

---

---

**Metallic and other inorganic  
coatings — Measurement of Young's  
modulus of thermal barrier coatings  
by beam bending**

*Revêtements métalliques et autres revêtements inorganiques —  
Mesurage du module de Young des revêtements barrières thermiques  
par flexion de poutre*



This document is a preview generated by EBS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org

# Contents

	Page
Foreword .....	iv
Introduction .....	v
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	1
4 Principle .....	2
5 Apparatus for measuring Young's modulus .....	2
5.1 Testing machine .....	3
5.2 Four-point bending jig .....	3
5.3 Strain measuring equipment .....	4
6 Specimen .....	4
7 Measuring procedure .....	5
7.1 Specimen dimension .....	5
7.2 Force-strain diagram .....	5
8 Calculation of Young's modulus .....	8
9 Test report .....	9
Annex A (informative) Measurement method of Young's modulus of TBC specimen with significant porosity .....	11
Bibliography .....	14

## 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 documents 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)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 107, *Metallic and other inorganic coatings*.

## Introduction

Thermal barrier coatings are highly advanced material systems, generally applied to surfaces of hot-section components made of nickel or cobalt-based superalloys, such as combustors, blades, and vanes of power-generation gas turbines in thermal power plants and aero-engines operated at elevated temperatures.

The function of these coatings is to protect metallic components for extended periods at elevated temperatures by employing thermally insulating materials which can sustain an appreciable temperature difference between load bearing alloys and coating surfaces. These coatings permit the high-temperature operation by shielding these components, thereby extending their lives.

Although Young's modulus is an important property of thermal barrier coatings, the existing ISO standard only describes a method for measuring the Young's modulus of monolithic ceramics.

This International Standard specifies a method for measuring the Young's modulus of thermal barrier coatings that consist of multilayers formed on substrate by thermal spraying.

The measuring procedure of this International Standard is applicable for the measurement of the Young's modulus of various thermally sprayed coatings.



# Metallic and other inorganic coatings — Measurement of Young's modulus of thermal barrier coatings by beam bending

## 1 Scope

This International Standard specifies a method for measuring the in-plane Young's modulus, at room temperature, of thermal barrier coatings formed on substrates by thermal spraying.

## 2 Normative references

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

ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions, and surface texture parameters*

ISO 13385 (all parts), *Geometrical product specifications (GPS) — Dimensional measuring equipment*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 14188, *Metallic and other inorganic coatings — Test methods for measuring thermal cycle resistance and thermal shock resistance for thermal barrier coatings*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14188 and the following apply.

### 3.1

#### **thermal barrier coating**

#### **TBC**

two-layer coating consisting of a metallic bond coat (BC) and a ceramic top coat (TC), in order to reduce heat transfer from outside of the top coat through the coating to the substrate

Note 1 to entry: See [Figure 1](#).