This is a free page sample. Access the full version online.

NSAI Standards

Irish Standard
I.S. EN ISO 2178:2016

# Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method (ISO 2178:2016)

© CEN 2016 No copying without NSAI permission except as permitted by copyright law.

This is a free page sample. Access the full version online.

**I.S. EN ISO 2178:2016**

*Incorporating amendments/corrigenda/National Annexes issued since publication:*

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

*This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):*

*NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.*

| *This document is based on:* | *Published:* |
|---|---|
| EN ISO 2178:2016 | 2016-04-06 |

| *This document was published* under the authority of the NSAI and comes into effect on: | ICS number: |
|---|---|
| 2016-04-24 | 25.220.40<br>25.220.50<br><br>NOTE: If blank see CEN/CENELEC cover page |


| | | |
|---|---|---|
| NSAI | T +353 1 807 3800 | Sales: |
| 1 Swift Square, | F +353 1 807 3838 | T +353 1 857 6730 |
| Northwood, Santry | E standards@nsai.ie | F +353 1 857 6729 |
| Dublin 9 | W NSAI.ie | W standards.ie |

Údarás um Chaighdeáin Náisiúnta na hÉireann

This is a free page sample. Access the full version online.

## National Foreword

I.S. EN ISO 2178:2016 is the adopted Irish version of the European Document EN ISO 2178:2016, Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method (ISO 2178:2016)

This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with this document does not of itself confer immunity from legal obligations.**

*In line with international standards practice the decimal point is shown as a comma (,) throughout this document.*

This is a free page sample. Access the full version online.

This page is intentionally left blank

This is a free page sample. Access the full version online.


EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN ISO 2178

April 2016

ICS 25.220.40; 25.220.50

Supersedes EN ISO 2178:1995

English Version

# Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method (ISO 2178:2016)

Revêtements métalliques non magnétiques sur métal de base magnétique - Mesurage de l'epaisseur du revêtement - Méthode magnétique (ISO 2178:2016)

Nichtmagnetische Überzüge auf magnetischen Grundmetallen - Messen der Schichtdicke - Magnetverfahren (ISO 2178:2016)

This European Standard was approved by CEN on 27 February 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**

© 2016 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN ISO 2178:2016 E

This is a free page sample. Access the full version online.


# Contents

Page

**European foreword** ..... **3**

This is a free page sample. Access the full version online.


# European foreword

This document (EN ISO 2178:2016) 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” 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 October 2016, and conflicting national standards shall be withdrawn at the latest by October 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 2178:1995.

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 2178:2016 has been approved by CEN as EN ISO 2178:2016 without any modification

This is a free page sample. Access the full version online.

This page is intentionally left blank

This is a free page sample. Access the full version online.


# INTERNATIONAL STANDARD

# ISO 2178

Third edition
2016-03-15

# Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method

*Revêtement métalliques non magnétiques sur métal de base magnétique — Mesurage de l'epaisseur du revêtement — Méthode maguétique*

Reference number
ISO 2178:2016(E)

© ISO 2016

This is a free page sample. Access the full version online.


**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

This is a free page sample. Access the full version online.


# Contents

Page

**Foreword** ..... **v**

**1 Scope** ..... **1**

**2 Normative references** ..... **1**

**3 Terms and definitions** ..... **1**

**4 Principle of measurement** ..... **2**
4.1 Basic principle of all magnetic measurement methods ..... 2
4.2 Magnetic pull-off method ..... 2
4.3 Magnetic inductive principle ..... 3
4.4 Magnetic flux gauge ..... 5

**5 Factors affecting measurement accuracy** ..... **6**
5.1 Basic influence of the coating thickness ..... 6
5.2 Magnetic properties of the base metal ..... 6
5.3 Electrical properties of the coating materials ..... 7
5.4 Geometry: base metal thickness ..... 7
5.5 Edge effect ..... 7
5.6 Geometry: surface curvature ..... 7
5.7 Surface roughness ..... 8
5.8 Cleanliness: lift-off effect ..... 8
5.9 Probe pressure ..... 8
5.10 Probe tilt ..... 8
5.11 Temperature effects ..... 9
5.12 External electromagnetic fields ..... 9

**6 Calibration and adjustment of the instrument** ..... **9**
6.1 General ..... 9
6.2 Thickness reference standards ..... 9
6.3 Methods of adjustment ..... 10

**7 Measurement procedure and evaluation** ..... **10**
7.1 General ..... 10
7.2 Number of measurements and evaluation ..... 11

**8 Uncertainty of the results** ..... **11**
8.1 General remarks ..... 11
8.2 Uncertainty of the calibration of the instrument ..... 12
8.3 Stochastic errors ..... 13
8.4 Uncertainties caused by factors summarized in Clause 5 ..... 13
8.5 Combined uncertainty, expanded uncertainty and final result ..... 14

**9 Precision** ..... **14**
9.1 General ..... 14
9.2 Repeatability ($r$) ..... 14
9.3 Reproducibility limit ($R$) ..... 15

**10 Test report** ..... **15**

**Annex A** (informative) **Basic principle of all measurement methods** ..... **17**

**Annex B** (informative) **Basic performance requirements for coating thickness gauges which are based on the magnetic method described in this International Standard** ..... **19**

**Annex C** (informative) **Examples of experimental estimation of factors affecting the measurement** ..... **21**

**Annex D** (informative) **Example of uncertainty estimation (see Clause 8)** ..... **26**

**Annex E** (informative) **Basics of the determination of the uncertainty of a measurement of the used measurement method corresponding to ISO/IEC Guide 98-3** ..... **29**

© ISO 2016 – All rights reserved

This is a free page sample. Access the full version online.


**Annex F** (informative) **Table of the student factor** ..... **31**
**Annex G** (informative) **Details on precision** ..... **32**
**Bibliography** ..... **37**


© ISO 2016 – All rights reserved

This is a free page sample. Access the full version online.


# 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 107, *Metallic and other inorganic coatings.*

This third edition cancels and replaces the second edition (ISO 2178:1982), which has been technically revised.

© ISO 2016 – All rights reserved

This is a free page sample. Access the full version online.

This is a free page sample. Access the full version online.


# Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method

## 1 Scope

This International Standard specifies a method for non-destructive measurements of the thickness of non-magnetizable coatings on magnetizable base metals.

The measurements are tactile and non-destructive on typical coatings. The probe or an instrument with integrated probe is placed directly on the coating to be measured. The coating thickness is displayed on the instrument.

In this International Standard the term "coating" is used for material such as, for example, paints and varnishes, electroplated coatings, enamel coatings, plastic coatings, powder coatings, claddings.

NOTE This method can also be applied to the measurement of magnetizable coatings on non-magnetizable base metals or other materials (see ISO 2361).

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in 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 5725-1:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles 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.

**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 shall 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".

© ISO 2016 – All rights reserved

SAI GLOBAL

This is a free preview.  Purchase the entire publication at the link below:

Product Page

Looking for additional Standards? Visit Intertek Inform Infostore

Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation