

Specification for

Observation and gauge glasses for pressure vessels

UDC 666.11.025:621.183.31:681.128:621.642:66.023

Confirmed November 2008

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Co-operating organizations

The Glass Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following scientific and industrial organizations.

- British Glass Industry Research Association
- British Lampblown Scientific Glassware Manufacturers' Association
- British Plastics Federation
- Department of the Environment
- Flat Glass Manufacturers' Association*
- Glass Manufacturers' Federation
- Scientific Instrument Manufacturers' Association
- Society of Glass Technology
- University of Sheffield (Department of Glass Technology)

The industrial organization marked with an asterisk in the above list, together with the following, was directly represented on the committee entrusted with the preparation of this British Standard:

- British Valve Manufacturers' Association
- Chemical Industries Association
- Council of British Manufacturers of Petroleum Equipment
- Department of Trade
- Electricity Supply Industry in England and Wales
- Engineering Equipment Users' Association
- Institution of Mechanical Engineers
- Society of Chemical Industry

This British Standard, having been approved by the Glass Industry Standards Committee, was published under the authority of the Executive Board on 31 October 1975

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First published January 1962
First revision October 1975

The following BSI references relate to the work on this standard:
Committee reference GLC/4
Draft for comment 73/52683

ISBN 0 580 08636 4

Amendments issued since publication

Amd. No.	Date of issue	Comments

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Foreword

This British Standard was first prepared in 1962 at the request of the steam using (power) and chemical industries and with the support and participation of manufacturers and users of observation and gauge glasses fitted to pressure vessels containing steam and water or other fluids.

The Technical Committee representing these interests which prepared the standard based the requirements on the characteristics of glasses which had been shown to meet adequately the demands of service under conditions of high pressure and temperature in contact with corrosive fluids. Attention was drawn to the requirements of the Factories Act, 1961, Section 32 (2) (d) in relation to protector glasses for gauge glasses.

Recommendations for the use of observation and gauge glasses on pressure vessels are given in Appendix A, but no attempt has been made to deal exhaustively with this subject, for which both reference to suitable modern textbooks and practical experience are indispensable.

The main changes incorporated in this revision as compared with the 1962 edition are the following.

- a) In the 1962 edition, ranges of standard dimensions for each type of glass were specified with the object of reducing the number of such sizes to be manufactured and kept in stock. In this revision, the need to increase the number of sizes has been recognized.
- b) Since 1962, liquid level indicators of the through-vision type having circular ports (referred to for example in BS 759 "Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers"), have gained worldwide acceptance, and specifications for the circular glasses used therein have now been included.
- c) The use of soda-lime glass for tubular glasses and annealed borosilicate glass for through-vision and reflex glasses is no longer permitted.
- d) The section on inspection and thermal shock testing of toughened glasses (which was originally given in an appendix) now contains mandatory methods and criteria and accordingly this material has been incorporated into the main body of the standard.
- e) Dimensions and units have been converted to metric units. For design stress the MN/m^2 ¹⁾ has been used; for fluid pressure, however, the bar²⁾ has been adopted.
- f) At the time of preparation of this British Standard, much borosilicate glass was still being supplied in imperial measure. In view of the stocks of these glasses and the expectation of their use continuing for a period before the changeover to metric sizes is complete, the thicknesses of borosilicate circular sight and light glasses are given in the former inch sizes but expressed in millimetres. In some cases the difference between the imperial and nearest metric equivalent is too large to ignore in design calculations, and it was therefore thought important in this revision to give (in Appendix A) recommended maximum pressures in graphical form to facilitate interpolation.
- g) Appendix B now lists separately the information to be provided with an order or enquiry.

¹⁾ $1 \text{ MN/m}^2 = 1 \text{ MPa}$.

²⁾ $1 \text{ bar} = 10^5 \text{ N/m}^2 = 100 \text{ kPa}$.

Certification. It is strongly recommended that in view of the nature of this specification manufacturers and purchasers should make use of the certification facilities described on the inside back cover of this standard.

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 to iv, pages 1 to 16, 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.

Section 1. General

1 Scope

This British Standard specifies requirements for the main types of observation and gauge glasses for pressure vessels, and also specifies inspection and testing techniques for toughened glasses, under the following main headings.

Section 1	General
Section 2	Tubular glasses for level gauges
Section 3	Protector glasses for tubular gauge glasses
Section 4	Through-vision and reflex glasses
Section 5	Circular sight and light glasses
Section 6	Port gauge glasses as used in fittings for steam boilers
Section 7	Inspection and thermal shock testing of toughened glasses and tubular glasses

2 References

The title of the British Standard referred to in this standard is given on the inside back cover.

3 Definitions

For the purposes of this British Standard, the following definitions apply.

3.1

annealed glass

glass which has had objectionable stresses removed by controlled heating and cooling

3.2

toughened glass (heat-treated glass, tempered glass, hardened glass)

glass, the surface of which has been rapidly cooled from near its softening point, so that after cooling a residual compressive stress remains in the surface and is balanced by tensile stresses below the surface. This increases the mechanical strength and thermal shock resistance of the glass and also, when it breaks, causes it to shatter into smaller and less angular fragments than an annealed glass. Chemically toughened glass is not permitted within the scope of this British Standard

3.3

“as drawn” glass

glass tubing in the “as made” state, not having been furnace annealed, and containing certain desirable residual stresses, in particular compression stress in the outer surface. For design purposes, stress values for annealed glasses (see A.3.2) may be used

3.4

soda-lime glass

glass in which the main constituents are silica, soda and lime. Soda-lime glass has a relatively high coefficient of expansion and hence in the annealed state has only little resistance to thermal shock but its strength and thermal resistance can be greatly increased by toughening

3.5

borosilicate glass

silicate glass containing boron as a characteristic constituent. Borosilicate glass has a relatively low coefficient of expansion and hence has considerable resistance to thermal shock. Because it has a low coefficient of expansion, it does not develop as much stress as soda-lime glass under comparable toughening treatments. Because of its higher softening temperature, borosilicate glass withstands higher duty temperatures than does soda-lime glass without de-toughening. Because it is more resistant to corrosion than soda-lime glass, borosilicate glass is recommended for all reflex glasses

3.6

defects

defects that may occur in glass and affect its performance, as listed and defined in BS 3447

3.7

corrosion

chemical and mechanical attack of glass surfaces by the contents of the pressure vessel

NOTE Owing to the difficulty of distinguishing corrosion and erosion as separate processes, the term corrosion is used to cover both processes.

4 Marking

Glasses for which compliance with this standard is claimed shall be permanently marked with the following inscriptions:

- The manufacturer's identification or trade mark.
- The number of this British Standard, i.e. “BS 3463”.

These markings shall not interfere with the function of the glass and preferably shall be placed so as to be visible when mounted. This latter requirement does not apply to through-vision and reflex glasses as described in section 4 nor to port gauge glasses as described in section 6.

Section 2. Tubular glasses for level gauges

5 Material

Tubular glasses shall be made of borosilicate glass. It is recommended that for steaming conditions, tubular glasses should not be used above 18.5 bar³⁾. For non-steaming conditions higher pressures are allowable up to a limit of 30 bar. Tubing used for steaming conditions shall be in the “as drawn” state and not annealed. Tubing used for non-steaming conditions may be “as drawn” or annealed.

NOTE Requirements are not specified for toughened tubular glasses, as the manufacture of these is not practicable at present.

6 Quality of glass

Tubular glasses shall be free from defects that would interfere with vision or service.

7 Dimensions

7.1 Diameters and wall thicknesses of tubular glasses shall be as specified in Table 1. Each of the three sizes is available with two different tolerances on diameter, the two grades being designated “selected grade” and “ordinary grade”.

7.2 The lengths of tubular glasses are determined by the design of the fittings into which they are assembled. For steaming applications, such fittings should not be further than 505 mm apart if the glass is unsupported, or 600 mm apart if an intermediate support is used. For non-steaming applications, the corresponding distances should be 1 000 mm and 1 200 mm. For the purposes of this British Standard the respective lengths of tubular glasses shall be 505 mm, 600 mm, 1 000 mm and 1 200 mm. Unless otherwise agreed between purchaser and manufacturer, the tolerance on length shall be ± 2.0 mm.

8 Finish of ends

The ends of tubular gauge glasses shall be cut at right angles to the axis, then fused and flame cooled to prevent severe ring stress.

9 Straightness

Tubular glasses shall be straight within limits agreed between purchaser and manufacturer.

Table 1 — Diameters, thicknesses and tolerances of tubular glasses

Nominal external diameter	Tolerance on external diameter		Wall thickness
	Selected grade	Ordinary grade	
mm	mm	mm	mm
13	} + 0 - 0.8	} + 0.4 - 0.8	1.8 to 2.5
16			2.6 to 3.3
19			2.8 to 3.5

10 Ovality

The maximum and minimum external diameters of any cross section at right angles to the axis of tubular glasses shall not differ by more than 3 % of the nominal diameter.

11 Thermal shock requirements

Manufacturers shall certify that tubular glasses for steaming conditions will pass the thermal shock test and acceptance conditions described in section 7. In the event of a purchaser requiring tests to be made on any consignment, the sampling procedure described in section 7 shall be adopted.

NOTE With tubular glasses, it is not practicable to require destructive tests on small batches (10 glasses or fewer) because a sampling procedure is not considered appropriate at this level.

Glasses subjected to the test shall be destroyed after the test to prevent them being inadvertently put into service.

Section 3. Protector glasses for tubular gauge glasses

12 Material

Protector glasses shall be made of toughened soda-lime clear glass. Annealed or chemically toughened glass shall not be used.

13 Quality of glass

Protector glasses shall be free from defects that would interfere with vision or service.

14 Dimensions

14.1 Protector glasses should preferably be 57 ± 0.5 mm wide, and 12 ± 0.5 mm thick.

14.2 The length of protector glasses should preferably be as specified in Table 2 with a tolerance in each case of ± 0.8 mm.

³⁾ 1 bar = 10^5 N/m² = 100 kPa.