INTERNATIONAL STANDARD

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# Plastics — Epoxy resins — Determination of electrical conductivity of aqueous resin extracts

*Plastiques — Résines époxy — Détermination de la conductivité électrique des extraits aqueux de résine*



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## Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 21318 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 12, *Thermosetting materials*.

## Introduction

Where epoxy resins are used as insulation for electronic devices, ionic impurities such as chloride, sodium and catalyst residues present in the epoxy resin can cause failure of the device. Instead of determining these impurities separately, a test method may be used to evaluate their contents as a whole by measuring the electrical conductivity of a resin extract obtained by extraction of the resin with water at an elevated temperature. Because of its practical usage and simplicity, this method is becoming widely used in the quality control of epoxy resins for electronic insulation applications.

# Plastics — Epoxy resins — Determination of electrical conductivity of aqueous resin extracts

**SAFETY STATEMENT — Persons using this document should be familiar with normal laboratory practice, if applicable. This document does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory requirements.**

## 1 Scope

This International Standard specifies a method for the determination of the electrical conductivity of an aqueous extract obtained by extraction of an epoxy resin with water at 95 °C. The method is applicable only to epoxy resins that are in the molten state at the extraction temperature (95 °C).

The method is important for epoxy resins which are used as insulation materials for electronic devices. The electrical conductivity of the extract is used as a measure of the concentration of the ionic species in the resin.



## 2 Materials

**2.1 Water**.



Use only distilled and/or deionized water, the electrical conductivity of which is below 2,0 µS/cm.

## 3 Apparatus

**3.1 Electrical conductivity meter**, accurate to 0,1 µS/cm, which can be dipped into the aqueous extract and which has a temperature-compensation function.

**3.2 Graduated glass cylinders**, 100 ml.

**3.3 Analytical balance**, accurate to 0,01 g.

**3.4 Air-circulation oven**, capable of maintaining a temperature of 95 °C ± 3 °C.

**3.5 High-density polyethylene bottle**, 100 ml (with a screw cap).

**3.6 Polyethylene cup**, 100 ml.

## 4 Procedure

**4.1** Weigh a test portion of 8,00 g ± 0,05 g into a 100 ml high-density polyethylene bottle (3.5).

**4.2** Add 80 ml ± 2 ml of water (2.1) to the bottle and put on the cap.

**4.3** Put the bottle into the oven (3.4) which has been stabilized at 95 °C.

**4.4** After 30 min, loosen the cap of the bottle to release the internal pressure in order to avoid possible bursting of the bottle. Then retighten the cap.

**WARNING — Never fail to follow procedure 4.4. Wear protective gloves and a face-shield when releasing the internal pressure.**

**4.5** After 20 h ± 0,5 h, remove the bottle from the oven and allow to cool to room temperature.

**4.6** Pour the water into a polyethylene cup (3.6), and measure the electrical conductivity using the electrical conductivity meter (3.1) at 25 °C.

**4.7** Carry out a blank test, following the same procedure and using the same water but without the test portion.

## 5 Expression of results

Calculate the electrical conductivity $\gamma$ of the aqueous resin extract, expressed in microsiemens per centimetre (µS/cm), from the following equation:

$$\gamma = \gamma_S - \gamma_B$$

where

$\gamma_S$ is the uncorrected electrical conductivity of the extract, expressed in microsiemens per centimetre (µS/cm);

$\gamma_B$ is the electrical conductivity of the blank, expressed in microsiemens per centimetre (µS/cm).



## 6 Precision

Precision data were determined from a round-robin trial organized in 2002 and 2003 involving eight laboratories in Japan. Two commercial epoxy resins were tested and the results analysed in accordance with ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*.

The repeatability and reproducibility calculated from the trial are given in Table 1.

**Table 1 — Precision data**

| Type of epoxy resin | Electrical conductivity (averaged) µS/cm | Repeatability $s_r$ | Reproducibility $s_R$ |
|---|---|---|---|
| BPA (bisphenol A type solid epoxy resin) | 3,6 | 0,11 | 0,31 |
| ECN (*o*-cresol novolac type solid epoxy resin) | 1,1 | 0,04 | 0,10 |

## 7 Test report

The test report shall include the following:

a) a reference to this International Standard;

b) all details necessary for identification of the sample;

c) the test result;

d) the date of the test;

e) any other relevant information which may have influenced the test result.

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