SLOVENSKI STANDARD
SIST EN 10314:2016

01-september-2016

Nadomešča:
SIST EN 10314:2003

Metoda za izpeljavo najmanjših vrednosti napetosti tečenja jekel pri povišanih temperaturah

Method for the derivation of minimum values of proof strength of steel at elevated temperatures

Verfahren zur Ableitung von Mindestwerten der Dehngrenze von Stahl bei erhöhten Temperaturen

Méthode de dérivation des valeurs minimales de la limite conventionnelle d'élasticité des aciers à températures élevées

Ta slovenski standard je istoveten z: **EN 10314:2016**

ICS:

77.140.30 Jekla za uporabo pod tlakom Steels for pressure purposes

SIST EN 10314:2016 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 10314

June 2016

ICS 77.140.30

Supersedes EN 10314:2002

English Version

Method for the derivation of minimum values of proof strength of steel at elevated temperatures

Méthode de dérivation des valeurs minimales de la limite conventionnelle d'élasticité des aciers à températures élevées

Verfahren zur Ableitung von Mindestwerten der Dehngrenze von Stahl bei erhöhten Temperaturen

This European Standard was approved by CEN on 18 March 2016.

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

Ref. No. EN 10314:2016 E

Contents

Page

European foreword

This document (EN 10314:2016) has been prepared by Technical Committee ECISS/TC 107 “Steels for pressure purposes”, the secretariat of which is held by DIN.

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 December 2016, and conflicting national standards shall be withdrawn at the latest by December 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 10314:2002.

Regarding the most significant technical changes that have been made in this new edition of EN 10314, see Annex A.

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.

Introduction

Minimum values for tensile properties are specified in European Standards for steels and other metals for elevated temperature service. Such values are used to determine design strength values particularly where the materials are used in pressure systems.

Two International Standards, ISO 2605-1 and ISO 2605-2 (meanwhile withdrawn) were adopted by CEN as European Prestandards, ENV 22605-1 and ENV 22605-2. They set out procedures, based on statistical assessments of bodies of data, for the derivation and verification of minimum values of 0,2 % proof strength at elevated temperatures. These procedures determine the minimum values from lower confidence lines. A third International Standard, ISO 2605-3, adopted by CEN as ENV 22605-3, sets out procedures for determining minimum values from the average trend behaviour of the property of interest as a function of temperature.

One of the purposes of the procedures in ISO 2605-1 and ISO 2605-2 (ENV 22605-1 and ENV 22605-2) is to give an alternative to the requirement for elevated temperature tensile acceptance tests on individual products by organizations and manufacturers contributing data for assessment and as a result of this to reduce the test frequency.

Experience has shown that the procedures in ISO 2605-1 and ISO 2605-2 (ENV 22605-1 and ENV 22605-2) have limitations affecting the relationship between derived minimum property values and the minima of the test data arising from the statistical and some subjective decisions at various stages of the procedures. They also require relatively large amounts of data to produce an acceptable level of accuracy.

The procedure set out in ISO 2605-3 (ENV 22605-3) requires less data but because it is designed to always give conservative values from few data can give non-representative results. However, the principle of this procedure is considered to be more realistic and is adopted as the basis of this European Standard; the objective is to produce an assessment procedure for tensile property data which is simple to operate, gives representative results and is usable in computerized form.

This European Standard, which supersedes EN 10314:2002, which in turn superseded ENV 22605-1, −2 and −3, sets out a method for deriving minimum proof strength values for steels at elevated temperatures with the intention that such values are specified in relevant product standards.

This European Standard does not specify a frequency of testing for the product standards where EN 10314 is applied. Verification of tensile properties at elevated temperatures is normally specified in the relevant product standard using the minimum property values derived by the procedure established in this European Standard.

The method has been tested for proof strength values of steel. However, it is considered that the method can also be applied for the derivation of minimum values of tensile strength at elevated temperatures.

1 Scope

This European Standard specifies a method for deriving the minimum proof strength values for steels at elevated temperatures.

However, this European Standard does not specify a verification procedure.

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.

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1)*

EN ISO 6892-2, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature (ISO 6892-2)*

3 Terms and definitions

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

3.1
data set
property value data from room and elevated temperatures from the product selected for testing

Note 1 to entry: This data can include averaged values where more than one set of tests at a given temperature representing one location is carried out.

3.2
data group
property value data from 'X' data sets as used for each assessment

3.3
result set
ratio values for each data set

4 Symbols and abbreviations

For the purposes of this document, the following symbols apply.

— t elevated temperature in °C;

— $f_{(t)}$ ratio value; property value at elevated temperature t (in °C) divided by property value at room temperature;

— $f_{av(t)}$ the $f_{(t)}$- value resulting from the trend curve for a specified temperature;

— R_e yield strength (in MPa[1)]);

— R_p proof strength (in MPa[1)]);

1) 1 MPa = 1 N/mm^2.

— $R_{p(t)}/R_{p(20)}$ ratio value; proof strength at elevated temperature t divided by proof strength value at room temperature (20 °C);

— s_r residual scatter.

5 Method

5.1 Input data groups

5.1.1 For a given steel grade, input data, to form a data group, shall be established by tensile tests at:

a) room temperature in accordance with EN ISO 6892-1;

b) elevated temperature in accordance with EN ISO 6892-2.

5.1.2 The data shall be identified by reference to a product standard and a steel grade (steel name and/or steel number as appropriate).

Where input data predates the publication of the European Standards detailed in 5.1.1 a) and 5.1.1 b) the sampling and tensile testing shall have been carried out in accordance with the relevant product standard.

5.1.3 Test pieces for tensile tests both at room and elevated temperatures shall be taken from the same product. The location of the test piece shall be in accordance with the relevant product standard. Test pieces shall be taken as close to each other as possible.

5.1.4 Input data shall clearly identify the test method used and all data within each set (see definitions) shall have been determined by the same method.

5.2 Ratio values

Property values resulting from the tensile tests at elevated temperature in accordance with 5.1 are normalized by expressing each value as a ratio $f_{(t)}$ of the equivalent property value at room temperature obtained in accordance with Subclause 5.1:

$$f_{(t)} = \frac{property\ value\ at\ elevated\ temperature\ in\ °C}{property\ value\ at\ room\ temerature\ in\ °C}$$

The ratio values $f_{(t)}$ obtained for each data set constitute a result set. Each result set is plotted as a function of temperature and the value $f_{av(t)}$ at each temperature is determined from a trend curve which passes through a ratio value of 1,0 at room temperature, see Figure 1. The trend curve should be determined by a recognized procedure, normally a polynomial curve with degree 1-4, using a recognized statistical procedure such as a “least squares” technique.

Before fitting the trend curve the data shall be examined to determine whether it forms more than one population; where that is the case the data shall be examined in detail with respect to its pedigree (see 6.2) and where deemed necessary treated separately (see also 6.1 and 6.3).

5.3 Minimum proof strength values

From the trend curve established and average ratio values $f_{av(t)}$ derived in accordance with 5.2, the minimum proof strength values $R_{p(t)min}$ (where appropriate R_e may be used instead of R_p) are determined by alternative application of one of the following procedures, depending on the lowest value of $f_{av(t)}$ achieved over the temperature range for which minimum proof strength values are required:

a) When $f_{av(t)} \geq 0,4$ within the range of temperature values of interest:

$$R_{p(t)min} = R_{p(20)min}\left(1,1\,f_{av(t)} - 0,1\right)$$

NOTE 1 In deriving the formula a linear relationship has been anticipated between $R_{p(t)}$ and $R_{p(20)}$ at a given temperature t where the average ratio value $f_{av(t)}$ is the slope of the regression line which passes through the zero point, and where the standard deviation of the residual scatter s_r is set equal to 0,05 $R_{p(20)min}$.

For the purpose of this standard the specified minimum proof strength value $R_p(t)min$ at a given temperature t is defined as the proof strength value derived from the lower (– 2s) confidence level value for proof strength at a room temperature which is 0,1 $R_{p(20)min}$ higher than the specified minimum proof strength value at room temperature.

In terms of probability the minimum proof strength value $R_{p(t)min}$ approximately represents the value of $R_{p(t)}$ on the – 2s confidence level of a virtual data set the lowest room temperature proof strength value of which is equal to $R_{p(20)min}$.

b) When $f_{av(t)} < 0,4$ within the range of temperature values of interest:

1) for 20 °C ≤ t < 250 °C

$$R_{p(t)min} = R_{p(20)min}\left[f_{av(t)} - \frac{0,05\left(t-20\right)}{230}\right]$$

2) for $t \geq 250$ °C

$$R_{p(t)min} = R_{p(20)min} \cdot \left(f_{av(t)} - 0,05\right)$$

NOTE 2 At those temperatures where $f_{av(t)} \geq 0,4$, method 5.3 b) would provide lower $R_{p(t)}$ values than method 5.3 a).

5.4 Minimum yield strength values

If only minimum yield strength values at room temperature are defined, and minimum proof strength values at higher temperatures should be derived, the formulae in Subclause 5.3 apply under condition that $R_{p(20)min}$ shall be replaced by $R_{e(20)min.}$ In this case, $f_{(t)}$ shall be obtained from measured values of proof strength at elevated temperature and yield strength at room temperature. As proof strength values are lower than yield strength values at room temperature, special care is needed to establish the trend curve at lower temperatures (≤ 200 °C) and mixing of yield and proof strength values at room temperature should be avoided.

6 Application of the method

6.1 Representative data groups

The method in accordance with Clause 5 shall be applied separately for each data group supplied for assessment representing groups of material specified in product standards on the basis of:

— steel grade;

— product form;

— heat treatment temperature range(s);