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Paints and varnishes — Electro-deposition coatings —

Part 6: Entry marks

Peintures et vernis — Peintures d'électrodéposition —

Partie 6: Repères d'immersion

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Foreword

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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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

A list of all parts in the ISO 22553 series can be found on the ISO website.

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.

Paints and varnishes — Electro-deposition coatings —

Part 6:
Entry marks

1 Scope

This document specifies a method for identifying entry marks, which can occur during electro-deposition coating. Entry marks can often occur in the form of streaks when the workpiece, either set as cathode or anode, is immersed in the electro-deposition tank under applied electric potential (relation of voltage and current). These marks occur parallel to the bath surface on the objects to be coated.

It is applicable to electro-deposition coatings 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 2808, *Paints and varnishes — Determination of film thickness*

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*

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
breakaway voltage
electric potential, from which the deposition of the electro-deposition coating material ceases to be continuous any longer though, for instance, significant variations of the film thickness, gas formation or heat development occur

Note 1 to entry: The breakaway voltage can only be experimentally determined by means of an electromotive series.

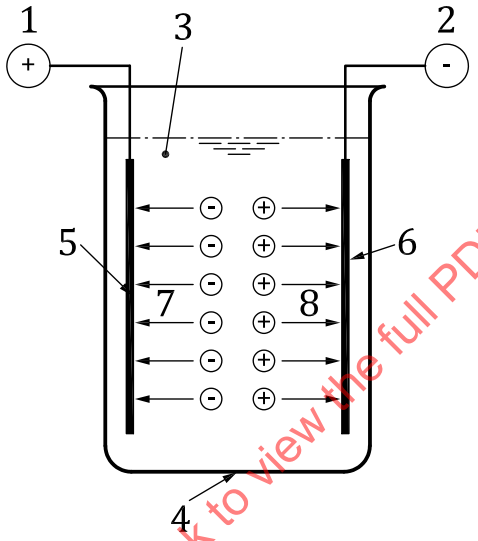
4 Principle

The test panel is wetted with demineralized water on one half of the side which is facing the counter electrode. It is immediately vertically mounted to the immersion unit and contacted with the voltage source. Then the test panel is immediately immersed under the specified deposition conditions in the e-coat material and it is coated.

5 Apparatus and materials

Ordinary laboratory apparatus, together with the following.

5.1 Laboratory deposition system, consisting of a deposition tank with tank recirculation and DC voltage equipment, see Figure 1.



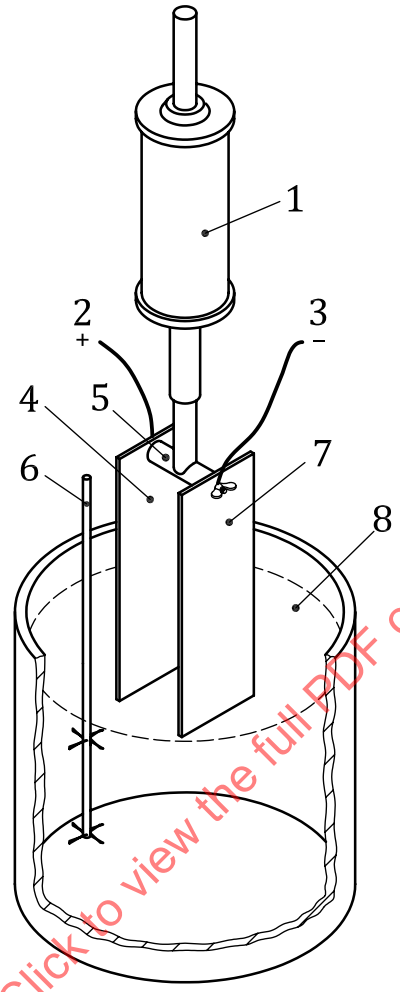
Key

1	anode	5	anode (counter electrode for cathodic e-coat)
2	cathode	6	cathode (test panel for cathodic e-coat)
3	electro-deposition coating material	7	acid
4	deposition tank	8	electro-deposition coating material

Figure 1 — Schematic diagram of a laboratory deposition system with cathodic e-coat material as an example

The container of the deposition system is filled with the electro-deposition coating material and the tank circulation (stirrer or pump) is initiated. Subsequently, the test panels are immersed in the container. The deposition conditions are adjusted according to the specification and the deposition process is initiated. Upon completion of the deposition process, remove the test panels from the container and thoroughly rinse using demineralized water as specified in ISO 23321, so that any excess of the electro-deposition coating material (cream coat) is removed.

5.2 Conveyor unit, with controllable conveying speed (for an example, see Figure 2).



Key

1	conveyer unit	5	electrically isolating joint
2	positive pole	6	stirrer
3	negative pole	7	test panel (for cathodic e-coating)
4	counter electrode (for cathodic e-coating)	8	EDC tank

Figure 2 — Example of a laboratory deposition system with conveyor unit

5.3 Film thickness measuring device, with a maximum permissible error of 0,1 µm.

5.4 Thermometer, with a reading accuracy of 0,1 °C.

5.5 Oven, in which the test can be carried out reliably and where the specified or agreed test temperature can be held to within ±2 °C (for temperatures up to 150 °C) or ±3,5 °C (for temperatures between 150 °C and 200 °C).

5.6 Demineralized water, in accordance with ISO 23321.

6 Test panels

Use electrically conductive test panels with pretreatment as specified in ISO 1514 and with dimensions of approximately 190 mm × 105 mm × 0,75 mm.

7 Number of determinations

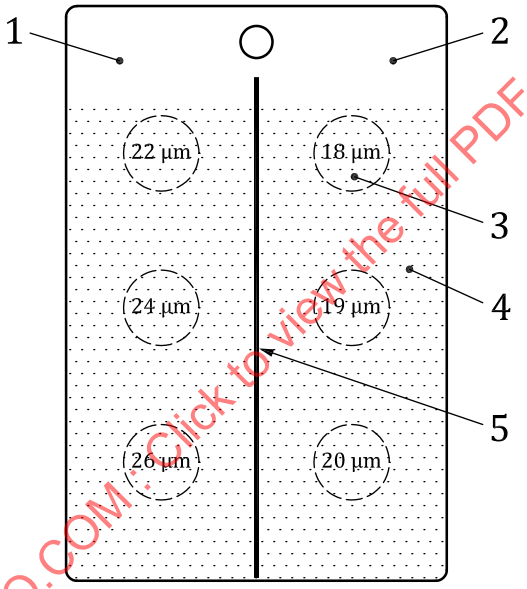
Carry out the determination in duplicate.

8 Procedure

Fill the tank with the electro-deposition coating material up to about 1 cm below the edge and homogenize the coating material, e.g. using a stirring machine with a paddle stirrer (diameter min. 50 mm) at 500 min^{-1}, so that sufficient tank circulation is visually detectable.

Put the test panel in the laboratory deposition system (5.1) and connect the anode and cathode to the current source. Maintain stirring the electro-deposition coating material with a stirring machine or a magnet stirrer.

Divide the test panel into a left and right half using, for example, a marker or a scribing iron. No tape or anything similar may be used for dividing, since adhesive or other foreign substances could be introduced into the tank. Wet the right side using demineralized water (5.6) in accordance with ISO 23321 (see Figure 3).



Key

1	unwetted side of the test panel	4	coating
2	wetted side of the test panel	5	division
3	measuring point for film thickness measurement		

Figure 3 — Test panel

Adjust the laboratory deposition system (5.1) and the conveyor unit (5.2) to the values given in Table 1.

Table 1 — Adjustment parameters for the laboratory deposition system

Parameter	Value
Anode/cathode relation	1:4 in relation to the surface (for cathodic e-coating)
Anode/cathode distance	10 cm
Tank temperature	29 °C to 35 °C
Immersion voltage	40 V below the breakaway voltage
Series resistor	0 Ω
Rotational speed of the stirrer	500 min^{-1}
Immersion angle	90°
Immersion speed	1 cm s^{-1}
Immersion depth	14 cm
Distance of the lower edge of the sheet to the bottom of the tank	1 cm
Tank height	15 cm
Coating duration	2 min

Mount the prepared test panel on the conveyor unit (5.2) and immerse in the tank with the adjusted speed under an applied electrical potential. Turn off the laboratory deposition system (5.1) after 2 min and retract the test panel by means of the conveyor unit. Rinse the test panel with demineralized water (5.6) and stove the coating in the oven (5.5) in accordance with the requirements of the product specification.

Cool the test panel to room temperature and measure the dry-film thickness (see 9.2).

9 Evaluation

9.1 Visual evaluation

Visually evaluate the coating on the dry and wetted half in regard to plastic marks and hashmarks. Characteristic values for evaluation are specified in Table 2.

Table 2 — Characteristic values for the assessment of the marks

Characteristic value	Mark
0	No visible marks
1	Only minor visual changes, e.g. gloss
2	Significant visual marks
3	Flat plastic marks
4	Clearly visible plastic marks and hashmarks
5	Severe plastic marks

One example for hashmarks is ISO 22553-1:2019, Figure 5. In that figure, significant hashmarks are detectable on the right side, which is wetted with demineralized water. On the left side of the division there are decidedly less hashmarks.

For an example of plastic marks, see Figure 4.