

Specification for

# Ceramic components for use in envelopes for electronic tubes

UDC 621.385.032.7:621.315.612:666.3

Confirmed  
January 2011

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# Co-operating organizations

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

- British Broadcasting Corporation
- British Electrical and Allied Manufacturers' Association
- British Radio Equipment Manufacturers' Association
- British Radio Valve Manufacturers' Association\*
- British Railways Board
- Cable and Wireless Ltd.
- Crown Agents for Oversea Governments and Administrations
- Department of Employment and Productivity (H.M. Factory Inspectorate)
- Electrical Contractors' Association (Incorporated)
- Electrical Research Association
- Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
- Electronic Engineering Association\*
- Electronic Valve and Semi-Conductor Manufacturers' Association\*
- Home Office
- Institution of Electrical Engineers
- Institution of Electronic and Radio Engineers\*
- Institution of Production Engineers
- Ministry of Defence, Army Department
- Ministry of Defence (Directorate of Standardization)
- Ministry of Defence, Navy Department\*
- Ministry of Defence, Procurement Executive
- Post Office
- Radio and Electronic Component Manufacturers' Federation
- Relay Services Association of Great Britain
- Science Research Council — Radio and Space Research Station
- Scientific Instrument Manufacturers' Association\*
- Society of British Aerospace Companies Ltd.
- Telecommunication Engineering and Manufacturing Association

The Government department 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:

- United Kingdom Atomic Energy Authority.
- British Ceramic Research Association.
- Individual experts.

This British Standard, having been approved by the Telecommunication Industry Standards Committee, was published under the authority of the Executive Board on 30 March 1972

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The following BSI references relate to the work on this standard:  
Committee reference TLE/5  
Draft for comment 71/20608

ISBN 580 06699 1

## Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------|----------|
|          |      |          |
|          |      |          |
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## Foreword

This standard makes reference to the following British Standards:

BS 784, *Methods of test for chemical stoneware*.

BS 903, *Methods of testing vulcanized rubber — Part A26: Determination of hardness*.

BS 1598, *Ceramic insulating materials for general electrical purposes*.

BS 4518, *Metric dimensions of toroidal sealing rings and their housings (O-rings)*.

This British Standard which has been prepared under the authority of the Telecommunication Industry Standards Committee is based on a draft prepared on behalf of the Department for Co-ordination of Valve Development, Ministry of Defence, by a working party drawn from government establishments and from the tube industry. It has been discussed with the ceramic manufacturers, and the British Ceramic Research Association has tested a wide range of commercial materials to establish realistic limits (Ref. 1, Appendix H). The standard deals with three categories of materials as follows:

Category 1. A high grade material suitable for valve body parts.

Category 2. A special grade suitable for high power microwave windows.

Category 3. A special grade with high thermal conductivity.

All categories are required to be vacuum tight. The standard does not deal with the ceramic materials sometimes used for internal parts in valve construction.

Although no explicit reference is made to any material, the properties called for in the standard for Categories 1 and 2 are those normally associated with high alumina content and those for Category 3 with high beryllia content. Other materials may, however, be accepted provided that allowance is made by the user for characteristic changes such as in the dielectric constant.

The standard is closely related to BS 1598:1964, "*Ceramic insulating materials for general electrical purposes*". However, the uses to which the ceramics will be put in tubes give rise to certain special requirements which involve either new limits or new tests. In the main these changes are as follows:

- 1) The ceramics must be vacuum tight. The standard includes details of a suitable test and the performance required.
- 2) High strength is required in order to give reasonable latitude in the design of ceramic-metal seals, which usually involves some degree of mismatch in expansion coefficient over part of the working or processing temperature range.
- 3) High thermal conductivity is important both in increasing thermal shock resistance and in avoiding excessive temperature rise in high power applications.
- 4) The ceramics should be capable of being metallized consistently. This requires close reproducibility of microstructure.
- 5) They require to have a high stability under a variety of processing and user conditions, that include firing in vacuum and in hydrogen for which tests have been laid down. They may also have to withstand bombardment by X-rays, electrons or ions. Working temperatures of up to 500 °C may be encountered in use and the trend is towards still higher temperatures (up to 1 000 °C) for some applications in the future.

A wide variety of sizes may be required, mainly in the form of tubes and discs. The guide to designers contained in BS 1598 is also applicable to this standard.

However, it should be noted that in addition to the fabrication methods mentioned in BS 1598 isostatic pressing is often employed for tube components. This method results in greater uniformity of density.

Ceramics conforming to the standard shall be supplied either 1) already metallized on the surfaces requiring this treatment so that the whole process is under the control of the ceramic supplier or 2) unmetallized but capable of being metallized.

In conformity with BS 1598:1964 the standard is confined to a description of the test to be applied, the number of specimens to be used for each test and the values defining pass or failure under the test. It covers type and batch testing, and also indicates tests to be applied to components. The main function of the tests laid down in this standard is the control of the ceramic as a material. It is emphasized, however, that results from test samples are affected by the forming method and this should, as far as possible, be the method used in the manufacture of production parts. Component tests agreed between user and supplier may, in addition to those recommended, bring out more specifically the suitability for the particular application.

NOTE Beryllium oxide will be the material normally used for Category 3. This material represents a toxic hazard and certain precautions which have been published (Ref. 2, Appendix H) should be taken. In particular, it is essential to realize that inhalation of dust or of volatile compounds of beryllia is dangerous. Contamination of wounds by beryllia must be avoided.

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.

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### Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 12 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.