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SWEDISH STANDARDS INSTITUTE

Oorganiska ytbeläggningar – Icke-ledande beläggningar på omagnetisk basmetall – Bestämning av skikttjocklek – Amplitudkänslig virvelströmsmetod (ISO 2360:2017)

Non-conductive coatings on non-magnetic electrically conductive base metals – Measurement of coating thickness – Amplitude-sensitive eddy-current method (ISO 2360:2017)

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Europastandarden EN ISO 2360:2017 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 2360:2017.

Denna standard ersätter SS-EN ISO 2360, utgåva 2.

The European Standard EN ISO 2360:2017 has the status of a Swedish Standard. This document contains the official version of EN ISO 2360:2017.

This standard supersedes the Swedish Standard SS-EN ISO 2360, edition 2.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.

Denna standard är framtagen av kommittén för Oorganiska ytbeläggningar, SIS/TK 116.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 2360

August 2017

ICS 25.220.20

Supersedes EN ISO 2360:2003

English Version

Non-conductive coatings on non-magnetic electrically conductive base metals - Measurement of coating thickness - Amplitude-sensitive eddy-current method (ISO 2360:2017)

Revêtements non conducteurs sur matériaux de base non magnétiques conducteurs de l'électricité - Mesurage de l'épaisseur de revêtement - Méthode par courants de Foucault sensible aux variations d'amplitude (ISO 2360:2017)

Nichtleitende Überzüge auf nichtmagnetischen metallischen Grundwerkstoffen - Messen der Schichtdicke - Wirbelstromverfahren (ISO 2360:2017)

This European Standard was approved by CEN on 8 July 2017.

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.

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

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

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European foreword

This document (EN ISO 2360:2017) has been prepared by Technical Committee ISO/TC 107 “Metallic and other inorganic coatings” in collaboration with Technical Committee CEN/TC 262 “Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys” the secretariat of which is held by BSI.

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 February 2018, and conflicting national standards shall be withdrawn at the latest by February 2018.

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

This document supersedes EN ISO 2360:2003.

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 2360:2017 has been approved by CEN as EN ISO 2360:2017 without any modification.

Non-conductive coatings on non-magnetic electrically conductive base metals — Measurement of coating thickness — Amplitude-sensitive eddy-current method

1 Scope

This document specifies a method for non-destructive measurements of the thickness of non-conductive coatings on non-magnetic electrically conductive base metals, using amplitude-sensitive eddy-current instruments.

In this document, the term "coating" is used for materials such as, for example, paints and varnishes, electroplated coatings, enamel coatings, plastic coatings, claddings and powder coatings. This method is particularly applicable to measurements of the thickness of most oxide coatings produced by anodizing, but is not applicable to all conversion coatings, some of which are too thin to be measured by this method (see Clause 6).

This method can also be used to measure non-magnetic metallic coatings on non-conductive base materials. However, the phase-sensitive eddy-current method specified in ISO 21968 is particularly usable to this application and can provide thickness results with a higher accuracy (see Annex A).

This method is not applicable to measure non-magnetic metallic coatings on conductive base metals. The phase-sensitive eddy-current method specified in ISO 21968 is particularly useful for this application. However, in the special case of very thin coatings with a very small conductivity, the amplitude-sensitive eddy-current method can also be used for this application (see Annex A).

Although the method can be used for measurements of the thickness of coatings on magnetic base metals, its use for this application is not recommended. In such cases, the magnetic method specified in ISO 2178 can be used. Only in case of very thick coatings above approximately 1 mm, the amplitude-sensitive eddy-current method can also be used for this application (see Annex A).

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.

ISO 2064, *Metallic and other inorganic coatings — Definitions and conventions concerning the measurement of thickness*

ISO 4618, *Paints and varnishes — Terms and definitions*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064 and ISO 4618 and the following apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
adjustment of a measuring system
set of operations carried out on a measuring system so that it provides prescribed indications corresponding to given values of a quantity to be measured

Note 1 to entry: Adjustment of a measuring system can include zero adjustment, offset adjustment, and span adjustment (sometimes called gain adjustment).

Note 2 to entry: Adjustment of a measuring system should not be confused with calibration, which is a prerequisite for adjustment.

Note 3 to entry: After an adjustment of a measuring system, the measuring system must usually be recalibrated.

Note 4 to entry: Colloquially, the term "calibration" is frequently, but falsely, used instead of the term "adjustment". In the same way, the terms "verification" and "checking" are often used instead of the correct term "calibration".

[SOURCE: ISO/IEC Guide 99:2007, 3.11 (also known as "VIM")]

3.2
calibration
operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication

Note 1 to entry: A calibration may be expressed by a statement, calibration function, calibration diagram, calibration curve, or calibration table. In some cases, it may consist of an additive or multiplicative correction of the indication with associated measurement uncertainty.

Note 2 to entry: Calibration should not be confused with adjustment of a measuring system, often mistakenly called "self-calibration", nor with verification of calibration.

Note 3 to entry: Often, the first step alone in the above definition is perceived as being calibration.

[SOURCE: ISO/IEC Guide 99:2007, 2.39 (also known as "VIM")]

4 Principle of measurement

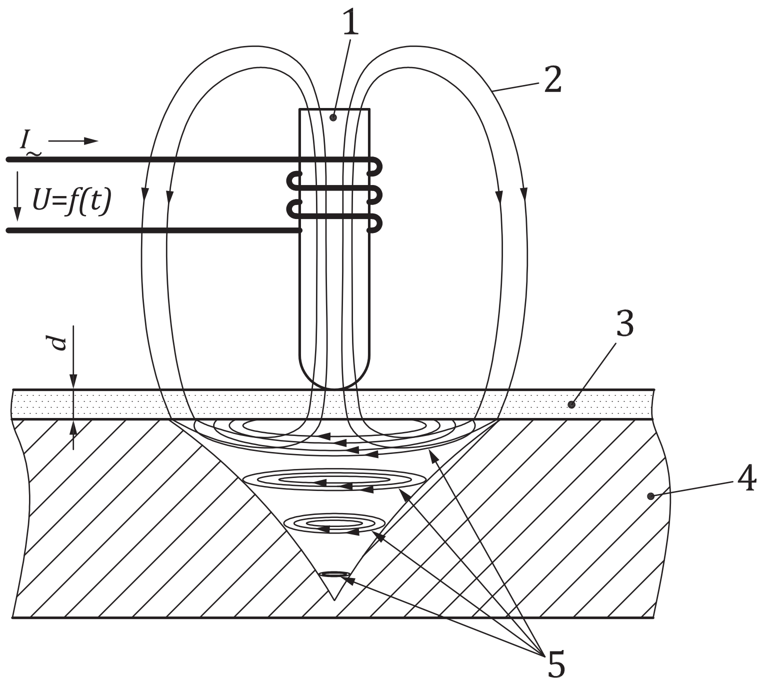
Eddy-current instruments work on the principle that a high frequency electromagnetic field generated by the probe system of the instrument will produce eddy-currents in the base metal beneath the coating on which the probe is placed (see Figure 1). These induced currents cause a change of the electromagnetic field surrounding the probe coil and therefore result in a change of the amplitude of the probe coil impedance. The induced eddy-current density is a function of the distance between the generating coil and the base metal surface. Consequently, this impedance change can be used as a measure of the thickness of the coating on the conductor by means of a calibration with reference standards (see also Annex A).

In order to measure a change of the coil impedance amplitude, the test coil is usually part of an oscillator circuit with a resonant frequency determined by the coil inductance and resistance. A change of the coil impedance amplitude results in a shift of the resonant frequency. Consequently, the measured resonant frequency is a measure of the coating thickness. The values are either pre-processed by digital means or are directly displayed on a usefully scaled gauge.

The probe and measuring system/display may be integrated into a single instrument.

NOTE 1 Annex C describes the basic performance requirements of the equipment.

NOTE 2 Factors affecting measurement accuracy are discussed in Clause 5.



Key

1	ferrite core of the probe	5	induced eddy-current
2	high frequency electromagnetic field	$I_{\sim}$	exciting current
3	non-conductive coating	t	coating thickness
4	base metal	$U = f(t)$	measurement signal

Figure 1 — Amplitude-sensitive eddy-current method

5 Factors affecting measurement uncertainty

5.1 Basic influence of the coating thickness

The sensitivity of a probe, i.e. the measurement effect, decreases with increasing thickness within the measurement range of the probe. In the lower measurement range, this measurement uncertainty (in absolute terms) is constant, independent of the coating thickness. The absolute value of this uncertainty depends on the properties of the probe system and the sample materials, e.g. the homogeneity of the base metal conductivity, the base metal roughness and the sample surface roughness. In the upper measurement range, the uncertainty becomes approximately a constant fraction of the coating thickness.

5.2 Electrical properties of the base metal

The conductivity of the base metal determines the induced eddy-current density for a given probe system and frequency. Consequently, the base metal conductivity causes the measurement effect for this method. The relationship between coating thickness and the measured value depends strongly on the conductivity of the base metal. Consequently, calibration procedures and measurements shall be made on the same material. Different materials with different conductivities as well as local fluctuations of the conductivity or variations between different samples can cause (more or less) errors in the thickness reading.

NOTE There are instruments and probes available that are capable of automatically compensating the base metal conductivity influence thus avoiding the resulting thickness error.