BRITISH STANDARD

BS 2701:1956

*Incorporating Amendment No. 1*

## Specification for

# Rees-hugill powder density flask

Confirmed November 2011

UDC 542.3:531.754

# Co-operating organizations

The Scientific Glassware and Related 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:

Admiralty*
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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
Department of the Government Chemist*
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High Commission of India
Metropolitan Water Board
University of London (Faculty of Science)
Individual manufacturers

This British Standard, having been approved by the Scientific Glassware and Related Laboratory Apparatus Industry Standards Committee and endorsed by the Chairman of the Chemical Divisional Council, was published under the authority of the General Council on 26 April 1956



The following BSI references relate to the work on this standard:
Committee reference LBC/1
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**Amendments issued since publication**

| Amd. No. | Date of issue | Comments |
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| 5496 | April 1965 | Indicating by a sideline in the margin |
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| | | |

# Contents

# Foreword

This British Standard has been prepared under the authority of the Scientific Glassware and Related Laboratory Apparatus Industry Standards Committee to cover the requirements of the refractories industry for apparatus for the rapid and accurate determination of the density of powdered or granular materials.

This type of flask was first described by the late Dr. W. J. Rees and the late Mr. W. Hugill (Trans. Brit. Ceram. Soc., **24**, 70, 1925). Manufacturers and users of silica refractories to whom a knowledge of the density of such refractories is important, in that it affords a good indication of the extent of quartz conversion, quickly recognized the value of this flask, for it enabled them to determine the powder density of a silica brick far more quickly than hitherto and with a minimum of apparatus. It is sometimes of value to know the powder density of other types of refractory, e.g. dead-burned magnesite and magnesite bricks, and the use of the flask has thus been extended; originally this was done by the provision of flasks to cover various ranges of density, but the present standard describes a flask for one range only (2.00–2.70 g/ml), powders of density outside this range being tested by taking an appropriate weight of sample and applying a conversion factor.

The use of the flask outside the refractories industry has been rather limited, but may well be extended when its convenience in control testing is more widely known.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 7 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

This British Standard specifies requirements for a flask with graduated neck suitable for the determination of the density of powdered or granular materials. The graduated neck is arranged to provide direct reading of density when a 100 gramme sample is used. Densities may be determined to an accuracy of about 0.5 per cent when the flask is used by the method described in Appendix B without applying any corrections. Greater accuracy is obtainable by more precise weighing and by applying appropriate corrections on capacity.

## 2 Range

The flask is specified with a main bulb of approximately 250 ml capacity and with a graduated neck giving direct readings of density in the range 2.00 to 2.70 g/ml when used with a 100 gramme sample. When the flask is required for determination of the density of a material which is outside this range, then the weight of the sample must be modified accordingly. If this weight is $W$ grammes and $R$ is the resultant scale reading, then the density of the sample is given by $\frac{RW}{100}$. Table 1 shows a selection of suitable sample weights together with the corresponding multiplying factors, and the resulting range of densities covered by the graduated scale.

**Table 1**

| Weight of sample taken in grammes | Multiplying factor to convert scale reading to density | Density range covered by the graduated scale |
|---|---|---|
| 120 | 1.2 | 2.40–3.24 |
| 150 | 1.5 | 3.00–4.05 |

## 3 Material

The flask shall be made of glass, as free as possible from visible defects, and shall be reasonably free from internal strain.

## 4 Construction

The flask shall be of the general shape and design shown in Figure 1, and shall be sufficiently robust to withstand normal usage. The wall thickness shall show no gross departure from uniformity. The flask shall comply with the following requirements: —

a) *Main bulb*. This shall be of stable form with its greatest diameter at a height of about $^1/_8$ to $^1/_6$ of the height to the base of the neck. The base shall be such that the flask stands firmly and upright on a level surface.

b) *Upper bulb*. This shall be of elongated shape, having a gradual taper at the ends where it joins the cylindrical portions of the neck.

c) *Neck*. The graduated portion of the neck shall be cylindrical with a minimum shoulder at the lower end of the ground portion. Above the ground portion the neck shall open out to a funnel, as shown in Figure 1. The top edge of the funnel shall be fire-polished.

d) *Stopper*. The stopper shall be of glass, preferably hollow-blown, and shall be finely ground to a good fit in the neck. The handle of the stopper shall be long enough for comfortable handling when in position in the funnel neck.

## 5 Dimensions

The flask shall conform to the dimensions specified in Table 2. The additional dimensions in Table 3 are given for the guidance of manufacturers.

**Table 2 — Mandatory dimensions for rees-hugill powder density flasks**

| | |
|---|---|
| Overall height of flask, excluding stopper | maximum 370 mm |
| Length of graduated scale on neck | 120 to 140 mm |
| Length of tube of uniform bore above and below datum mark | minimum 5 mm |
| Length of tube of uniform bore above and below graduated scale | minimum 10 mm |
| Difference between internal diameters of neck at datum mark and of graduated tube | maximum 1 mm |
| Wall thickness at any point | minimum 1 mm |

**Table 3 — Recommended dimensions for rees-hugill powder density flasks**

| | |
|---|---|
| External diameter of main bulb | 90 mm |
| Diameter of base | 70 mm |
| Approximate height from base to datum mark | 90 mm |
| Diameter at top of funnel neck | minimum 40 mm |

## 6 Capacity

The capacity of the main bulb up to the datum mark should be approximately 250 ml. The exact capacity is unimportant and the datum mark should be placed centrally on the short cylindrical portion of neck between the two bulbs.

The capacity above the datum mark to any given graduation mark on the scale shall be equal to the displacement of 100 g of solid material of a density corresponding to the graduation mark in question and is calculated from the formula

$$V = \frac{100}{\rho}$$

where $V$ is the capacity in millilitres to the graduation mark representing a density $\rho$, expressed in grammes per millilitre.

The capacity at any graduation mark on the upper portion of the neck shall be defined by the additional volume of water at 20 °C which must be added to the flask already filled to the datum mark, in order to bring the water surface up to the graduation mark in question, the lowest point of the water meniscus being adjusted to the top edge of the graduation mark in both cases.

The capacities above the datum mark of the highest and lowest marks of the graduated scale (i.e. the capacities which define the dimensional requirements of the neck of the flask) are given in Table 4. (The intermediate capacities corresponding to all the numbered graduation marks are given, for the convenience of manufacturers, in Appendix A.)

**Table 4 — Neck capacities for rees-hugill powder density flasks**

| | |
|---|---|
| Capacity between datum mark and lowest mark on scale | 37.037 ml |
| Capacity between lowest and highest marks on scale | 12.963 ml |

## 7 Tolerance on capacity

The capacity measured above the datum mark to any given mark on the graduated scale shall not differ from the calculated capacity as defined in Clause **6** by more than ± 0.1 ml.

## 8 Graduation marks

The graduation marks shall be fine clean permanent lines of uniform thickness, lying in planes perpendicular to the axis of the neck and shall be horizontal when the flask is standing on a level surface.

There shall be no obvious irregularity in the progressive variation of spacing of the graduation marks.

## 9 Length and numbering of graduation marks

The datum mark shall completely encircle the short neck between bulbs.

The graduated scale on the upper portion of the neck shall consist of short, medium and long lines, every tenth line being a long one and appropriately numbered. The short lines shall be at least 3 mm long and the medium and long lines shall extend equally on both sides beyond the ends of the short lines.

A suitable style of graduation and numbering is shown in Figure 2.

## 10 Inscriptions

Each flask shall have permanently and legibly marked on it:

a) The words “100 g sample” to indicate the weight of sample on which the graduation is based.

b) If required, an identification number.

c) The maker’s or vendor’s name or mark.

d) The number of this British Standard, i.e. “BS 2701”.[1)]

The British Standards Institution is the owner of the registered certification mark shown below:

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[1)] The mark “BS 2701” on the product is an indication by the manufacturer that it purports to comply with the requirements of this British Standard.

## Appendix A Capacities measured above the datum mark corresponding to numbered graduation marks

| Density | Displacement for 100 g | Interval capacity |
|---|---|---|
| | ml | ml |
| 2.0 | 50.000 | |
| | | 2.381 |
| 2.1 | 47.619 | |
| | | 2.164 |
| 2.2 | 45.455 | |
| | | 1.977 |
| 2.3 | 43.478 | |
| | | 1.811 |
| 2.4 | 41.667 | |
| | | 1.667 |
| 2.5 | 40.000 | |
| | | 1.538 |
| 2.6 | 38.462 | |
| | | 1.425 |
| 2.7 | 37.037 | |

## Appendix B Method of use of rees-hugill powder density Flask

A liquid shall be selected with properties suitable for the sample material, in that its density is less than that of the material, and the material is insoluble in it but is "wetted" by it. The volatility of the liquid shall be such as to minimize errors due to evaporation during the determination. In the refractories industry, where this flask was first employed, the liquid most commonly used is xylene.

The flask shall be filled with the test liquid to a few millimetres above the datum mark by means of a suitable funnel extending below the lowest graduation mark. If the walls of the neck above this mark have been wetted then the flask shall be allowed to stand for 10 minutes for drainage to take place. Care shall be taken to avoid further wetting of the upper walls. The lowest point of the meniscus shall then be adjusted to touch the datum mark by removing excess liquid by means of a piece of glass tubing drawn to a jet at the lower end.

$100.0 \pm 0.1$ g of the sample, prepared in a suitable state of subdivision to avoid aggregates or the inclusion of air pockets, shall be weighed in a suitable scoop or dish and transferred slowly and carefully into the funnel neck of the flask. To avoid thermal expansion errors all handling of the flask should be by means of the funnel top. Care shall be taken that none of the sample is spilled or lost and that each small quantity is allowed to sink to the bottom of the flask and air bubbles escape before the next portion is added.

When all the sample has been added the stopper shall be replaced and the flask shall be agitated gently to free any air bubbles which may be trapped in the sediment. This agitation is best carried out by holding the funnel top of the flask, inclining the flask at any angle and gently rolling the base to and fro on the bench.

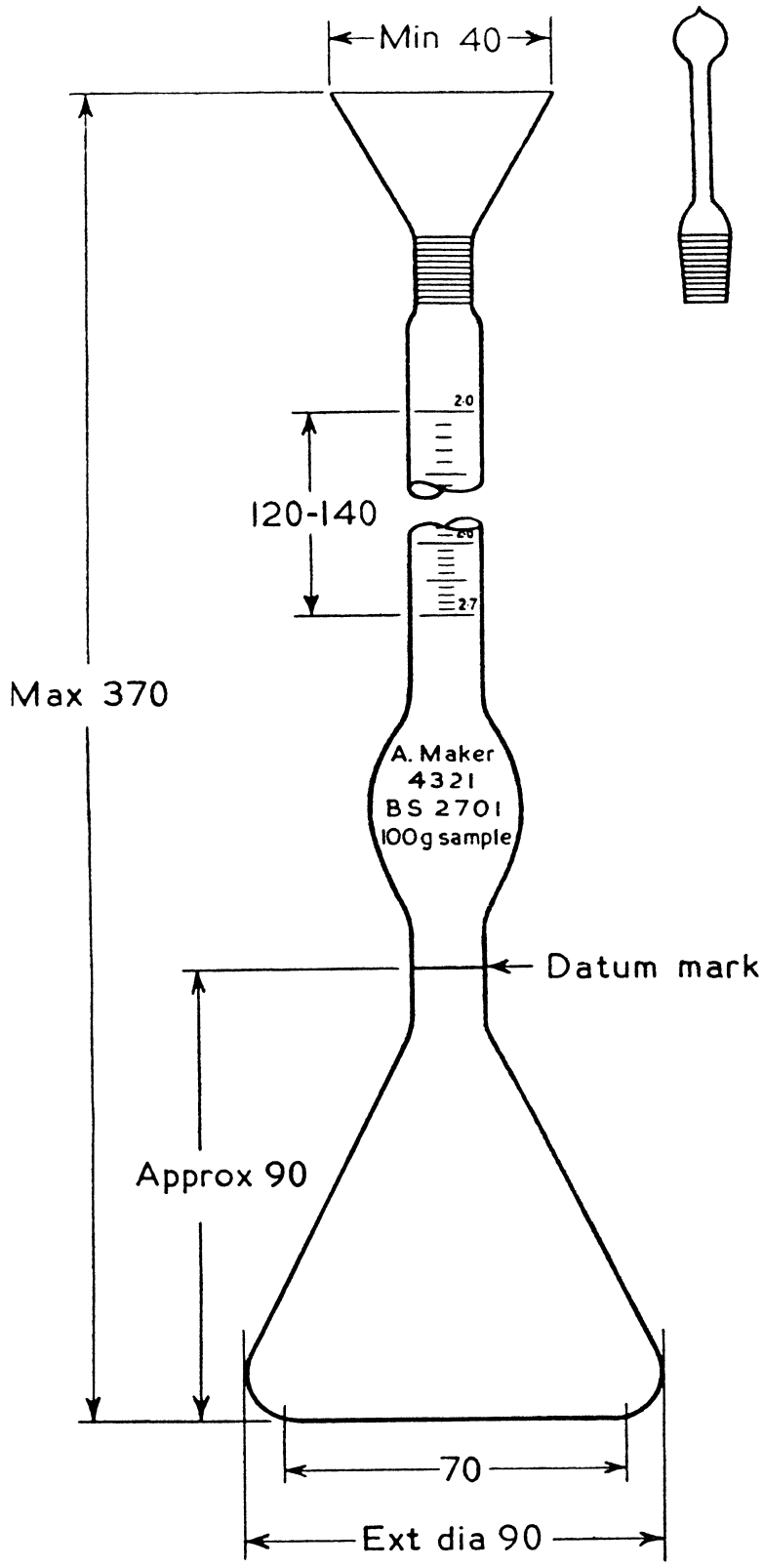
When all air has been expelled, the density of the sample may be read from the graduated scale at the level of the lowest point of the meniscus.

Most of the test liquid can be reclaimed by filtration after the determination has been made. If the flask is inverted smartly over a filter funnel then most of the sample will be swept out of the flask by the rush of liquid.

If a series of determinations is to be made using the same test liquid then a small amount of sediment remaining in the flask will not interfere with the next test provided that it is all washed down below the datum mark. It is essential that the graduated neck and small bulb are kept quite clean.

## Appendix C Testing of British Standard rees-hugill flasks

The National Physical Laboratory is prepared to accept Rees-Hugill powder density flasks marked with an identification number for examination for compliance with the requirements of this British Standard. Flasks complying with these requirements will be marked with the National Physical Laboratory monogram, but no certificate will be issued. Particulars of the fees charged can be obtained on application to the Director, National Physical Laboratory, Teddington, Middlesex.




All dimensions are in millimetres

**Figure 1 — General design of Rees-Hugill flask**

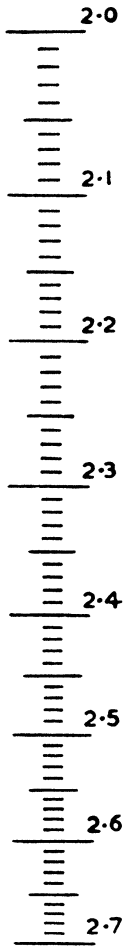



**Figure 2 — Suitable scale for Rees-Hugill flask**

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