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Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness —

Part 9: Field method for the conductometric determination of water-soluble salts

Préparation des subjectiles d'acier avant application de peintures et de produits assimilés — Essais pour apprécier la propreté d'une surface —

Partie 9: Méthode in situ pour la détermination des sels solubles dans l'eau par conductimétrie

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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).

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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 12, *Preparation of steel substrates before application of paints and related products*.

This second edition cancels and replaces the first edition (ISO 8502-9:1998), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Inclusion of new measurement methods according to the direct sample method;
- Improved connection to ISO 8502-6, and all extraction types;
- Dedication to Water soluble salts to avoid confusion with other analysis methods;
- Improvement to figure one to clarify the use of other volumes for analysis.

A list of all parts in the ISO 8502 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

The performance of protective coatings of paint and related products applied to steel is significantly affected by the state of the steel surface immediately prior to painting. The principal factors that are known to influence this performance are:

- a) the presence of rust and mill scale;
- b) the presence of surface contaminants, including salts, dust, oils and greases; and
- c) the surface profiles.

ISO 8501, ISO 8502 and ISO 8503 have been prepared to provide methods of assessing these factors, while ISO 8504 provides guidance on the preparation methods that are available for cleaning steel substrates, indicating the capabilities of each in attaining specified levels of cleanliness.

These International Standards do not contain recommendations for the protective coating systems to be applied to the steel surface. Neither do they contain recommendations for the surface quality requirements for specific situations even though surface quality can have a direct influence on the choice of protective coating to be applied and on its performance. Such recommendations are found in other documents such as national standards and codes of practice. It will be necessary for the users of these International Standards to ensure that the qualities specified are:

- compatible and appropriate both for the environmental conditions to which the steel will be exposed and for the protective coating system to be used, and
- within the capability of the cleaning procedure specified.

The four International Standards referred to above deal with the following aspects of preparation of steel substrates before application of paints and related products:

- ISO 8501, *Visual assessment of surface cleanliness*;
- ISO 8502, *Tests for the assessment of surface cleanliness*;
- ISO 8503, *Surface roughness characteristics of blast-cleaned steel substrates*;
- ISO 8504, *Surface preparation methods*.

Each of these International Standards is in turn divided into separate parts.

This document describes a field method for the assessment of the total amount of water-soluble salts, the salts being reported as one value. The more aggressive contaminants causing corrosion and blistering (the ionic species) can easily be dissolved off and determined by this method. Consequently, the less aggressive and not so easily dissolved; minor part of contaminant will remain un-assessed. For additional information on the test method, its potential and its limitations, see Bresle Å, Conductometric determination of salts on steel surfaces^[1] and Frankhuizen N, Measuring NaCl, Salt and Soluble Contaminants with Bresle Patches — Part 1 & 2^[3].

Rusty steel substrates, particularly those of rust grades C or D (see ISO 8501-1), even when blast-cleaned to preparation grade Sa 3 (see ISO 8501-1 and ISO 8501-2), might still be contaminated by water-soluble salts and corrosion products. These compounds are almost colourless and are localized at the lowest point of the rust pits. If they are not removed prior to painting, chemical reactions can result in blister formation and accumulations of rust that destroy the adhesion between the substrate and the applied protective coating.

Even if the salt is readily soluble in water, it is often impossible to remove it completely from the surface by a simple washing or extracting. The method described does not, therefore, determine the total amount of soluble materials on the surface but gives an indication of the cleanliness level of the surface. Prolonging the extractions time, or repeating the extraction procedure, should remove a larger proportion of the salt.

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Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness —

Part 9:

Field method for the conductometric determination of water-soluble salts

1 Scope

This document specifies a field method for the assessment of the surface density of various water-soluble salts on steel surfaces, before and/or after surface preparation, by conductometric determination. The individual surface densities of the salt composition like chlorides, sulphates, sodium, etc, cannot be determined by this method.

This method assesses only contaminants that forms an electrolyte (ions) when in contact with water. These represent the greater part of the contaminants.

2 Normative references

The following documents are referred to in the text in such a way that some or all 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 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 8502-6, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 6: Extraction of soluble contaminants for analysis using adhesive cells, The Bresle method*

3 Terms and definitions

No terms and definitions are listed in this document.

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 <https://www.electropedia.org/>

4 Principle

The salts on the given area of the steel surface are dissolved by using adhesive cells, one of which is in accordance with the original Bresle method (see ISO 8502-6), using water as solvent. The conductivity of the solution thus obtained is measured. Finally, the total surface density of the salts in this area is calculated and expressed as total soluble salts expressed as sodium chloride. This method gives a value for all salts present on the surface and is not ion specific for sodium and/or chloride. The unit as total soluble salts measured as sodium chloride refers to the calculation method used based on analytical principles.

5 Apparatus and materials

5.1 Conductometer

Conductometer with temperature compensation and the most accurate range possible, from 0 mS/m (0 μ S/cm) to 20 mS/m (200 μ S/cm) with a resolution of 0,01 mS/m (0,1 μ S/cm), 20 mS/m (200 μ S/cm) to 200 mS/m (2 000 μ S/cm) with a resolution of 0,1 mS/m (1 μ S/cm) and an accuracy of 2 %. Either being an immersion type instrument, where the electrode is submerged in the liquid under test, or a direct measuring type instrument where the liquid under test is injected in the measurement cell of the instrument. The conductometer shall be compensated to 25 °C.

NOTE The official SI-unit for conductivity is mS/m, but since most commercially available instruments use the unit μ S/cm, this unit is given within brackets within this document. 1 mS/m is equivalent to 10 μ S/cm.

5.2 Beaker

Beaker of sufficient size and shape for the solvent and, if relevant, for housing the electrode end of an immersion type conductometer (6.1) during measurement.

NOTE When using immersion type instruments, use of a glass beaker is advisable for avoiding electrostatic interference.

5.3 Equipment for sampling

Adhesive cell and other equipment as specified in ISO 8502-6.

The cell should not cause any noticeable variation in the contamination of the extraction liquid. To confirm accuracy, an initial cell blank test shall be required as described in ISO 8502-6.

5.4 Syringe

If a syringe is used in the extraction procedure as specified in ISO 8502-6, this is the syringe referred to in the following, see 7.2 and 7.3. The same syringe shall be use for the extraction, analysis and blank test.

5.5 Solvent

Water of at least grade 3 purity in accordance with ISO 3696.

NOTE Usually, distilled or de-ionized water of conductivity less than 0,5 mS/m (5 μ S/cm) meets this requirement.

6 Procedure

6.1 Calibration

Calibrate the conductometer according to the manufacturer's instructions and in the range to be used for the measurements. Calibration shall be performed before each test sequence or at least daily.

6.2 Preparation of water and equipment blank test

6.2.1 Pour into the beaker (5.2) an amount of water (5.5). For instruments with a sensor to be immersed, the beaker shall be just large enough for the operation of the conductometer (5.1). Usually a volume between 10 ml and 15 ml is needed. For direct measurement type instruments, the volume shall be sufficient for rinsing and filling the cell of the instrument and, if a syringe is used in the sampling procedure, sufficient to fill the syringe (5.4). To check for foreign matter inside the beaker and syringe, and on the conductometer probe, from influencing the result, carry out the following blank test (checking cleanliness of the syringe, beaker, water and conductometer zero reading).

6.2.2 In case a syringe is to be used in the extraction procedure (ISO 8502-6), completely fill the syringe (6.4) with water from the beaker.

6.2.3 For immersion type conductometers, empty the syringe back into the beaker and immerse the electrodes fully in the water in the beaker and agitate gently. For direct measurement type conductometers, apply the required volume of solution from the syringe on the sensor surface. Record the conductivity (γ_1) and the units in which it is expressed, for example mS/m or $\mu\text{S}/\text{cm}$

6.3 Sampling of salts from the steel surface

Perform extraction of salts as stated according in ISO 8502-6. Record the sampling area and the amount of water used for extraction according to ISO 8502-6 (V_e).

6.4 Conductometric measurement

For immersions type instrument, immerse the electrodes of the conductometer fully in the contaminated water from the sampling. If a dilution is required, use solvent of at least grade 3 purity in accordance with ISO 3696. Record the volume of sampled water (V_s with salts) and the amount of water added (V_a). Record the conductivity (γ_2) expressed in the same units as in 6.2.3.

For direct measuring type instruments, rinse the sensor surface several times with the solution and apply a suitable volume of solution in the cell of the instrument. Record the conductivity (γ_2) expressed in the same units as in 6.2.3.

Rinse the sensor, beaker, etc. between readings making sure that contamination from previous tests do not influence the measurement.

7 Calculations

7.1 Calculation of corrected volume

If dilution is performed, the volume V , to be used for the calculations of the amount of salt on the surface in 7.2, is calculated according to

$$V = V_e \left(1 + \frac{V_a}{V_s} \right) \quad (1)$$

where

V_e $V_{\text{extraction}}$; is the amount of water used for the extraction of salts from the surface (see ISO 8502-6);

V_s V_{sample} ; is the amount of water sampled from the extracted water i.e. sampled from V_e ;

V_a V_{added} is the amount of water added to the sample i.e. added to V_s .

7.2 Calculation of amount of salt on the surface

The total surface density ρ_A of the soluble salts is given by the Formula

$$\rho_A = \frac{m}{A} \quad (2)$$