INTERNATIONAL STANDARD

ISO 22553-7

First edition
2020-05

Paints and varnishes — Electrodeposition coatings —

Part 7: Electrical wet-film resistance

Peintures et vernis — Peintures d'électrodéposition —

Partie 7: Résistance électrique du film frais

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ISO 22553-7:2020
https://standards.iteh.ai/catalog/standards/sist/532989b4-4b89-4eb5-8551-73838f9b5a96/iso-22553-7-2020

Reference number
ISO 22553-7:2020(E)

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CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

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Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The electrical wet-film resistivity provides information about the deposition behaviour of electro-deposition coatings, i.e. about film thickness and changes in film thickness, throwing power and possibly also the deposition performance under defined conditions.

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Paints and varnishes — Electro-deposition coatings —

Part 7:
Electrical wet-film resistance

1 Scope

This document specifies a method for determining the wet-film resistivity of an electro-deposition coating (e-coat) for automotive industries and other general industrial applications, e.g. chiller units, consumer products, radiators, aerospace, agriculture.

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 1514, *Paints and varnishes — Standard panels for testing*

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

ISO 22553-1, *Paints and varnishes — Electro-deposition coatings — Part 1: Vocabulary*

ISO 23321, *Solvents for paints and varnishes — Demineralized water for industrial applications — Specification and test methods*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618, ISO 22553-1 and the following 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
electrical resistance
R
ratio of the potential difference along a conductor and the current through the conductor

Note 1 to entry: Resistance is given by Ohm's law shown in Formula (1):

$$R=\frac{U}{I} \tag{1}$$

where

U is the potential difference;

I is the current.

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The unit of electrical resistance is the ohm (Ω), given by:

$$1\,\text{ohm} = \frac{1\,\text{volt}}{1\,\text{ampere}}$$

The electrical resistance depends on the material of the conductor, its dimensions (length and cross-section) and its temperature.

[SOURCE: ISO 15091:2019, 3.1]

3.2
resistivity
ρ
resistance per unit length of a material of cross-sectional area

Note 1 to entry: Resistivity is given by Formula (2):

$$\rho = R \cdot \frac{A}{l} \tag{2}$$

where

A is the cross-sectional area of the conductor;

l is the length of the conductor.

The unit of electrical resistivity is the ohm · metre (Ω·m).

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[SOURCE: ISO 15091:2019, 3.2]

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3.3
electrical wet-film resistance
R_w
measured total *electrical resistance* (3.1) of the electro-deposition coating including substrate, pre-treatment and other coats

Note 1 to entry: When the electrical resistance is being measured, the technical measurement conditions also have an influence, e.g. membrane, measurement electrode.

Note 2 to entry: The unit of electrical wet-film resistance is the ohm (Ω).

3.4
dynamic electrical wet-film resistance
$R_{w,\,dyn}\,(t)$
measured total *electrical resistance* (3.1) of the electro-deposition coating including substrate, pre-treatment and other coats as a function of the deposition time

Note 1 to entry: The unit of *electrical wet-film resistance* (3.3) is the ohm (Ω).

3.5
static electrical wet-film resistance
$R_{w,\,sta}\,(t_{end})$
measured total *electrical resistance* (3.1) of the electro-deposition coating including substrate, pre-treatment and other coats as read off at the end of the deposition time

Note 1 to entry: The unit of *electrical wet-film resistance* (3.3) is the ohm (Ω).

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3.6
electrical wet-film resistivity
ρ_w
electrical wet-film resistance (3.3) multiplied by the area of the electrodes related to the distance between the electrodes

Note 1 to entry: Electrical wet-film resistivity is given by Formula (3):

$$\rho_w = R_w \cdot \frac{A}{l} \tag{3}$$

where

R_w is the electrical wet-film resistance;

A is the area of the electrodes;

l is the length of the conductor.

The unit of electrical wet-film resistivity is the ohm · metre (Ω·m).

3.7
electrical conductivity
γ
reciprocal of the *resistivity* (3.2)

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Note 1 to entry: Electrical conductivity is given by Formula (4):

$$\gamma = \frac{1}{\rho} = \frac{1}{R} \cdot \frac{1}{A} \tag{4}$$

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The unit of electrical conductivity is the siemens · metre^{-1} (S·m^{-1}).

[SOURCE: ISO 15091:2019, 3.4]

4 Principle

The test panel is entered into the deposition system and a constant current is set. The resulting voltage is read off at time intervals during the entire deposition time (method A). Alternatively, a constant voltage can be set and the resulting current can be read off at time intervals during the entire deposition time (method B). This data is used to calculate the electrical wet-film resistance, which differs depending on the method used. Both the dynamic and static electrical wet-film resistances can be measured with either method.

5 Apparatus and materials

Typical laboratory apparatus, together with the following:

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