Metallic materials - Sheet and strip - Determination of biaxial stress-strain curve by means of bulge test with optical measuring systems
(ISO 16808:2014)

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 16808:2014 sisaldab Euroopa standardi EN ISO 16808:2014 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 16808:2014 consists of the English text of the European standard EN ISO 16808:2014.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 16.07.2014.	Date of Availability of the European standard is 16.07.2014.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

77.040.10

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 16808

July 2014

ICS 77.040.10

English Version

Metallic materials - Sheet and strip - Determination of biaxial stress-strain curve by means of bulge test with optical measuring systems (ISO 16808:2014)

Matériaux métalliques - Tôles et bandes - Détermination de la courbe contrainte-déformation biaxiale au moyen de l'essai de gonflement hydraulique avec systèmes de mesure optiques (ISO 16808:2014)

Metallische Werkstoffe - Bleche und Bänder - Bestimmung der biaxialen Spannung/Dehnung-Kurve durch einen hydraulischen Tiefungsversuch mit optischen Messsystemen (ISO 16808:2014)

This European Standard was approved by CEN on 4 July 2014.

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

Foreword

This document (EN ISO 16808:2014) 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 2015, and conflicting national standards shall be withdrawn at the latest by January 2015.

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.

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 16808:2014 has been approved by CEN as EN ISO 16808:2014 without any modification.

Contents

Page

Foreword ... **iv**
1 Scope ... **1**
2 Symbols and abbreviated terms ... **1**
3 Principle ... **2**
4 Test equipment ... **2**
5 Optical measurement system ... **6**
6 Test piece ... **6**
6.1 General ... 6
6.2 Application of grid ... 6
7 Procedure ... **7**
8 Evaluation methods for the determination of the curvature and strains at the pole ... **7**
9 Calculation of biaxial stress-strain curves ... **8**
10 Test report ... **9**
Annex A (informative) **International comparison of symbols used in the determination of the bulge test flow curve** ... **11**
Annex B (normative) **Test procedure for a quality check of the optical measurement system** ... **13**
Annex C (informative) **Computation of the curvature on the basis of a response surface** ... **16**
Annex D (informative) **Determination of the equi-biaxial stress point of the yield locus and the hardening curve** ... **18**
Bibliography ... **26**

Metallic materials — Sheet and strip — Determination of biaxial stress-strain curve by means of bulge test with optical measuring systems

1 Scope

This International Standard specifies a method for determination of the biaxial stress-strain curve of metallic sheets having a thickness below 3 mm in pure stretch forming without significant friction influence. In comparison with tensile test results, higher strain values can be achieved.

NOTE In this document, the term "biaxial stress-strain curve" is used for simplification. In principle, in the test the "biaxial true stress-true strain curve" is determined.

2 Symbols and abbreviated terms

The symbols and designations used are given in Table 1.

Table 1

Symbol	Designation	Unit
d_{die}	Diameter of the die (inner)	mm
d_{BH}	Diameter of the blank holder (inner)	mm
R_1	Radius of the die (inner)	mm
h	Height of the drawn blank (outer surface)	mm
t_0	Initial thickness of the sheet (blank)	mm
t	Actual thickness of the sheet	mm
p	Pressure in the chamber	MPa
rms	Standard deviation (root mean square)	-
ρ	Radius of curvature	mm
r_1	Surface radius for determining curvature	mm
r_2	Surface radius for determining strain	mm
r_{1_100}	Surface radius to determine curvature with a die diameter of 100 mm	mm
a_i , b_i	Coefficients for response surface	-
σ_B	Biaxial stress	MPa
e	Engineering strain	-
ε_1	Major true strain	-
ε_2	Minor true strain	-
ε_3	True thickness strain	-
ε_E	Equivalent true strain	-
l_s	Coordinate and length of a section	mm
dz	Displacement in the z-direction	mm
dz_{mv}	Displacement after movement correction	mm