SLOVENSKI STANDARD
oSIST prEN 10373:2020

01-februar-2020

Ugotavljanje fizikalnih in mehanskih lastnosti jekel z uporabo modelov

Determination of the physical and mechanical properties of steels using models

Berechnungsmodell für die Datenbereitstellung von physikalischen und mechanischen Eigenschaften für Stähle

Détermination des propriétés physiques et mécaniques des aciers à l'aide de modèles

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Ta slovenski standard je istoveten z: **prEN 10373**

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ICS:

77.080.20 Jekla Steels

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2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

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Determination of the physical and mechanical properties of steels using models

Détermination des propriétés physiques et mécaniques des aciers à l'aide de modèles

Berechnungsmodell für die Datenbereitstellung von physikalischen und mechanischen Eigenschaften für Stähle

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 459/SC 12.

If this draft becomes a European Standard, 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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 10373:2019) has been prepared by Technical Committee CEN/TC 459 SC 12 “General issues”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

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Introduction

[Cited from proposals of CEN TC 459/SC 3/WG 2]

Since the physical and mechanical properties of steels are ultimately based upon the metallurgical transformations during the production process, there have been numerous efforts of the manufacturers in the past, to design models for providing property data for the whole product, in order to improve the control of the increasingly complex processes during the manufacturing of steel products.

In doing so, the use of models not only helps to reduce the amount of testing in the scope of factory production control, but it gives a more representative overview of the material properties of steels, since models can use all available data, determined during the production process, whereas conventional material testing represents in principle a spot check of the material properties at the time of sampling and at the place where the samples were taken.

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1 Scope

This document specifies the method for the verification of models for the determination of the property data of steels and the validation of the modelling process. It is applicable where modelling of mechanical or physical properties is used to substitute conventional testing for specific inspection. Models can be based on statistical data, thermo-physical data or indirect measurement (e.g. measurement of magnetic or ultrasonic data), or a combination of these methods.

This document applies only for providing the properties of rolled and/or heat-treated products such as plates, sheets, strip, sections and bars.

This document is used to demonstrate the ability of the model to supply property data which is equivalent to data, measured by conventional testing.

Any self-learning system is excluded from the scope.

NOTE A self-learning model is a model which changes its internal parameters by itself.

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.

EN 10021, *General technical delivery conditions for steel products*

EN 10204, *Metallic products - Types of inspection documents*

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NOTE At the time of the first release of this standard, there have been no normative references to statistical analyses of manufacturing processes and/or statistical methods, applicable for this standard. The bibliography contains references to technical literature, which can be taken into account.

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3 Terms and definitions

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

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

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at http://www.electropedia.org/

3.1
model
documented system for the generation of output data using input data

Note 1 to entry: The model shall provide the same data set in output with the same data set as input.

Note 2 to entry: The model calculates physical and/or mechanical property data from input data, the results of which can also be determined by physical and/or mechanical testing.

3.2
input data
measurement data, or data which is related to those parts of a manufacturing process, which are relevant to the product properties to be calculated

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3.3
output data
physical and/or mechanical property data of a steel product according to the scope, which is generated by a model according to 3.1

3.4
manufacturing process
entirety of all process steps (including all time periods between them), that leads from a starting product (e.g. raw material, or a semi-finished product) to an end product

3.5
model verification
documented system of initial comparative testing and analysis procedures, carried out by the manufacturer, proving the ability of a model to replace conventional testing of product properties by output data

3.6
modelling process validation
validation of the process by which the applicability and accuracy of models for prediction of specified properties is confirmed by an independent, or a notified body

Note 1 to entry: The validation shall be done before it can be used for release of products.

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3.7
model monitoring
documented system of regular checks, using data analysis procedures of input and output data, part of the modelling process, as well as regular comparative testing, to ensure the accuracy and reliability of modelled product properties

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3.8
application range
range of steel products, chemical composition, manufacturing conditions and all additional conditions affecting the model accuracy for which the model has been verified

4 Requirements on the application of models

4.1 General

Models can be based on direct measurement data (thermo-physical data), indirect measurement data (e.g. measurement of magnetic or ultrasonic data), statistical data generated from indirect and/or direct measurement data, or a combination of these methods.

The output data, determined by models, shall be equivalent to the results of conventional testing, within the limits of allowable gaps, distinctively specified for each physical and mechanical property.

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4.2 Application range

4.2.1 General

Models for determination of property data are intended to be used for quality control in the production process of steel products with specified physical properties, which are documented in standards or other specifications and which can be alternatively determined by physical testing.

The application range of the model shall be described and documented in reference to the steel products, in terms of chemical composition and manufacturing conditions and all additional conditions, that have an influence on the model accuracy, and for which the model has been verified.

4.2.2 Conditions for the application of models

The following restrictions shall apply to models:

a) Manufacturing processes shall run under control of a quality management system and shall produce input data, representative for the products and in an sufficient amount to apply appropriate documented statistical methods in the scope of the control and monitoring of models according to Clause 6 (e.g. large scale production).

NOTE Quality management systems in accordance with EN ISO 9001, or comparable systems, meet this requirement.

b) The application range of a model shall be explicitly defined and documented with respect to the considered products.

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c) The model outputs shall only be used for product release if the model is used within the application range.

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d) Determination of physical and/or mechanical properties by a model shall be in accordance to the requirements of a written specification (e.g. national, or international standards, or other appropriate technical documentation).

e) Only input data, which can be related explicitly to the test unit according to the inspection type, according to EN 10204 shall be used.

f) The modelling process shall have been validated by an independent or notified body before any initial application of any model according to Clause 5 of this document.

4.2.3 Conditions for extension of the application range of models

Extension can only be considered if the model itself, including any internal parameter, does not change.

Any extension of the application range which requires modification of the model or its internal parameters shall be treated as a new model.

In case of the extension of the application range of a model for the determination of physical and mechanical properties of steels, it shall be ensured, that:

a) The extension of the application range of a model is explicitly defined and documented in terms given in 4.2.2.

b) The application of the extended model is in accordance with the conditions of 4.2.2.

c) The validation according to Clause 5 of this document has been repeated for the extended application range of the model, prior to its regular use (e.g. for the manufacturers factory production control).

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4.3 Requirements on input data

4.3.1 General

For all measured input data, indispensable for the application of a model, the measurement methods shall be in accordance with accepted national, or international standards or written internal documentation.

4.3.2 Measurement facilities

All measurement facilities shall be uniquely identified and documented in respect to their positions in the manufacturing process, or parts thereof.

The unit of measurement, the accuracy and the range of valid results for each measured input shall be specified by the manufacturer.

4.3.3 Measurement methods

For the measurement of input data, appropriate direct, or indirect measurement methods shall be applied. The fundamentals of metrology, as well as the requirements for the analysis of measured parameters and of measurement uncertainties, shall be given by appropriate national, or international standards. When non-standardized metrology methods are used, these shall be described in the quality management system documentation of the manufacturer.

The choice of suitable measurement methods is at the discretion of the manufacturer and shall fulfil the rules of the quality management system.

4.4 Requirements on output data

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The output data determined by the model shall be the calculated physical and/or mechanical property values, according to the requirements, defined in the agreed specification. The unit of measurement, the accuracy and the range of valid results for each output parameter shall be specified by the manufacturer. They shall be in the scope of the application range of the model.

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NOTE Physical and/or mechanical property data are for example proof strength, tensile strength and elongation, as defined in the respective technical standard product specification, agreed at time of enquiry and order.

5 Requirements on model verification and application

5.1 General

The manufacturer is responsible for the accuracy and reliability of the modelled output data. For this purpose, he shall take the necessary actions, to determine the accuracy of the model, to define the allowable gaps and to prove by means of appropriate comparative conventional testing, that the required confidence level is met for the whole application area of the model.

To be an applicable method for the determination of physical and mechanical properties, a model shall be verified by the manufacturer. Before the initial application of any model the modelling process shall be validated by an independent or notified person agreed with the manufacturer. The validation of the modelling process should take place once a year. During this validation, the independent or notified body should have the possibility to check models in the same way the manufacturer does during the verification process.

A flowchart for the model verification is given in Figure 1. The elements of the modelling process validation are discussed in 5.3.

The extent of tasks of the manufacturer and the independent body in the scope of model verification and modelling process validation are specified in Table 1.