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**Paints and varnishes — Determination  
of resistance to liquids —**

**Part 2:  
Water immersion method**

*Peintures et vernis — Détermination de la résistance aux liquides —  
Partie 2: Méthode par immersion dans l'eau*

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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](http://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](http://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 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](http://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*.

This third edition cancels and replaces the second edition (ISO 2812-2:2007), which has been technically revised. The main changes compared to the previous edition are as follows:

- a terms and definitions clause ([Clause 3](#)) has been added;
- the reference to tank size has been changed to be an example only;
- the angle of the support for the test panels has been changed from 15° to 20° to 0° to 20°;
- the tolerance of the water temperature has been changed from  $\pm 1$  °C to  $\pm 2$  °C;
- rearranging the test panels has been amended by “if specified” because rearranging the test panels is not always required.

A list of all parts in the ISO 2812 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](http://www.iso.org/members.html).

# Paints and varnishes — Determination of resistance to liquids —

## Part 2: Water immersion method

### 1 Scope

This document specifies a method for determining the resistance of an individual layer or multi-layer system of coating materials to the effects of water by partial or full immersion.

This method enables the determination of the effects of water on the coating and, if necessary, the assessment of the damage to the substrate.

### 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 1513, *Paints and varnishes — Examination and preparation of test samples*

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

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

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

ISO 4624, *Paints and varnishes — Pull-off test for adhesion*

ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

ISO 15711, *Paints and varnishes — Determination of resistance to cathodic disbonding of coatings exposed to sea water*

ISO 17872, *Paints and varnishes — Guidelines for the introduction of scribe marks through coatings on metallic panels for corrosion testing*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 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

A coated test panel is immersed in water and the effects of immersion are evaluated by criteria agreed in advance between the interested parties, these criteria usually being of a subjective nature.

## 5 Apparatus

All parts of the apparatus in contact with water shall be made from inert materials.

The usual laboratory apparatus and, in particular, the following.

**5.1 Tank**, of suitable size, fitted with a cover, a heater and thermostatic control. An example of a convenient tank size is 700 mm × 400 mm × 400 mm.

**5.2 System for circulation and aeration of water**, or a means for stirring, used in conjunction with a source of dry, oil-free, pressurized air. If a pump is used, it shall be of a suitable capacity to agitate the whole contents of the tank.

**5.3 Support for the test panels**, made from material that is electrically non-conducting, and arranged so that the panels are maintained at an angle of 0° to 20° to the vertical, with the test surface uppermost, and with their plane parallel to the direction of flow of water in the tank. The panels shall be at least 30 mm apart, situated at least 30 mm from the bottom of the tank and at least 30 mm from the walls of the tank. If not otherwise agreed, their positions shall be changed periodically, either mechanically or by hand.

## 6 Sampling

Take a representative sample of the coating material to be tested, in accordance with ISO 15528.

Pretest each sample in accordance with ISO 1513 and prepare it for further testing.

## 7 Test panels

### 7.1 Materials and dimensions

Unless otherwise specified or agreed, the test panels shall be of polished steel complying with ISO 1514, and of approximate dimensions 150 mm × 100 mm and a thickness of 0,7 mm to 1,0 mm.

### 7.2 Preparation and coating

Prepare each test panel as described in ISO 1514, and then coat it by the specified method with the product or system under test.

Both sides should preferably be coated and the edges protected. It should be agreed whether the reverse side of the panel is to be protected with a sufficiently resistant coating, or whether both sides of the panel are to be coated with the coating material under test.

### 7.3 Drying and conditioning

Dry (or stove) and age (if applicable) each coated test panel for the specified time under the specified conditions. The test procedure shall be carried out as soon as possible.

### 7.4 Artificial damaging

If not otherwise agreed between the interested parties, apply a scribe to the coating, as specified in ISO 17872, or an artificial holiday, as specified in ISO 15711.

## 7.5 Coating thickness

Determine the dry film thickness of the coating, in micrometres, using one of the non-destructive methods specified in ISO 2808.

## 8 Procedure

### 8.1 Number of determinations

Carry out the test in duplicate, unless otherwise agreed.

### 8.2 Determination

Test pieces can either be partially or fully immersed. If partial immersion is required, the test pieces should be immersed for three-quarters of their length. If full immersion is required, the test pieces should be immersed such that the water level is a minimum of 50 mm above the top of the test piece to avoid waterline oxygen concentration difference effects.

Add as much water as required to the tank (5.1) such that the test panels, when positioned on the support (5.3), are immersed for three-quarters of their length or fully immersed, as required. If specified, commence the circulation and aeration of the water (5.2) in the tank. Unless otherwise agreed, adjust the temperature of water to  $(40 \pm 2) ^\circ\text{C}$  and maintain this temperature throughout the test.

Water conforming to the requirements of grade 3 of ISO 3696 shall be used. Depending upon the end use of the coating, other grades of water may be used, for example natural or artificial seawater.

Place the test panels in the tank for the specified period, rearranging them at regular intervals of not more than 3 days, unless otherwise agreed. If water of grade 3 of ISO 3696 is used, replace the test water if at any time during the test it becomes turbid or coloured or its conductivity exceeds 2 mS/m, or if the oxygen content falls below 5 mg/l.

## 9 Evaluation

### 9.1 Interim inspections

For interim inspections during the test period, if specified, remove each panel from the tank at the appropriate time(s) and dry the panels by blotting with lint-free absorbent paper.

Within 1 min of drying, examine the panels for blistering in accordance with ISO 4628-2, or other signs of deterioration, and immediately return them to the tank.

### 9.2 Final inspection

At the end of the specified test period, remove each panel from the tank and dry the panels by blotting with lint-free absorbent paper. If required, within 1 min of drying, examine the whole test surface of each panel for blistering as described in ISO 4628-2, or for other signs of deterioration of the coating. If required, assessment of the change of adhesion as described in ISO 4624 shall also be carried out at this stage.

Allow the panels to stay at room temperature for 24 h and examine the test surface of each panel for blistering in accordance with ISO 4628-2, or for other agreed characteristics, e.g. loss of adhesion, rust staining, change of colour or embrittlement.

If specified, carefully remove a 150 mm × 50 mm strip from the test surface with a non-corrosive paint remover and examine the exposed metal for signs of corrosion. For reference purposes, protect the exposed area by a suitable transparent lacquer.

If the results of the evaluation of the duplicate determinations for blistering or other signs of deterioration differ significantly, repeat the determination, again in duplicate.

Report the results of all determinations, including any repeat determinations.

## 10 Precision

No details are currently available for the repeatability limit ( $r$ ) and reproducibility limit ( $R$ ).

## 11 Test report

The test report shall contain at least the following information:

- a) all information necessary for identification of the coating examined;
- b) a reference to this document (i.e. ISO 2812-2:2018);
- c) details of the test panels, including:
  - 1) the material (including thickness) and surface pretreatment of the substrate;
  - 2) the application method for applying the sample coating to the substrate, including the drying time and drying conditions for all layers; where applicable, ageing conditions before the test;
  - 3) the dry film thickness of the coating, in micrometres, including the measuring method chosen in ISO 2808;
- d) details of the method used, including:
  - 1) the duration of the test;
  - 2) whether the test piece was fully or partially immersed and, if partially, the immersion depth;
  - 3) the temperature of the water;
  - 4) the time between judgements and the removal of the panel from the water;
- e) the result of test as specified in [Clause 9](#), including any difference observed between the immersed and non-immersed portions of the test surface;
- f) the name of the person who conducted the test;
- g) any deviations from the procedure specified;
- h) any unusual features (anomalies) observed during the test;
- i) the date of the test.