SLOVENSKI STANDARD
SIST EN ISO 14577-1:2015

01-oktober-2015

Nadomešča:

SIST EN ISO 14577-1:2004

Kovinski materiali - Instrumentirano vtiskanje pri preskušanju trdote in drugih lastnosti materialov - 1. del: Preskusna metoda (ISO 14577-1:2015)

Metallic materials - Instrumented indentation test for hardness and materials parameters - Part 1: Test method (ISO 14577-1:2015)

Metallische Werkstoffe - Instrumentierte Eindringprüfung zur Bestimmung der Härte und anderer Werkstoffparameter - Teil 1: Prüfverfahren (ISO 14577-1:2015)

Matériaux métalliques - Essai de pénétration instrumenté pour la détermination de la dureté et de paramètres des matériaux - Partie 1: Méthode d'essai (ISO 14577-1:2015)

Ta slovenski standard je istoveten z: **EN ISO 14577-1:2015**

ICS:

77.040.10	Mehansko preskušanje kovin	Mechanical testing of metals

SIST EN ISO 14577-1:2015 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 14577-1

July 2015

ICS 77.040.10

Supersedes EN ISO 14577-1:2002

English Version

Metallic materials - Instrumented indentation test for hardness and materials parameters - Part 1: Test method (ISO 14577-1:2015)

Matériaux métalliques - Essai de pénétration instrumenté pour la détermination de la dureté et de paramètres des matériaux - Partie 1 : Méthode d'essai (ISO 14577-1:2015)

Metallische Werkstoffe - Instrumentierte Eindringprüfung zur Bestimmung der Härte und anderer Werkstoffparameter - Teil 1: Prüfverfahren (ISO 14577-1:2015)

This European Standard was approved by CEN on 16 April 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

European foreword

This document (EN ISO 14577-1:2015) has been prepared by Technical Committee ISO/TC 164 “Mechanical testing of metals” in collaboration with Technical Committee ECISS/TC 101 “Test methods for steel (other than chemical analysis)” the secretariat of which is held by AFNOR.

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 January 2016, and conflicting national standards shall be withdrawn at the latest by January 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 14577-1:2002.

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

Endorsement notice

The text of ISO 14577-1:2015 has been approved by CEN as EN ISO 14577-1:2015 without any modification.

INTERNATIONAL STANDARD

ISO 14577-1

Second edition
2015-07-15

Metallic materials — Instrumented indentation test for hardness and materials parameters —

Part 1: Test method

Matériaux métalliques — Essai de pénétration instrumenté pour la détermination de la dureté et de paramètres des matériaux — Partie 1: Méthode d'essai

Reference number
ISO 14577-1:2015(E)

COPYRIGHT PROTECTED DOCUMENT

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

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).

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).

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 3, *Hardness testing*.

This second edition cancels and replaces the first edition (ISO 14577-1:2002), which has been technically revised.

ISO 14577 consists of the following parts, under the general title *Metallic materials — Instrumented indentation test for hardness and materials parameters*:

— *Part 1: Test method*

— *Part 2: Verification and calibration of testing machines*

— *Part 3: Calibration of reference blocks*

— *Part 4: Test method for metallic and non-metallic coatings*

Introduction

Hardness has typically been defined as the resistance of a material to permanent penetration by another harder material. The results obtained when performing Rockwell, Vickers, and Brinell tests are determined after the test force has been removed. Therefore, the effect of elastic deformation under the indenter has been ignored.

ISO 14577 (all parts) has been prepared to enable the user to evaluate the indentation of materials by considering both the force and displacement during plastic and elastic deformation. By monitoring the complete cycle of increasing and removal of the test force, hardness values equivalent to traditional hardness values can be determined. More significantly, additional properties of the material, such as its indentation modulus and elasto-plastic hardness, can also be determined. All these values can be calculated without the need to measure the indent optically. Furthermore, by a variety of techniques, the instrumented indentation test allows to record hardness and modulus depth profiles within a, probably complex, indentation cycle.

ISO 14577 (all parts) has been written to allow a wide variety of post-test data analysis.

Metallic materials — Instrumented indentation test for hardness and materials parameters —

Part 1: Test method

1 Scope

This part of ISO 14577 specifies the method of instrumented indentation test for determination of hardness and other materials parameters for the following three ranges:

— macro range: 2 $N \leq F \leq 30$ kN;

— micro range: 2 $N > F$; $h > 0{,}2$ µm;

— nano range: $h \leq 0{,}2$ µm.

For the nano range, the mechanical deformation strongly depends on the real shape of indenter tip and the calculated material parameters are significantly influenced by the contact area function of the indenter used in the testing machine. Therefore, careful calibration of both instrument and indenter shape is required in order to achieve an acceptable reproducibility of the materials parameters determined with different machines.

The macro and micro ranges are distinguished by the test forces in relation to the indentation depth.

Attention is drawn to the fact that the micro range has an upper limit given by the test force (2 N) and a lower limit given by the indentation depth of 0,2 µm.

The determination of hardness and other material parameters is given in Annex A.

At high contact pressures, damage to the indenter is possible. For this reason in the macro range, hardmetal indenters are often used. For test pieces with very high hardness and modulus of elasticity, permanent indenter deformation can occur and can be detected using suitable reference materials. It is necessary that its influence on the test result be taken into account.

This test method can also be applied to thin metallic and non-metallic coatings and non-metallic materials. In this case, it is recommended that the specifications in the relevant standards be taken into account (see also 6.3 and ISO 14577-4).

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 14577-2:2015, *Metallic materials — Instrumented indentation test for hardness and materials parameters — Part 2: Verification and calibration of testing machines*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Symbols and designations

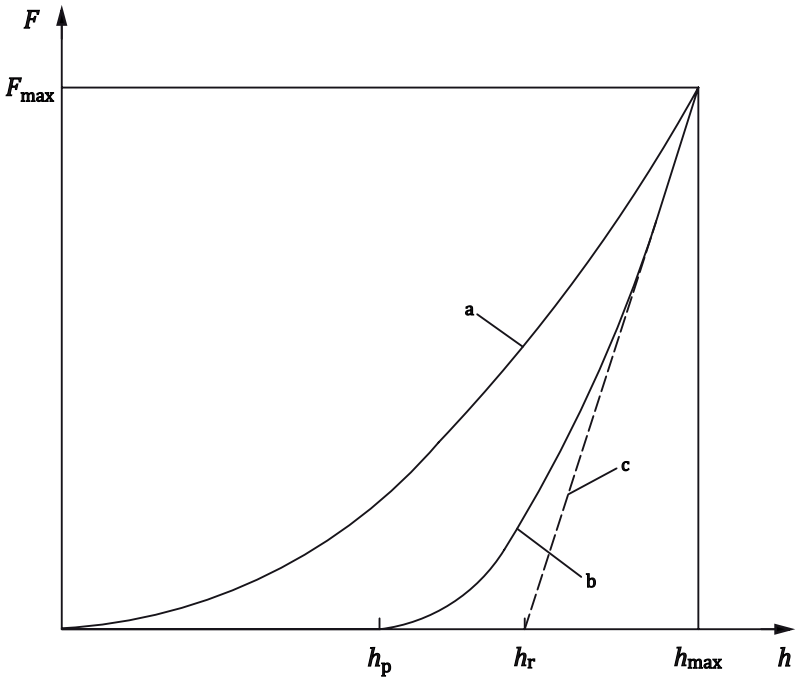
For the purposes of this document, the symbols and designations in Table 1 shall be applied (see also Figure 1 and Figure 2).

Table 1 — Symbols and designations

Symbol	Designation	Unit
A_p (h_c)	Projected area of contact of the indenter at distance h_c from the tip	mm²
A_s (h)	Surface area of the indenter at distance h from the tip	mm²
C_{IT}	Indentation creep	%
C_T	Total measured compliance of the contact (dh/dF tangent to the force removal curve at maximum test force)	nm/mN
C_F	Instrument compliance	nm/mN
C_S	Compliance of the contact after correction for machine compliance	nm/mN
E_{IT}	Indentation modulus of the test piece	GPa
E_r	Reduced plane strain modulus of the contact (combination of test piece and indenter plane strain moduli)	GPa
F	Test force	N
F_{max}	Maximum test force	N
h	Indentation depth under applied test force	mm
h_c	Depth of the contact of the indenter with the test piece at F_{max}	mm
h_{max}	Maximum indentation depth at F_{max}	mm
h_p	Permanent indentation depth after removal of the test force	mm
h_r	Point of intersection of the tangent c to curve b at F_{max} with the indentation depth-axis as identified on Figure 1	mm
H_{IT}	Indentation hardness	GPa
HM	Martens hardness	GPa
HM_s	Martens hardness, determined from the slope of the increasing force/indentation depth curve	GPa
HM_{diff}	Martens hardness, determined from the first derivative of h vs $\sqrt{F}$	GPa
ν_s	Poisson's ratio of the test piece	
r	Radius of spherical indenter	mm
R_{IT}	Indentation relaxation	%
W_{elast}	Elastic reverse deformation work of indentation	N·m
W_{total}	Total mechanical work of indentation	N·m
α	Cone semi-angle or angle of facet to the indentation axis for pyramidal indenters	°
θ	Maximum angle between the contact surface and the indenter for calculation of radial displacement	°
η_{IT}	Ratio W_{elast} / W_{total}	%

NOTE 1 To avoid very long numbers, the use of multiples or sub-multiples of the units is permitted.

NOTE 2 The continued use of the unit N/mm² is allowed. 1 MPa = 1 N/mm².



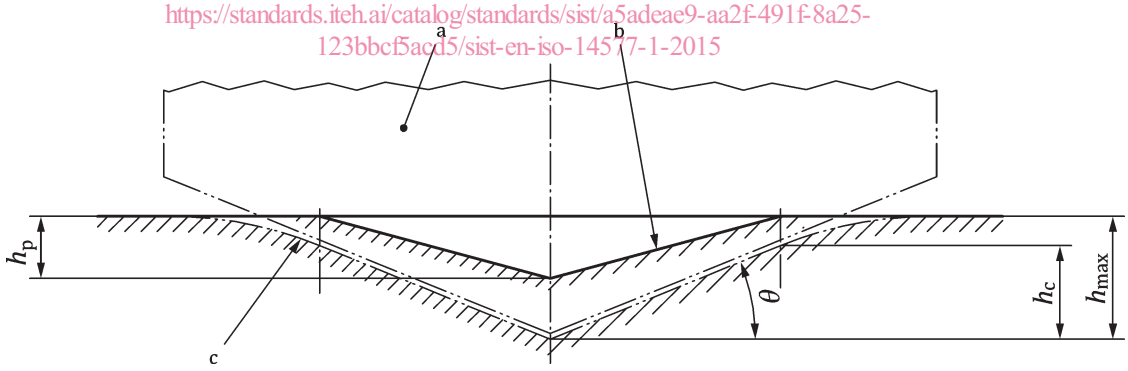
Key

a application of the test force

b removal of the test force

c tangent to curve b at F_{max}

Figure 1 — Schematic representation of the test procedure



Key

a indenter

b surface of residual plastic indentation in a test piece that has a “perfectly plastic” response

c surface of test piece at maximum indentation depth and test force

θ maximum angle between the test piece surface and the indenter

Figure 2 — Schematic representation of the cross section of indentation in the case of material “sink-in”