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ADVANCED TECHNICAL CERAMICS - METHODS OF TESTING MONOLITHIC CERAMICS - THERMOMECHANICAL PROPERTIES - PART 3: DETERMINATION OF RESISTANCE TO THERMAL SHOCK BY WATER QUENCHING

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Contents

Foreword

This document (EN 820-3:2004) has been prepared by Technical Committee CEN/TC 184 “Advanced technical ceramics”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by February 2005.

This document supersedes ENV 820-3:1993.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

EN 820 *Advanced technical ceramics — Methods of testing monolithic ceramics — Thermomechanical properties* consists of five Parts:

— Part 1: *Determination of flexural strength at elevated temperatures*

— Part 2: *Determination of self-loaded deformation*

— Part 3: *Determination of resistance to thermal shock by water quenching*

— Part 4: *Determination of flexural creep deformation at elevated temperatures*

— Part 5: *Determination of elastic moduli at elevated temperatures*

Part 4 is a European Prestandard (ENV) and Part 5 is a Technical Specification (CEN/TS).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This Part of EN 820 specifies the principles of thermal shock testing, and provides a general method for conducting thermal shock tests by quenching into water for both test pieces and components by quenching into water.

NOTE This document does not cover thermal stress developed as a result of steady inhomogeneous temperature within a ceramic body or of thermal expansion mismatch between joined bodies.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 623-1, *Advanced technical ceramics — Monolithic ceramics — General and textural properties — Part 1: Determination of the presence of defects by dye penetration tests*

EN 843-1, *Advanced technical ceramics — Monolithic ceramics — Mechanical properties at room temperatures — Part 1: Determination of flexural strength*

EN 60584-1, *Thermocouples — Part 1: Reference tables (IEC 60584-1:1995)*

EN 60584-2, *Thermocouples — Part 2: Tolerances (IEC 60584-2:1982)*

EN 60672-2, Ceramic and glass insulating materials — Part 2: Methods of test (IEC 60672-2:1999)

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:1999)*

3 Principle

A set of test pieces is heated to a given temperature, and then quickly and smoothly transferred to a water bath. The test pieces or components are then inspected for cracks or other damage, either by an appropriate mechanical test to establish whether weakening has occurred, or by using a dye penetrant to detect the presence of cracks (see EN 623-1).

NOTE 1 Dye penetration tests are unsatisfactory for porous or highly microcracked materials.

This thermal shock test determines whether a material or component has a capability of withstanding a water quench through a large temperature difference from high temperature without failure, under the conditions of heat transfer prevailing in such a quenching environment, and for the given geometry and section thickness.

NOTE 2 By agreement between parties an alternative quenching medium may be employed. Details of the medium employed should be incorporated in the report.

If the test pieces for the quench test are available as regular bar shapes, then the inspection after quenching with the mechanical test, such as a flexural test, may be preferred, as it enables the onset of loss of strength with increasing initial temperature to be determined. Sets of at least five test pieces are heated to a series of temperatures above that of the quenching bath, quenched, dried and subjected to a short-term strength test. The temperature drop corresponding to that at which a sudden loss of strength occurs is termed the critical temperature difference, ΔT_c. This temperature difference can be estimated using the first kind of thermal shock parameter, R (see A.3.2), to which it is numerically equal at an infinite rate of heat transfer.