



BSI Standards Publication

**Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for fracture resistance of monolithic ceramics at room temperature by indentation fracture (IF) method**

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## National foreword

This British Standard is the UK implementation of ISO 21618:2025. It supersedes BS ISO 21618:2019, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RPI/13, Advanced technical ceramics.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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International  
Standard

**ISO 21618**

**Fine ceramics (advanced ceramics,  
advanced technical ceramics) —  
Test method for fracture resistance  
of monolithic ceramics at room  
temperature by indentation  
fracture (IF) method**

*Céramiques techniques (céramiques avancées, céramiques  
techniques avancées) — Méthode d'essai pour déterminer la  
résistance à la rupture par indentation (IF) des céramiques  
monolithiques à température ambiante*

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# Contents

Page

|                                                                                                                                            |           |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Foreword</b>                                                                                                                            | <b>iv</b> |
| <b>1 Scope</b>                                                                                                                             | <b>1</b>  |
| <b>2 Normative references</b>                                                                                                              | <b>1</b>  |
| <b>3 Terms and definitions</b>                                                                                                             | <b>1</b>  |
| <b>4 Principle</b>                                                                                                                         | <b>2</b>  |
| <b>5 Apparatus</b>                                                                                                                         | <b>3</b>  |
| 5.1 Testing machine                                                                                                                        | 3         |
| 5.2 Indenter                                                                                                                               | 3         |
| 5.3 Verification by standard reference materials                                                                                           | 3         |
| 5.4 Metallurgical microscope or travelling microscope                                                                                      | 3         |
| <b>6 Test specimen</b>                                                                                                                     | <b>3</b>  |
| 6.1 Thickness                                                                                                                              | 3         |
| 6.2 Surface finish                                                                                                                         | 3         |
| <b>7 Procedure</b>                                                                                                                         | <b>3</b>  |
| 7.1 Specimen placement                                                                                                                     | 3         |
| 7.2 Specimen levelling                                                                                                                     | 4         |
| 7.3 Cleaning of the indenter                                                                                                               | 4         |
| 7.4 Adjustment of stage movement                                                                                                           | 4         |
| 7.5 Application of test force                                                                                                              | 4         |
| 7.6 Acceptability of indentations                                                                                                          | 4         |
| 7.7 Number of indentations                                                                                                                 | 5         |
| 7.8 Measurement of indentation size                                                                                                        | 5         |
| 7.9 Measurement of crack size                                                                                                              | 6         |
| <b>8 Calculation</b>                                                                                                                       | <b>7</b>  |
| <b>9 Test report</b>                                                                                                                       | <b>8</b>  |
| <b>Annex A (informative) General machining procedure for test piece preparation</b>                                                        | <b>10</b> |
| <b>Annex B (normative) Adjustment of the axis of travelling-stage and calibration of the length measurement using the travelling stage</b> | <b>12</b> |
| <b>Annex C (informative) Interlaboratory evaluation of the indentation fracture (IF) test procedure</b>                                    | <b>14</b> |
| <b>Bibliography</b>                                                                                                                        | <b>16</b> |

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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This document was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

This second edition cancels and replaces the first edition (ISO 21618:2019), of which it constitutes a minor revision. The changes are as follows:

- replacement of the withdrawn normative reference ISO 4287 by the current equivalent standard ISO 21920-2;
- editorial changes.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for fracture resistance of monolithic ceramics at room temperature by indentation fracture (IF) method

## 1 Scope

This document specifies a test method for determination of the fracture resistance of monolithic ceramics at room temperature using the indentation fracture (IF) method.

This document is applicable to dense monolithic ceramics and whisker- or particulate-reinforced ceramics which are regarded as macroscopically homogeneous. This document is not applicable to monolithic silicon nitride ceramics for bearing balls and continuous-fibre-reinforced ceramics composites.

This document is applicable for material development, material comparison, quality assurance, characterization and reliability data generation.

Indentation fracture resistance,  $K_{I,IFR}$ , as defined in this document is not to be equated with fracture toughness determined using other test methods such as  $K_{Isc}$  and  $K_{Ipb}$ .

NOTE  $K_{I,IFR}$  is an estimate of a material's resistance to cracking as introduced by an indenter and has correlations with wear resistance and rolling contact fatigue performance as well as machining processes, since these properties are governed by the resistance to crack extension in localized damage areas.<sup>[1]–[3]</sup> By contrast, fracture toughness properties  $K_{Isc}$  and  $K_{Ipb}$  are intrinsic properties of a material and are relevant to macroscopic and catastrophic fracture events with long cracks rather than those phenomena caused by microscopic and successive damage accumulation associated with short cracks.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 6507-2, *Metallic materials — Vickers hardness test — Part 2: Verification and calibration of testing machines*

ISO 6507-3, *Metallic materials — Vickers hardness test — Part 3: Calibration of reference blocks*

ISO 14705, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for hardness of monolithic ceramics at room temperature*

ISO 17561, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for elastic moduli of monolithic ceramics at room temperature by sonic resonance*

ISO 21920-2, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 2: Terms, definitions and surface texture parameters*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### fracture resistance

measure of resistance of extension of a crack introduced by an indenter

### 3.2

#### fracture resistance value

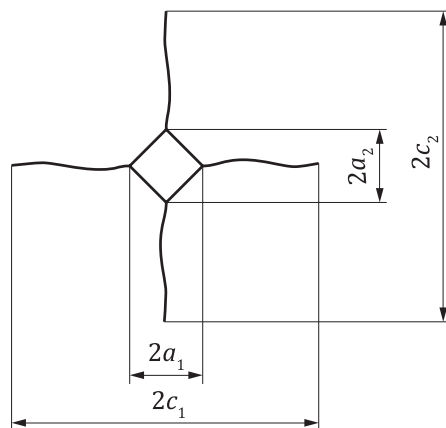
$K_{I,IFR}$

value of crack-extension resistance as measured by the indentation fracture (IF) method

Note 1 to entry: The indentation fracture resistance,  $K_{I,IFR}$ , as used here is not to be equated to fast fracture toughness  $K_{Ic}$ .  $K_{I,IFR}$  is an estimate of a material's resistance to cracking as introduced by an indenter.  $K_{Ic}$  is considered to be an intrinsic property of a material and is independent of the test method.

## 4 Principle

This document is for material development, material comparison, quality assurance, characterization and reliability data generation of dense monolithic ceramics. The method determines the indentation fracture resistance value,  $K_{I,IFR}$ , from the elastic modulus and indentation force by forcing a Vickers indenter (diamond pyramid) into the surface of a test piece and measuring the lengths of both the diagonals and the associated cracks of the indentation that are left in the surface after removal of the indenter (see [Figure 1](#)). [4] The method is applicable to the half-penny-crack type but not to the Palmqvist type. The two types of crack profile can be estimated using the ratio of the crack length,  $2c$ , to the diagonal length,  $2a$ . If  $2c/2a$  is more than 2,5, the crack is half-penny type. But the critical  $2c/2a$  values can be smaller than 2,5 for some ceramics. In such cases, direct observation of crack morphology by the decoration technique or serial sectioning of the indented surface is also useful to differentiate the two crack profiles. The measurement of the crack length and the observation of the crack tips are performed separately in order to improve the accuracy. The crack length should not be measured in a single optical image because doing so inevitably limits the magnification that can be used. Travelling microscopy is a solution that allows both reading of the crack length and detection of the crack tips to be performed at high resolution, albeit separately. Both an objective lens of  $40\times$  or higher and a calibrated optical stage shall be employed to ensure reliability. Both international and domestic interlaboratory comparison study (round robin) projects on the advanced IF method are described in [Annex C](#) (see References [5] to [8]).



#### Key

$2a$  diagonal length of the indent

$2c$  diagonal length of the crack

**Figure 1 — Crack lengths and diagonal sizes of the Vickers indentation**