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Recommendations for

Design of glass vacuum vessels (including desiccators) for laboratory use

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Committees responsible for this British Standard

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- British Laboratory Ware Association
- British Lampblown Scientific Glassware Manufacturers' Association Ltd.
- Chemical Industries Association
- Department of Health and Social Security
- Department of Trade and Industry (Laboratory of the Government Chemist)
- Glass Manufacturers' Federation
- Institute of Medical Laboratory Sciences
- Institute of Science Technology
- Royal Society of Chemistry

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Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 Glass quality	1
3 Design features	1
4 Symbols	1
5 Base thickness (design features A and F)	2
6 Body thickness and shape (design feature B)	3
7 Step thickness and radius of curvature (design feature C)	3
8 Flange thickness and shape (design feature D)	4
9 Lid thickness and curvature (design feature E)	6
10 Opening for vacuum (design feature F)	7
11 Grinding of flanges (design feature G)	8
12 Elastomeric joint seals (design feature H)	8
13 Tests	8
14 Size description of desiccators	8
Appendix A Equations for calculation of minimum thickness of lids based on stress considerations only	9
Appendix B Hydraulic external pressure tests	10
Appendix C Polarized light test	10
Appendix D Test for ground flat flanges	12
Figure 1 — Common design of vacuum desiccator with flat ground flange	1
Figure 2 — Common design of vacuum desiccator with grooved flange	1
Figure 3 — Base with radiused corners	3
Figure 4 — Base with sharp corners	3
Figure 5 — Methods of reinforcing radiused corners	3
Figure 6 — Curved side-wall with subsidiary curve at corner	4
Figure 7 — Form of step	4
Figure 8 — Alternative flange designs	5
Figure 9 — Part-spherical form lid	6
Figure 10 — Hemispherical form lid	7
Figure 11 — Semi-ellipsoidal form lid	7
Figure 12 — Dished form lid	7
Figure 13 — Part-spherical form lid	7
Figure 14 — Factor k_4 for hemispherical and semi-ellipsoidal lids	9
Figure 15 — Hydraulic test rig	10
Figure 16 — Tensometer for polarized light test	11
Figure 17 — Apparatus for testing ground flat flanges	13
Table 1 — Letter symbols	2
Table 2 — Minimum side-wall thickness	3
Table 3 — Minimum step thickness t_e ; for $\alpha = 55^\circ$ calculated using equation 3	4
Table 4 — Examples of flange thickness t_f calculated using equation 4	6
Table 5 — Examples of lid and flange thicknesses t_f calculated using equation 5	6
Table 6 — Minimum safe-handling thicknesses (t_e minimum) for lids	7
Publications referred to	Inside back cover

Foreword

This British Standard has been prepared under the direction of the Laboratory Apparatus Standards Committee and was first published in 1962 as “Recommendations for the design of glass vacuum desiccators”. This revision has been prepared to cover a wider range of glass vacuum vessels for laboratory use because the same basic principles are relevant to all such vessels. There has been a reduction in the number of different types of vacuum desiccators commercially available and, therefore, a number of the figures in the earlier edition have not been included in this revision; an O-ring type of seal for the lids of desiccators and similar vessels has been introduced.

In this standard, glass vacuum vessels are considered as pressure vessels subject to an external pressure of 1 atm. Suitable structures and thicknesses of glass are recommended for each part of the vessel. The standard gives equations which should be applied in calculating the thickness of glass vacuum vessels for laboratory use where the external pressure will not exceed 1 atm. The calculated glass thickness, however, is sometimes less than that considered adequate for ordinary handling hazards; in these cases, the recommended minimum thicknesses given in this standard take these hazards into account and are greater than the calculated values.

Appendix A gives equations for calculation of minimum thickness. Appendix B to Appendix D describe methods for the hydraulic testing of glass vacuum vessels, for examining them in polarized light under a strain-viewer and for testing the grinding of the flanges.

It is not at present the purpose of this British Standard to specify a range of sizes of desiccators, and the sizes mentioned in the tables are given merely by way of example. The size of desiccators is designated by the internal diameter measured at the flange, which gives a better indication of the usable space compared with the practice in some countries of designating by the outside diameter of the flange.

The use of a safety cage to contain the glass vacuum vessel is strongly recommended.

At the time of publication of this British Standard, no corresponding International Standard exists.

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 14, an inside back cover 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 recommends minimum thicknesses and safety considerations for the design and construction of glass vessels for use under vacuum in a laboratory, including desiccators and filter flasks. Other configurations of desiccating vessels which are not for use under vacuum are outside the scope of this standard.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Glass quality

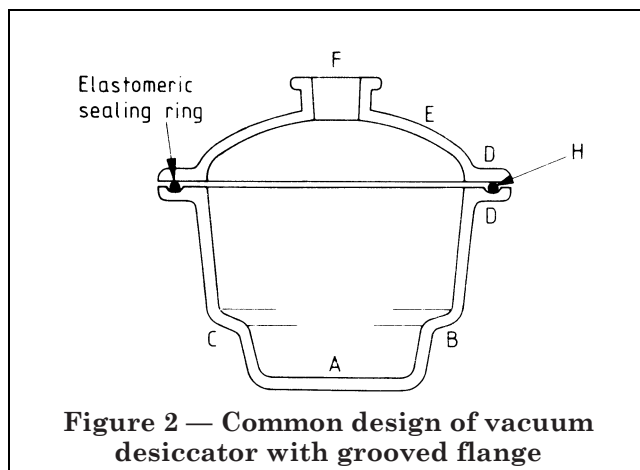
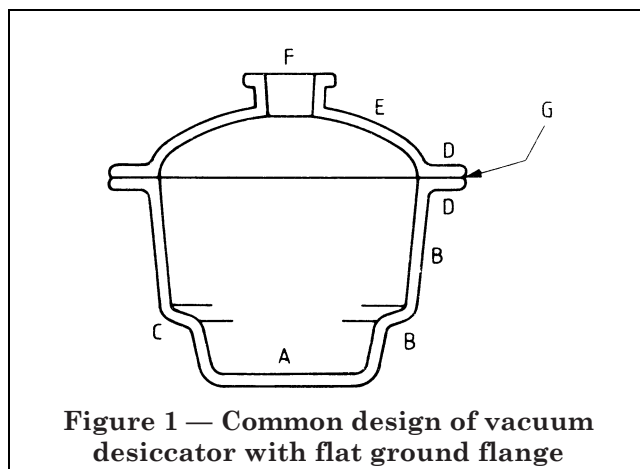
The vessels should be free from defects that will weaken the glass, and substantially free from blisters, seed, striae, cord, etc. They should be well annealed.

3 Design features

Figure 1 and Figure 2 indicate by the letters A to H the features included in this standard for vacuum vessels in common use.

Recommendations for these features are given in the clauses listed below.

Feature	Clause
A Flat base with radiused or sharp lower corners	5
B Lower and upper parts of side-wall	6
C Step to carry perforated plate	7
D Flange of body or lid	8
E Lid form	9
F Opening for vacuum	10
G Flange, ground finish	8
H Flange, grooved with elastomeric insert	8



4 Symbols

The letter symbols used in this standard together with the quantities to which they refer are listed in Table 1.

Table 1 — Letter symbols

Symbol	Unit	Quantity
p	kPa	Maximum pressure differential (i.e. excess of external pressure over internal pressure) to which the vessel is subjected when in use
f	N/mm ²	Design tensile stress
f_c	N/mm ²	Maximum compressive stress
E	N/mm ²	Modulus of elasticity of glass
k_1, k_2 , etc.		Factors for various forms of construction as defined in clauses 5 to 10
d_i	mm	Internal diameter
d_o	mm	External diameter
t_e	mm	Lid, base or step thickness
t_w	mm	Wall thickness
t_f	mm	Flange thickness
r	mm	Internal corner radius
r_1	mm	Internal radius of vessel or lid
r_2	mm	External radius of vessel or lid
h_o	mm	External height of lid
h_i	mm	Internal height of lid
l	mm	Cantilever length, i.e. the width of the flange face external to body or lid
γ	degree	Angle between the sloping side and the vertical axis
β	degree	Angle between the axis and the tangent to the curve of a part-spherical lid where it meets the flange
α	degree	Half-angle of a conical lid or section

5 Base thickness (design features A and F)

5.1 Flat base with radiused or sharp lower corners

5.1.1 Recommendations. The minimum thickness t_e of a flat base should be not less than the larger of the two values given by the following equations.

$$t_e = 0.05 d_i \quad [1(a)]$$

$$t_e = d_i \left(\frac{p}{k_1 f} \right)^{0.5} \quad [1(b)]$$

where

d_i is the internal diameter measured at the base (in mm);

k_1 is a factor derived from equation 2;

p and f are defined in Table 1.

In the construction shown in Figure 3, where the internal corner radius r is greater than $3t_e$, k_1 is derived from the following equation.

$$k_1 = \frac{4}{\left(1 - \frac{r}{d_i} - \frac{2r^2}{d_i^2} \right)^2} \quad (2)$$

In the construction shown in Figure 4, where the internal corner radius r is less than $3t_e$, k_1 is given the value 5.25. It is recommended that, for desiccator bases, r should be not less than t_e .

NOTE Equation 1, with $k_1 = 5.25$, is applicable in the calculation of the minimum thickness of flat plates.

5.1.2 Calculations of minimum values of t_e . Using equation 1, with an example of a 150 mm diameter base, of different corner radii, where $t_e = 0.05d_i$, the following values are obtained.

a) *Base with radiused corners*

$r = 32$ mm, $k_1 = 8.0$, $t_e = 6.5$ mm

$r = 25$ mm, $k_1 = 6.6$, $t_e = 7.4$ mm