

SPECIFICATION FOR

SPIRIT LEVEL VIALS

Confirmed
January 2010

THIS BRITISH STANDARD, having been approved by the Instrument Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 1st June, 1962.

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 4000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook,

This standard makes reference to the following British Standard:

B.S. 958. Precision levels for engineering workshops.

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 references INE/9 and INE/9/2
Draft for comment AA(INE) 9011

CONTENTS

	Page
Co-operating organizations	4
Foreword	5

SPECIFICATION

SECTION ONE: GENERAL

1. Scope	6
2. Definitions	6
3. Materials	7

SECTION TWO: GRADUATION MARKS

4. Straight cylindrical vials	8
5. Bent cylindrical vials	9
6. Circular vials	9

SECTION THREE: DIMENSIONS

7. Straight cylindrical vials	10
8. Bent cylindrical vials	12
9. Circular vials	12

SECTION FOUR: PERFORMANCE

10. Straight cylindrical vials	13
11. Bent cylindrical vials	16
12. Circular vials	16

APPENDICES

A. Recommended method of testing	17
B. Recommendations for standard mounts	19
C. Metric-inch conversions	24

CO-OPERATING ORGANIZATIONS

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

Association of Scientific Workers
British Clock and Watch Manufacturers' Association
British Electrical and Allied Industries Research Association
British Electrical and Allied Manufacturers' Association
British Industrial Measuring and Control Apparatus Manufacturers' Association
British Iron and Steel Federation
British Nautical Instrument Trade Association
British Railways, The British Transport Commission
*British Scientific Instrument Research Association
Council of British Manufacturers of Petroleum Equipment
Electricity Council, the Generating Board and the Area Boards in England and Wales
Electronic Engineering Association
Engineering Equipment Users' Association
Gauge and Tool Makers' Association
*Institute of Physics and The Physical Society
Institution of Chemical Engineers
Institution of Electrical Engineers
Institution of Heating and Ventilating Engineers
Institution of Mechanical Engineers
Iron and Steel Institute
Meteorological Office
Ministry of Health
Ministry of Housing and Local Government
National Coal Board
*National Physical Laboratory (D.S.I.R.)
Oil Companies Materials Association
*Scientific Instrument Manufacturers' Association
*Society of Instrument Technology
*War Office
Water-tube Boilermakers' Association

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 standard:

Admiralty
British Photographic Manufacturers' Association Ltd.
Federation of Manufacturing Opticians
Royal Microscopical Society
Manufacturers of Spirit Level Vials

BRITISH STANDARD SPECIFICATION FOR SPIRIT LEVEL VIALS

FOREWORD

This British Standard has been prepared under the authority of the Instrument Industry Standards Committee to introduce simplification into the manufacture of spirit levels by reducing their diversity, to guide interested users in their requirements and to permit the greatest possible degree of interchangeability.

The only other standard in which reference is made to spirit levels is B.S. 958, 'Precision levels for engineering workshops', and this has been taken into account in the preparation of the present standard. The scope of this standard, B.S. 3509, however, includes spirit levels used on surveying instruments, on general levelling instruments and in inspection techniques.

Spirit levels have hitherto been specifically designed to suit the instruments in which they are fitted and used, consequently, although the sensitivity requirement of any particular vial has been directly related to the accuracy and function of the instrument, its size has been governed by the space available for its fitting in each individual case.

This standard will lead the designer or user to choose a vial of the optimum size for a given accuracy. In this connection it should be pointed out that there is little to be gained in accuracy by increasing the sensitivity of a vial beyond the values given for a particular size.

NOTE. The values given herein, whether metric or British units, are to be regarded as standard; Appendix C contains conversions for British and metric units. These conversions are approximate. More accurate conversions should be based on B.S. 350, 'Conversion factors and tables'.

SPECIFICATION

SECTION ONE: GENERAL

SCOPE

1. This British Standard deals in detail with the various sizes and performance requirements for both precise and coarse spirit level vials. Ranges of parameters of spirit level vials for use in precision surveying, inspection and general levelling instruments are related to the sensitivity, and preferred sets of parameters for given sensitivities are indicated. In Appendix A is given a recommended method of testing vials and recommendations are made in Appendix B for preferred forms of mounting.

DEFINITIONS

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

a. Spirit level vial. A glass vessel suitably processed, partially filled with a liquid of low freezing point and viscosity, and completely sealed.

b. Straight cylindrical vial. A vial made from nominally straight glass tube which has been fully barrel ground or partially ground internally to a required radius of curvature longitudinally.

c. Bent cylindrical vial. A vial made by bending the glass tube to a required radius of curvature longitudinally.

d. Circular vial. A vial possessing a spherical functional surface whereby inclinations in all directions can be detected in contradistinction to vials in *b* and *c* above which are only required to be sensitive to tilts along their longitudinal axis.

e. Bubble. The small space created inside the sealed glass tube due to partial filling. This is occasionally referred to as the air-space or air-bell.

NOTE. It is customary to refer to spirit level vials themselves as 'bubbles'; to avoid confusion of terms this mode of reference is not used in this specification.

f. Sensitivity. That angle of tilt which causes the bubble in the vial to move through one scale division.

g. Range. The total angle of tilt throughout which a vial can be used.

h. Roll. The rotation of a straight cylindrical vial about an axis parallel to the axis of the internally ground surface.

j. Roll error. The longitudinal movement of the bubble (due to imperfections in the ground surface of the vial) when rolled through a specified amount about the above axis in definition *h*.

k. Repeatability. The measure of the ability of the bubble to return to its original position when the vial has been disturbed and subsequently restored to its original attitude.

l. Settling time. The time taken for a bubble to return to within one tenth of a scale division of its steady position when the vial has been tilted through a specified angle.

MATERIALS

3. *a. Glass.* The glass shall be well annealed and, over the viewing portion transparent, free from striæ, flaws and other defects. The composition of the glass shall be such that it is not reacted upon by the filling liquid or any colouring agent used.

b. Filling liquid. The liquid shall be clear, free from impurities and solid particles and shall be chemically inert to the glass and, if present, the colouring material. It shall not cloud or decompose on prolonged exposure to sunlight and shall remain fluid at a temperature of -40°C . The filling liquid should not normally be coloured. Fluorescent materials such as eosin (for orange) and fluorescein (for green) may be used if specified by the purchaser.

SECTION TWO: GRADUATION MARKS

STRAIGHT CYLINDRICAL VIALS

4. *a.* Graduation marks shall be centrally located along the parallel portion of the vial to within ± 1 mm.

NOTE 1. Where a vial with one end square and the other end pipped is used, the graduation marks will, by conforming to this requirement, appear 'off centre' in relation to the overall vial length. This feature can be corrected during mounting so that the graduation marks appear central over the viewing portion.

NOTE 2. The top of the vial will usually be graduated to assist in bringing the bubble into the centre of its run and to indicate the movement of the bubble for a specified tilt. An exception to this is when a special coincidence prism reading arrangement is added to the bubble assembly.

b. When a vial is to be graduated, one of the forms shown in Fig. 1 shall be adopted.

c. In all cases, save Type I and Type II vials (see Table 1), the nominal distance between two consecutive graduation marks shall be 2 mm, whilst the quoted sensitivity for a vial graduated with two graduation marks only shall be for a 2 mm run. For Type I and Type II vials the scale interval shall be 2.5 mm. (The scale spacing between graduation marks may vary by ± 5 per cent from their average, the average interval being within ± 10 per cent of the nominal.)

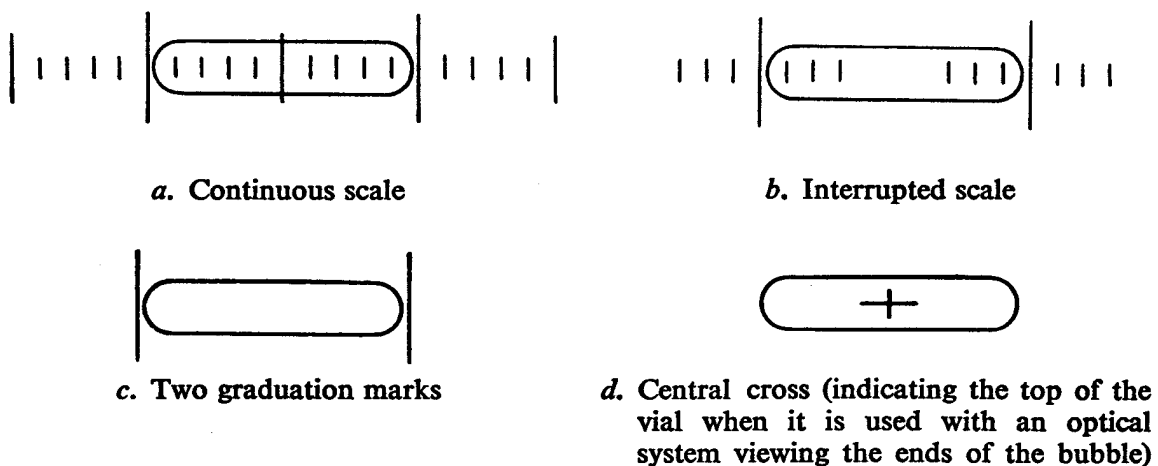


Fig. 1. Forms of vial graduation marks

d. The two major graduation marks of any scale shall be clearly designated by their increased length and/or their being terminated by dots. They shall be the same length and shall indicate the position of the bubble at the centre of its run.

These major graduation marks shall be separated by a distance equal to the length of the bubble plus 0.5 mm to 3 mm at 20°C.