

Fastställt	Utgåva	Sida
2001-01-12	2	1 (1+17)

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Metallic and non-metallic coatings – Measurement of thickness – Beta backscatter method (ISO 3543:2000)

The European Standard EN ISO 3543:2000 has the status of a Swedish Standard. This document contains the official English version of EN ISO 3543:2000.

This standard supersedes the Swedish standard SS-ISO 3543, edition 1.

Swedish Standards corresponding to documents referred to in this Standard are listed in "Catalogue of Swedish Standards", issued by SIS. The Catalogue lists, with reference number and year of Swedish approval, International and European Standards approved as Swedish Standards as well as other Swedish Standards.

Oorganiska ytbeläggningar – Mätning av skiktjocklek – Beta- återspridningsmetod (ISO 3543:2000)

Europastandarden EN ISO 3543:2000 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 3543:2000.

Standarden ersätter SS-ISO 3543, utgåva 1.

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ICS 25.220.20; 25.220.40; 17.040.20; 25.220.99

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Tryckt i mars 2001

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 3543

December 2000

ICS 02.022.20

Supersedes EN ISO 3543:1994

English version

**Metallic and non-metallic coatings - Measurement of thickness -
Beta backscatter method (ISO 3543:2000)**

Revêtements métalliques et non métalliques - Mesurage de
l'épaisseur - Méthode par rétrodiffusion des rayons bêta
(ISO 3543:2000)

Metallische und andere anorganische Schichten -
Dickenmessung - Betarückstreu-Verfahren (ISO
3543:2000)

This European Standard was approved by CEN on 15 December 2000.

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 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 Management Centre has the same status as the official versions.

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Contents

	Page
Foreword	3
1 Scope	4
2 Terms and definitions	4
3 Principle	7
4 Apparatus	9
5 Factors relating to measurement uncertainty	9
6 Calibration of instruments	12
7 Measuring procedure	13
8 Measurement uncertainty	14
9 Test report	14
Annex A (informative) General information	16

Foreword

The text of the International Standard ISO 3543:2000 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 supersedes EN ISO 3543:1994.

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 June 2001, and conflicting national standards shall be withdrawn at the latest by June 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

NOTE FROM CMC: The foreword is susceptible to be amended on reception of the German language version. The confirmed or amended foreword, and when appropriate, the normative annex ZA for the references to international publications with their relevant European publications will be circulated with the German version.

Endorsement notice

The text of the International Standard ISO 3543:2000 was approved by CEN as a European Standard without any modification.

Metallic and non-metallic coatings — Measurement of thickness — Beta backscatter method

1 Scope

WARNING Beta backscatter instruments used for the measurement of coating thicknesses use a number of different radioactive sources. Although the activities of these sources are normally very low, they can present a hazard to health, if incorrectly handled. Therefore, reference should be made to current international and national standards, where these exist.

This International Standard specifies a method for the non-destructive measurement of coating thicknesses using beta backscatter gauges. It applies to both metallic and non-metallic coatings on both metallic and non-metallic substrates. To make use of this method, the atomic numbers or equivalent atomic numbers of the coating and the substrate need to differ by an appropriate amount.

NOTE Since the introduction of the X-ray fluorescence method (ISO 3497), the beta backscatter method has been used less and less for the measurement of coating thickness. However, because of its lower cost, it is still a very useful method of measurement for many applications. In addition it has a wider measuring range.

2 Terms and definitions

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

2.1
radioactive decay
spontaneous nuclear transformation in which particles or gamma radiation are emitted or X-radiation is emitted following orbital electron capture, or the nucleus undergoes spontaneous fission

[ISO 921:1997, definition 972]

2.2
beta particle
electron or positron which has been emitted by an atomic nucleus or neutron in a nuclear transformation

[ISO 921:1997, definition 81]

2.3
beta-emitting isotope
beta-emitting source
beta emitter
material, the nuclei of which emit beta particles

NOTE 1 It is possible to classify beta emitters by the maximum energy level of the particles that they release during their disintegration.

NOTE 2 Table A.1 lists some isotopes used with beta backscatter gauges.

2.4**electron-volt**

unit of energy equal to the change in energy of an electron in passing through a potential difference of 1 V

NOTE 1 $1 \text{ eV} = 1,602\ 19 \times 10^{-19} \text{ J}$

[ISO 921:1997, definition 393]

NOTE 2 Since the electron-volt is too small for the energies encountered with beta particles, the mega-electron-volt (MeV) is commonly used.

2.5**activity****disintegration rate**

number of spontaneous nuclear disintegrations occurring in a given quantity of material during a suitably small interval of time divided by that interval of time

[ISO 921:1997, definition 23]

NOTE 1 In beta backscatter measurements a higher activity corresponds to a greater emission of beta particles.

NOTE 2 The SI unit of activity is the becquerel (Bq). The activity of a radioactive element used in beta backscatter gauges is generally expressed in microcuries (μCi) ($1 \mu\text{Ci} = 3,7 \times 10^4 \text{ Bq}$, which represents $3,7 \times 10^4$ disintegrations per second).

2.6**radioactive half-life**

time required for the activity to decrease to half its value by a single radioactive decay process

[ISO 921:1997, definition 975]

2.7**scattering**

process in which a change in direction or energy of an incident particle or incident radiation is caused by a collision with a particle or a system of particles

[ISO 921:1997, definition 1085]

2.8**backscatter**

scattering as a result of which a particle leaves a body of matter from the same surface at which it entered

NOTE Radiations other than beta rays are emitted or backscattered by a coating and substrate and some of these can be included in the backscatter measurement. In this International Standard the term "backscatter" is used to mean the total radiation measured.

2.9**backscatter coefficient (of a body)**

R

ratio of the number of particles backscattered to that entering the body

NOTE The value of R is independent of the activity of the isotope and of the measuring time.

**2.10
backscatter count**

**2.10.1
absolute backscatter count**

X
number of particles backscattered during a fixed interval of time, and received by a detector

NOTE X depends on the activity of the isotope, the measuring time, the geometric configuration of the measuring system and the properties of the detector. The count produced by the uncoated substrate is generally designated by X_o , and that of the coating material by X_s . To obtain these values, both these materials have to be available with a thickness greater than the saturation thickness (see 2.13).

**2.10.2
normalized backscatter count**

X_n
quantity that is independent of the activity of the isotope, the measuring time and the properties of the detector and defined by the equation:

$$X_n = \frac{X - X_o}{X_s - X_o}$$

where

X_o is the absolute backscatter count of the saturation thickness of the substrate material;

X_s is the absolute backscatter count of the saturation thickness of the coating material;

X is the absolute backscatter count of the coated specimen;

each of these counts being taken over the same interval of time

NOTE 1 The value of X_n is valid between 0 and 1.

NOTE 2 For simplicity, it is often advantageous to express the normalized backscatter count as a percentage by multiplying X_n by 100.

**2.11
normalized backscatter curve**

curve obtained by plotting the coating thickness as a function of X_n

**2.12
equivalent (apparent) atomic number**

for a material, which can be an alloy or a compound, the atomic number of an element that has the same backscatter coefficient R as the material

**2.13
saturation thickness**

minimum thickness of a material that, if exceeded, does not produce a change in backscatter

NOTE Figure A.1 shows saturation thickness, s , plotted as a function of density for different isotopes.