
**Paints and varnishes —
Electro-deposition coatings —**

**Part 2:
Throwing power**

*Peintures et vernis — Peintures d'électrodéposition —
Partie 2: Pouvoir de pénétration*

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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).

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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.

Introduction

An important quality characteristic of an electro-deposition coating material is the property of coating cavities inside a workpiece. As examples, rockers and pillars of car bodies can be mentioned. The obtained dry-film thickness has an influence on the corrosion protection.

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Paints and varnishes — Electro-deposition coatings —

Part 2: Throwing power

1 Scope

This document specifies two methods for the determination of the throwing power of electro-deposition coating materials.

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 and ISO 22553-1 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/>

4 Principle

For method A, a special test specimen is coated with an electro-deposition coating material under specified conditions.

For method B, special test specimens are coated with an electro-deposition coating material in a multiple-chamber system under specified conditions.

The coating is stoved and the dry-film thickness is measured on test panels in defined distances from the lower edge of the test specimen. For other test specimens, the dry-film thickness is determined on defined measuring points.

5 Number of determinations

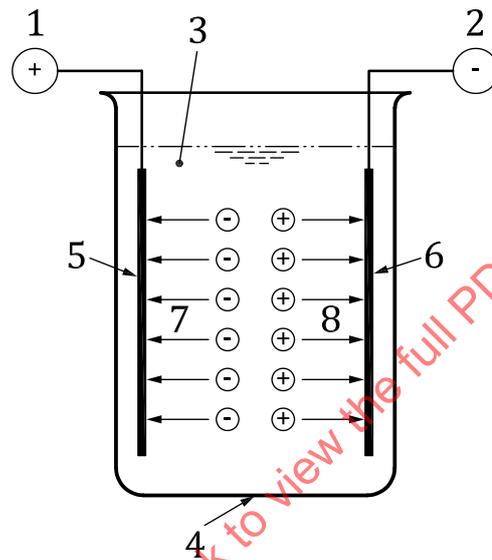
Carry out one single determination.

6 Method A — Single-chamber method

6.1 Apparatus and materials

Ordinary laboratory apparatus, together with the following.

6.1.1 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.

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

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

6.1.4 Timer, with a reading accuracy of 1 s.

6.1.5 Ruler, with a reading accuracy of 1 mm.

6.1.6 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 $\pm 3,5$ °C (for temperatures between 150 °C and 200 °C).

6.2 Test panels

Use electrically conductive test panels with pretreatment as specified in ISO 1514 and with dimensions of approximately 300 mm × 105 mm × 0,75 mm.

6.3 Preparation of the test specimen

For a cathodic electro-deposition coating (cathodic e-coating), the test specimen consists of a spacer in the form of a plastic rack (see [Figure 2](#)), two test panels, two plastic fastening bars or tape, a fastening bolt (see [Figures 3](#) and [4](#)) as a cathode (negative pole) and an anode (positive pole) (see [Figure 5](#)). For an anodic electro-deposition coating (anodic e-coating), the test specimen is connected as anode and the counter electrode as cathode.

Position one test panel before and one behind each spacer in a way that a test side is facing inward and outward. Fasten both test panels to the rack by means of a bolt and thoroughly mount in place with two fastening bars or tape.

NOTE The test panel has no contact to the bottom of the deposition tank; the distance is at least 10 mm (see [Figure 2](#)).

6.4 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.

Mount the test specimen (see [Figures 3](#) and [4](#)) on the coating unit (for an example, see [Figure 5](#)) and immerse by about 280 mm. Observe that the test specimen yields sufficient distance to the bottom of the tank (about 30 mm). No coating material shall be between test panels and spacers. Connect the anode and cathode to the current source. Maintain stirring the electro-deposition coating material with a stirring machine or a magnet stirrer.

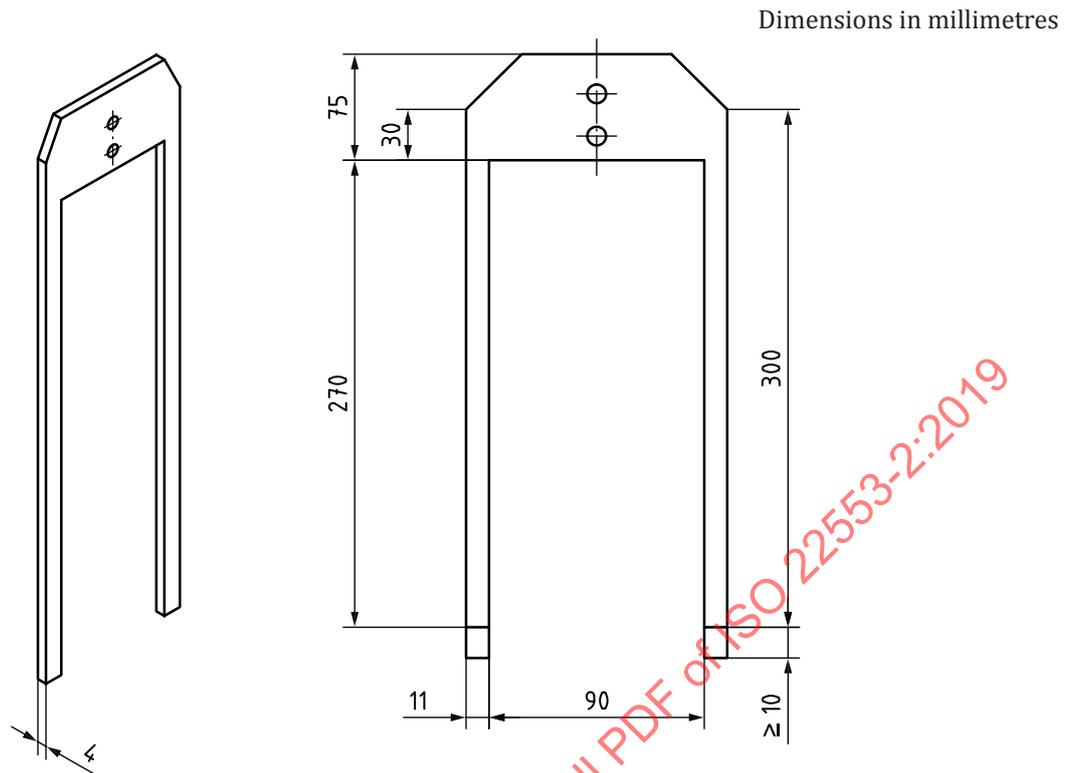
Set the bath temperature to the temperature specifically required for the product, to $\pm 0,5$ °C.

NOTE Usually the temperature is in the range of 25 °C to 35 °C.

Select the deposition voltage so that the film thickness of the electro-deposition coating on the outsides of the test panels corresponds to the nominal dry-film thickness of the electro-deposition coating.

Increase the voltage to the selected coating voltage (if necessary, without a series resistor). Maintain this voltage for a time that has been agreed.

Remove the coating unit after coating, rinse with demineralized water, disassemble and dry/stove the two test panels in accordance with the specification for the electro-deposition coating material.

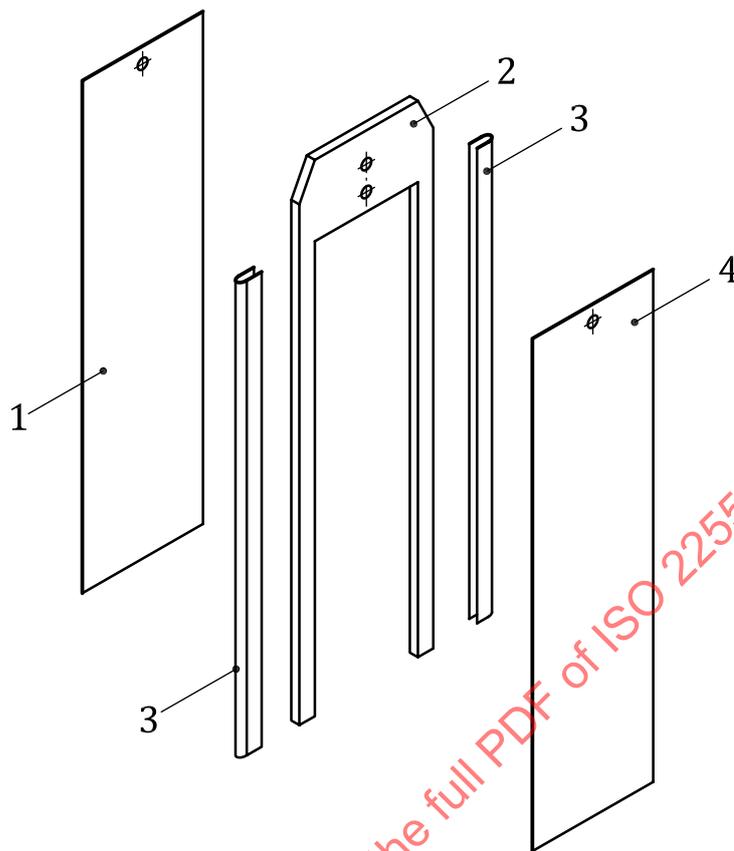


Key

- 300 length of the test panel;
- ≥ 10 distance from test panel to the bottom of the deposition tank;
- 11 width of the arms of the rack;
- 4 thickness of the arms of the rack.

Figure 2 — Spacer with dimensions

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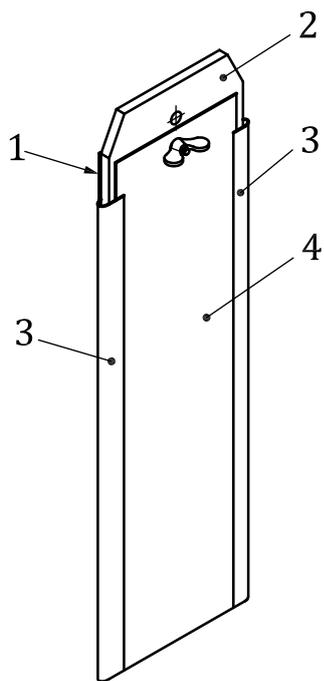


Key

- 1 first test panel
- 2 rack
- 3 fastening profiles
- 4 second test panel

Figure 3 — Components of the test specimen

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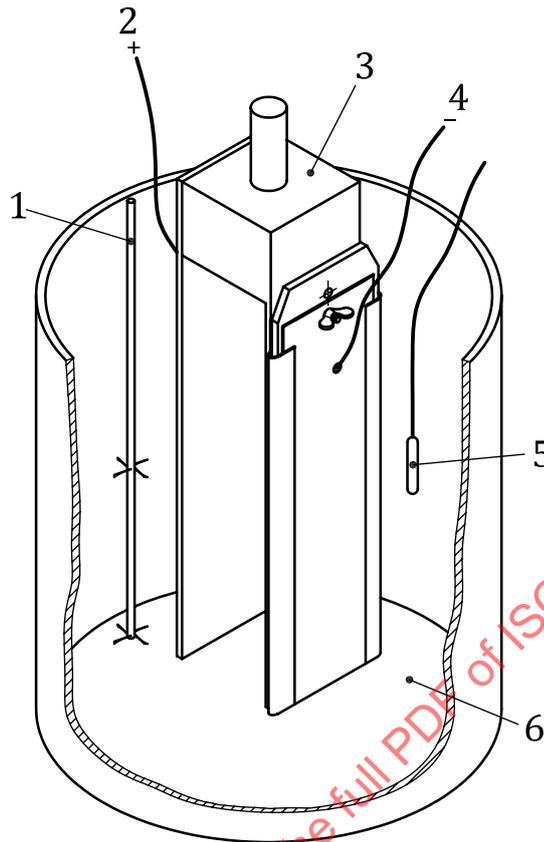


Key

- 1 first test panel
- 2 rack
- 3 fastening profiles
- 4 second test panel

Figure 4 — Test specimen

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**Key**

- 1 stirrer
- 2 positive pole
- 3 coating unit consisting of non-conductive rack, test specimen and counter electrode
- 4 negative pole
- 5 temperature sensor/thermometer
- 6 tank

Figure 5 — Example of a coating unit

6.5 Evaluation

Measure the dry-film thickness using one of the non-destructive methods described in ISO 2808.

Measure the dry-film thickness on the inside, every 5 cm from the lower edge of the test panel. Determine the dry-film thickness at minimum of three measuring points and calculate the mean value.

Visually determine the end of the coating and measure the distance in centimetres from the lower edge of the test panel to this point on the inside of the test panels.

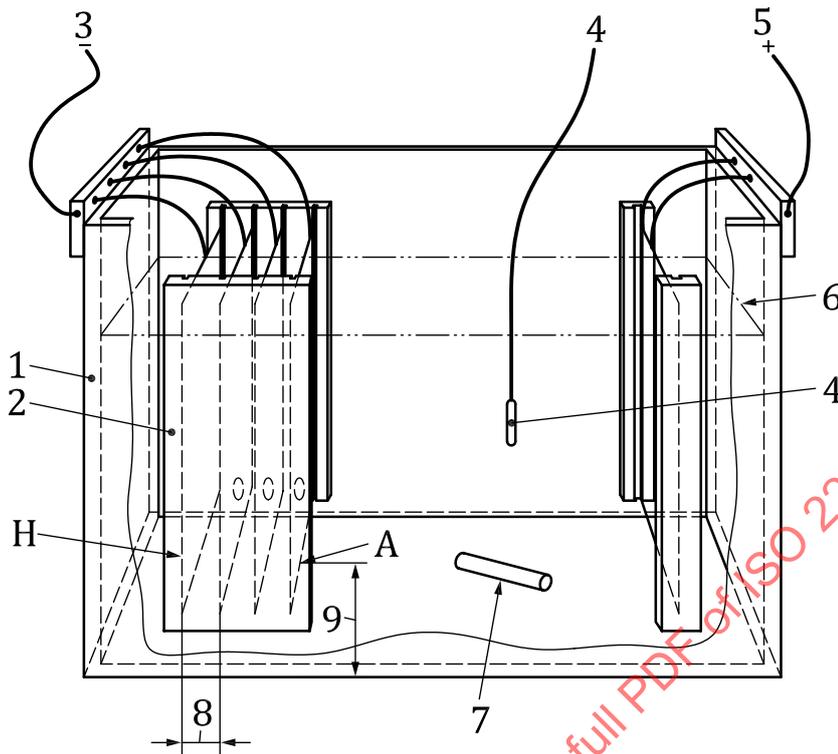
Measure the obtained dry-film thickness (outside film thickness), t , in micrometres, on the outside of the test panels.

7 Method B — Multiple-chamber method

7.1 Apparatus and materials

Ordinary laboratory apparatus, together with the following.

7.1.1 **Laboratory deposition system**, in accordance with [Figure 6](#).



Key

- 1 tank
- 2 spacer
- 3 negative pole
- 4 temperature sensor/thermometer
- 5 positive pole (for cathodic e-coating, as illustrated here, this is the counter electrode)
- 6 fill level of the tank
- 7 stirrer
- 8 distance between the test panels
- 9 distance of the test panels from the bottom of the tank
- A outside of panel A of the test specimen
- H outside of panel H of the test specimen

Figure 6 — Laboratory deposition system for method B

7.1.2 **Counter electrode**, consisting of an uncoated and not pretreated sheet metal, usually stainless steel, in test-panel size.

7.1.3 **Tape**, width 12 mm, temperature-resistant up to 200 °C, free of surface-active substances.

7.1.4 **Tape**, width 12,7 mm, free of surface-active substances.

7.1.5 **Film thickness measuring device**, with a measurement error of 0,1 µm.

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

7.2 Test panels

Use electrically conductive test panels with pretreatment as specified in ISO 1514 and with dimensions of approximately 150 mm × 70 mm × 0,75 mm¹⁾.

7.3 Preparation of the test specimen

The test specimen (see [Figure 10](#)) consists of four phosphated metal panels and three spacers (150 mm × 70 mm × 20 mm). Letter each side of the panels: A and B for the first panel, C and D for the second panel, E and F for the third panel and G and H for the fourth panel. A and H are the outsides of the test specimen. Punch out a hole with a diameter of 8 mm of each panel A/B, C/D and E/F, see [Figure 7](#). The hole shall be punched out before phosphating.

NOTE 1 The hole is usually punched out with a distance of 50 mm to the lower edge of the test specimen, as shown in [Figure 7](#), or with a distance of 45 mm to the lower edge of the test specimen.

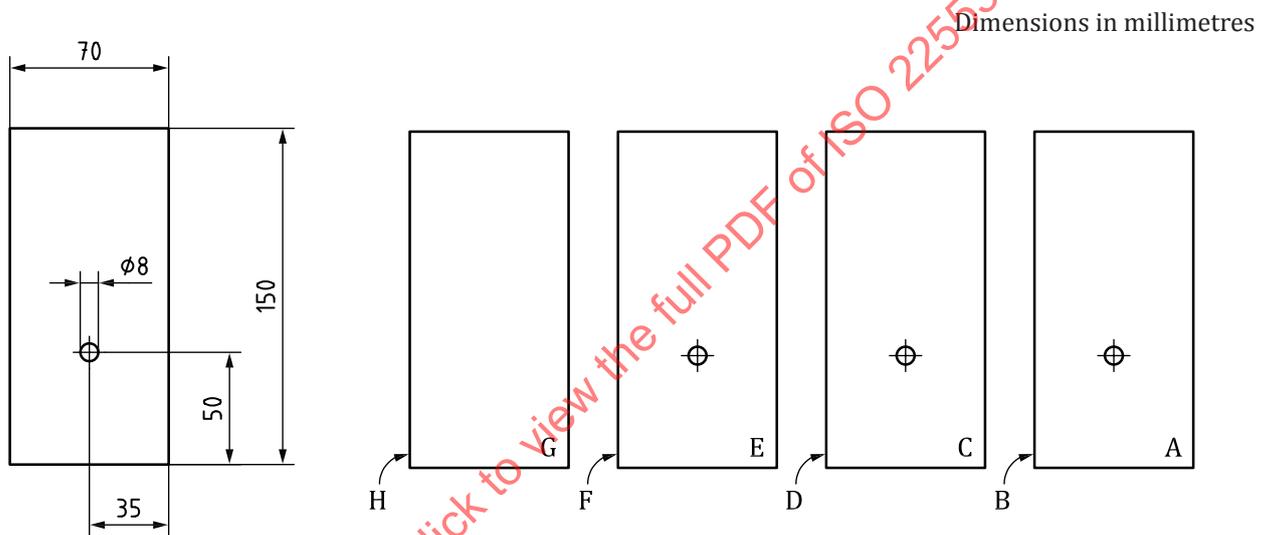


Figure 7 — Test panels

Mask the sides and lower edges of the four panels with tape ([7.1.3](#)), observing that a maximum of 5 mm of the edge shall be masked (see [Figure 8](#)).

1) Information about sources of supply: DIN Standards Committee Coating materials and coatings (NAB), Burggrafenstraße 6, D-10787 Berlin.

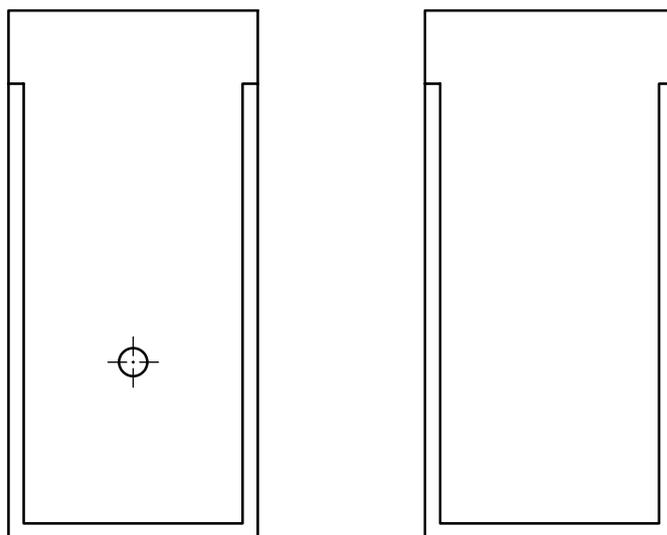


Figure 8 — Masking of the edges

With a distance of 95 mm to the lower side of panel A, introduce a permanent marking (see [Figure 9](#)). This line corresponds to the immersion depth.

NOTE 2 When the hole is introduced with a distance of 45 mm to the lower edge of the test specimen (see NOTE 1) the immersion depth is 90 mm.

Dimensions in millimetres

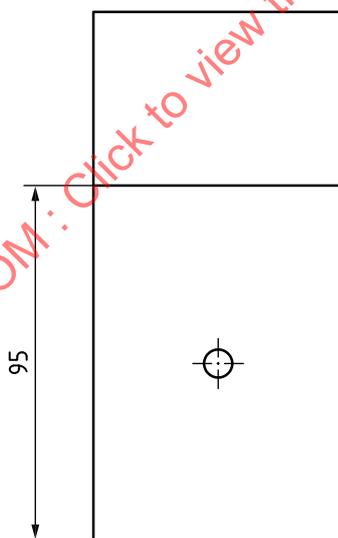


Figure 9 — Test panel A with hole and marking of the immersion depth

Position a spacer between each panel so that the panels are spaced by 20 mm. Thoroughly tape together this arrangement (see [Figure 10](#)) using tape ([7.1.4](#)).

The electro-deposition coating material may only enter the test specimen through the holes in the first three test panels.

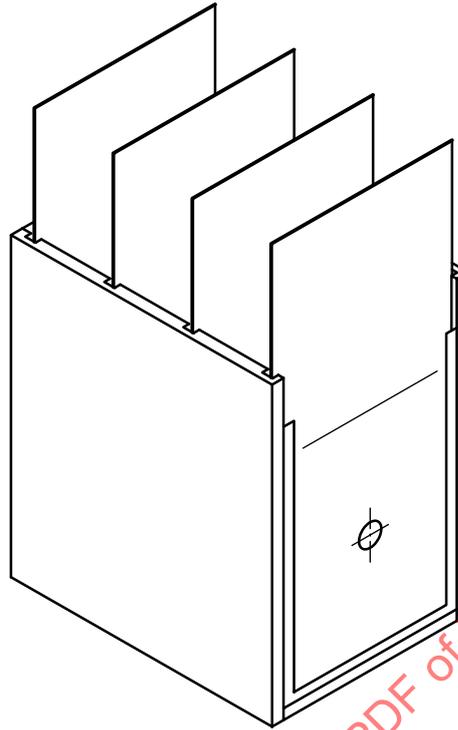


Figure 10 — Test specimen

7.4 Procedure

Fill the laboratory deposition system (7.1.1) with the electro-deposition coating material up to the immersion depth of the test specimen (see Figure 9) and stir the coating material with a speed of about 700 min^{-1} .

Position the counter electrode (7.1.2) in the holder attached to the tank (see Figure 11). The uncoated side shall face the counter electrode.

Set the bath temperature to the temperature specifically required for the product, to $\pm 0,5 \text{ }^\circ\text{C}$.

NOTE Usually the temperature is in the range of $25 \text{ }^\circ\text{C}$ to $35 \text{ }^\circ\text{C}$.