
**Binders for paints and varnishes —
Epoxy resins — General methods of
test**

*Liants pour peintures et vernis — Résines époxydiques — Méthodes
générales d'essai*

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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).

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.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, *Paints and varnishes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 7142:2007), which has been technically revised.

The main changes are as follows:

- the concentration of the phenolphthalein solution in [A.1.5](#) has been reduced to 0,5 g/l;
- the text has been editorially revised and the normative references have been updated.

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.

Binders for paints and varnishes — Epoxy resins — General methods of test

1 Scope

This document specifies general methods of test for epoxy resins for use in paints, varnishes and similar products. It is also applicable to those solutions made from epoxy resins that are intended for use as binders for paints and varnishes.

The test methods described in this document are not intended for epoxy esters.

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 385, *Laboratory glassware — Burettes*

ISO 648, *Laboratory glassware — Single-volume pipettes*

ISO 1523, *Determination of flash point — Closed cup equilibrium method*

ISO 3001, *Plastics — Epoxy compounds — Determination of epoxy equivalent*

ISO 3146, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods*

ISO 3219-2, *Rheology — Part 2: General principles of rotational and oscillatory rheometry*

ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content*

ISO 3679, *Determination of flash point — Method for flash no-flash and flash point by small scale closed cup tester*

ISO 4615, *Plastics — Unsaturated polyesters and epoxide resins — Determination of total chlorine content*

ISO 4625-1, *Binders for paints and varnishes — Determination of softening point — Part 1: Ring-and-ball method*

ISO 4625-2, *Binders for paints and varnishes — Determination of softening point — Part 2: Cup-and-ball method*

ISO 4630, *Clear liquids — Estimation of colour by the Gardner colour scale*

ISO 6271, *Clear liquids — Estimation of colour by the platinum-cobalt colour scale*

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

ISO 21627-2, *Plastics — Epoxy resins — Determination of chlorine content — Part 2: Easily saponifiable chlorine*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

epoxy resin

synthetic resin containing epoxy groups, generally prepared from epichlorohydrin and a bisphenol

Note 1 to entry: Epoxy esters obtained by reacting materials containing epoxy groups with fatty acids or oils which dry by oxidation are not covered by this document.

[SOURCE: ISO 4618:2023, 3.101, modified — Note 1 to entry has been added.]

4 Sampling

Take a representative sample of the product to be tested, as specified in ISO 15528.

5 Test methods

The properties which shall be tested and correspondent test methods are listed in [Table 1](#). The test methods to be applied to an individual epoxy resin shall be the subject of agreement between the interested parties.

Table 1 — Properties and test methods

Property	Test method
Colour	ISO 4630 (Gardner colour scale) or ISO 6271 (Platinum-cobalt scale)
Viscosity ^{a b}	ISO 3219-2 or other agreed methods
Volatile or non-volatile matter	ISO 3251 ^c
Flashpoint ^a	ISO 1523 or ISO 3679
Epoxy equivalent	ISO 3001
Hydroxyl value	Annex A
Total chlorine content	ISO 4615
Easily saponifiable chlorine	ISO 21627-2
Melting point	ISO 3146
Softening point	ISO 4625-1 or ISO 4625-2

^a For epoxy resin solutions, liquid resins and resins in test solutions only. Solid epoxy resins should be tested in a standard test solution of 40 % mass fraction in diethylene glycol mono-*n*-butylether. The solvent used and the concentration of the test solution should be indicated in the test report.

^b If the flow-time is used for the characterization of the flow behaviour, it should be determined by the method specified in ISO 2431.

^c Take a test portion of 5 g and heat it at 140 °C for 3 h without addition of solvent, as specified in ISO 3251.

6 Test report

In the test report, at least the following information shall be provided:

- a) the type and identification of the product tested;
- b) a reference to this document, i.e. ISO 7142:2023;
- c) the result of the tests, and the test methods used;
- d) any deviation, by agreement or otherwise, from the procedures specified;

- e) any unusual features (anomalies) observed during the test;
- f) the dates of the tests.

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Annex A (normative)

Hydroxyl value

A.1 Reagents

During the analysis, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

WARNING — Take all necessary safety precautions when using the reagents [A.1.1](#) to [A.1.3](#).

A.1.1 Pyridine

The pyridine shall be clear and shall not cause a significant colour during the blank test.

A.1.2 Pyridinium perchlorate

Slowly add 144 g of 70 % (mass fraction) perchloric acid to 120 ml of pyridine, keeping the mixture cool. Recrystallize the precipitate twice in hot water and allow it to dry in air.

A.1.3 Acetic anhydride/pyridine mixture

Mix 12 g of 95 % (mass fraction) acetic anhydride with 88 g of pyridine.

Store the mixture in an airtight bottle and in the dark.

A.1.4 Potassium hydroxide, methanolic standard volumetric solution, $c(\text{KOH}) = 1 \text{ mol/l}$.

A.1.5 Phenolphthalein, 0,5 g/l solution in 95 % (volume fraction) ethanol, methanol or 2-propanol.

A.2 Apparatus

Ordinary laboratory apparatus together with the following.

A.2.1 Conical flask, of capacity about 250 ml, fitted with a ground glass joint.

A.2.2 Reflux condenser, with ground glass joint, fitting on the conical flask ([A.2.1](#)).

A.2.3 Burette, of capacity 50 ml, complying with the requirements of ISO 385, for the potassium hydroxide solution ([A.1.4](#)).

A.2.4 Pipette, of capacity 25 ml, complying with the requirements of ISO 648.

A.2.5 Suitable heating device.

A.3 Procedure

A.3.1 Number of determinations

Carry out the determination in duplicate.

A.3.2 Test portion

Select the mass of the test portion according to the expected epoxy equivalent (see [Table A.1](#)).

Weigh, to the nearest 1 mg, the test portion into the conical flask ([A.2.1](#)).

Table A.1 — Mass of test portion

Epoxy equivalent g/mol	Mass of test portion g	Mass of pyridinium perchlorate g
up to 180	2,5	4,00
above 180 to 195		3,50
above 195 to 215		3,25
above 215 to 240		3,00
above 240 to 290	3,0	3,00
above 290 to 350		2,50
above 350 to 425		2,00
above 425 to 515		1,75
above 515 to 650		11,35
above 650 to 760		1,10
above 760		1,00

A.3.3 Determination

Weigh the corresponding mass of the pyridinium perchlorate ([A.1.2](#)) given in [Table A.1](#) into the conical flask ([A.2.1](#)). Add by the pipette ([A.2.4](#)) 25 ml of the acetic anhydride/pyridine mixture ([A.1.3](#)). Warm the mixture until the test portion is completely dissolved. Fit the reflux condenser ([A.2.2](#)) onto the conical flask and heat to boiling and maintain at the boiling point under reflux for 30 min.

Add 2 ml of water and 10 ml to 15 ml of the pyridine ([A.1.1](#)) to the top of the condenser so as to rinse the condenser tube. Mix the contents of the flask and cool to ambient temperature.

Add 3 drops of the phenolphthalein solution ([A.1.5](#)) and titrate with the potassium hydroxide solution ([A.1.4](#)).

A.3.4 Blank test

Carry out a blank test, following the same procedure but omitting the test portion and the pyridinium perchlorate ([A.1.2](#)).

A.3.5 Expression of results

Calculate the hydroxyl equivalent (HE) by [Formula \(A.1\)](#):

$$HE = \frac{1\,000}{\frac{5,569 \times m_2 + (V_0 - V_1)}{m_1} - \frac{2\,000}{EE}} \quad (A.1)$$

where

- HE is the hydroxyl equivalent, in grams of resin per equivalent of hydroxyl group (OH);
- m_1 is the mass of the test portion (A.3.2), in grams;
- m_2 is the mass of the pyridinium perchlorate (A.1.2), in grams;
- V_0 is the volume of the potassium hydroxide solution (A.1.4), required for the blank test (A.3.4), in millilitres;
- V_1 is the volume of the potassium hydroxide solution (A.1.4), required for the determination (A.3.3), in millilitres;
- EE is the epoxy equivalent, determined by the method specified in ISO 3001, in grams per mole.

Calculate the hydroxyl value (HV) by [Formula \(A.2\)](#):

$$HV = \frac{56,109 \times 1\,000}{HE} = \frac{56\,109}{HE} \quad (\text{A.2})$$

where

- HV is the hydroxyl value, in grams of potassium hydroxide per kilogram;
- HE is the hydroxyl equivalent, in grams of resin per equivalent of hydroxyl group (OH).

A.3.6 Precision

A.3.6.1 Repeatability (r)

ISO 7142:2023

The value below which the absolute difference between two single test results, on identical material, obtained by one operator in one laboratory using the same equipment within a short interval of time using the standardized test method, may be expected to lie with a 95 % probability, is 10 %.

A.3.6.2 Reproducibility (R)

The value below which the absolute difference between two single test results, on identical material, obtained by operators in different laboratories, using the standardized test method, may be expected to lie with a 95 % probability, is 20 %.