANDARD HYDROMETERS

The following notes are provided to assist in the selection of the particular British Standard hydrometers which are the most suitable in any given circumstances. Intending purchasers are advised to state precisely, when enquiring or ordering from suppliers, which of the variants referred to are required. The references on the right are to the relevant portions of the standard.

1. Series, which govern the size of the hydrometer.

Series	Nominal range of individual scales (g/ml or sp. gr.)	Scale subdivision (g/ml or sp. gr.)
L20 (long)	0.020	0.000 2
L50 or L50SP (long)	0.050	0.000 5
M50 or M50SP (medium)	0.050	0.001
M100 (medium)	0.100	0.002
S50 (short)	0.050	0.002

Reference

Table 1

2. Range of hydrometer required. Selection to be made according to requirements from the 70 hydrometers in series L20, the 28 in series L50, M50 or S50, and the 14 in series M100; or from the 10 covering the range 0.6 to 1.1 g/ml in sub-series L50SP or M50SP. Clause 3

3. Basis of scale. Density at 20°C or specific gravity 60/60°F; or, for sub-series L50SP and M50SP only, density at 15°C or specific gravity 60/60°F. Clause 8

4. Surface tension category. Low, medium or high according to the type of liquid and the method of use. Clause 9

5. Special requirements, where unavoidable, in accordance with the particular circumstances. For example, a smaller maximum error than that specified in the standard may be essential; or it may be probable that the hydrometer will be used at a temperature higher than 70°C, in which case either the loading material should have a softening point higher than 80°C, or a hydrometer with mercury loading should be used. Clause 10
Table 1
Clause 4

It may also be desired to order special hydrometer jars appropriate to the instruments which are being purchased. Appendix D

SPECIFICATION

SCOPE

1. This British Standard specifies five series of hydrometers for general use, which are graduated either to indicate density (g/ml) at 20°C or to indicate specific gravity 60/60°F. Each series comprises hydrometers which between them cover the interval 0.6 to 2.0 g/ml or specific gravity. The hydrometers are graduated appropriately for use in liquids of low, medium or high surface tension.

The standard also specifies two sub-series of hydrometers which are graduated either to indicate specific gravity 60/60°F or to indicate density at 15°C. They have smaller tolerances on scale error, are limited to the range 0.6 to 1.1 g/ml or sp.gr. and are for use in liquids of low surface tension.

DEFINITIONS

2. For the purpose of this British Standard, the following definitions, which are in accordance with standard practice in hydrometry, apply:

Density (g/ml). The density (g/ml) of a liquid at temperature t is the mass in grammes per millilitre of the liquid at t .

Specific gravity t_1/t_2 . The specific gravity t_1/t_2 of a liquid is the ratio:

$$\frac{\text{Mass of a given volume of the liquid at temperature } t_1}{\text{Mass of an equal volume of pure water at temperature } t_2}$$

In particular, the specific gravity 60/60°F of a liquid is the ratio:

$$\frac{\text{Mass of a given volume of the liquid at 60°F}}{\text{Mass of an equal volume of pure water at 60°F}}$$

These specific gravities can conveniently be denoted by S_{t_1/t_2} and $S_{60/60°F}$ respectively.

Mass. Mass is quantity of matter and is independent of external conditions such as the buoyancy of the atmosphere or the acceleration due to gravity.

Some notes on the implications of these definitions are included in Appendix E.

PRINCIPAL FEATURES

3. The hydrometers specified are inter-related in such a way that very few different bulb volumes are required.

The principal features are given in Table 1, which also includes the tolerances allowed on scale error. In this table the prefixed code letters L, M and S stand for 'long', 'medium' and 'short', and the code numbers associated with them indicate the scale intervals covered by each hydrometer of the particular series concerned.

The nominal ranges of the L20 hydrometers shall begin with 0.620*, 0.640, etc., those of the L50, M50 and S50 hydrometers with 0.600, 0.650, 0.700, etc., and those of the M100 series with 0.600, 0.700, 0.800, etc.

* Exceptionally, L20 hydrometers having a range 0.600 to 0.620 may be required.