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Korrosion hos metaller och legeringar – Bestämning av kritisk spalttemperatur (CCT) för rostfritt stål vid potentiostatisk kontroll (ISO 18089:2015, IDT)

Corrosion of metals and alloys – Determination of the critical crevice temperature (CCT) for stainless steels under potentiostatic control (ISO 18089:2015, IDT)

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Den internationella standarden ISO 18089:2015 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 18089:2015.

The International Standard ISO 18089:2015 has the status of a Swedish Standard. This document contains the official English version of ISO 18089:2015.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.

Denna standard är framtagen av kommittén för Korrosion i vätskor, SIS/TK 146/AG 2664.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 156, *Corrosion of metals and alloys*.

Introduction

Stainless steel is susceptible to pitting corrosion, crevice corrosion, and stress-corrosion cracking, etc., although it is used as generally corrosion-resistant material. The basic methodology for testing localized corrosion was first standardized in ASTM G 150. This method describes the susceptible to pitting corrosion and it is also standardized in ISO 17864. In this International Standard, the susceptible to crevice corrosion is examined. This is performed by recording the electrochemical critical crevice corrosion temperature for a material using a specific crevice former. Crevice corrosion phenomenon is generally of a random nature and therefore these measurements require at least a couple of values.

Corrosion of metals and alloys — Determination of the critical crevice temperature (CCT) for stainless steels under potentiostatic control

1 Scope

This International Standard describes the procedure for determining the critical crevice temperature (CCT) for stainless steels under potentiostatic control.

The principal advantage of the test is the rapidity with which the CCT can be measured in a single test procedure. The CCT, as determined in this International Standard, can be used as a relative index of performance, for example, to compare the relative performance of different grades of stainless steel.

The test described in this International Standard is not intended to determine the temperature at which crevice corrosion will occur in service.

This method is not intended for materials with critical pitting temperature (CPT) values below 20 °C measured in accordance with ISO 17864, when measured in the same test solution and at the same potential

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 8044, *Corrosion of metals and alloys — Basic terms and definitions*

ISO 17864, *Corrosion of metals and alloys — Determination of the critical pitting temperature under potientiostatic control*

ISO 18070, *Corrosion of metals and alloys — Crevice corrosion formers with disc springs for flat specimens or tubes of stainless steels in corrosive solutions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044, ISO 17864 and the following apply.

3.1
critical crevice temperature
CCT
lowest temperature on the surface of the specimen at which stable propagating crevice corrosion occurs under specified test conditions

Note 1 to entry: The critical crevice corrosion temperature is defined as the temperature of the specimen at which the current density exceeds a specified value. A recommended value is 10 µA cm^{-2}, referring to area exposes in the measurement to make sure that it is above the passive current, for 60 s. A 60 s delay is used in order to ensure that the observed current increase originates from stable propagating crevice corrosion, and not a short-lived current peak.[4]

3.2
temperature ramp rate
rate at which the temperature of the surface of the specimen is increased during the test

4 Principle

4.1 The test involves increasing the temperature of the surface of the specimen at a specified rate, while exposing the specimen to a solution and maintaining the potential of the specimen at a specified value. The temperature of the surface of the specimen is increased by heating the solution.

4.2 The temperature ramp rate, environment and applied potential may be varied, depending on the material.

5 Equipment

5.1 Experimental set-up is a vessel with immersion heater or a thermostatic bath.

5.1.1 The test specimen, a reference electrode connected appropriately for measuring the electrode potential, see 5.10, an auxiliary electrode, a port for insertion of a temperature-measuring device and a facility for stirring the solution in a repeatable manner.

NOTE This can be achieved using a mechanical stirring device, using a peristaltic pump or by bubbling inert gas through the solution at a controlled rate.

5.1.2 Any part of the test cell or specimen holder that comes into contact with the solution shall be constructed from an inert material. The connection of the electrode shall be design so no corrosion occurs in the connection point.

NOTE 1 Examples of how the connections can be made are given in Annex A.

NOTE 2 Polycarbonates, glass, polytetrafluoroethylene (PTFE), polypropylene (PP), polyethylene (HD-PE) are suitable materials but styrolic plastics are not allowed.

5.1.3 The ratio of the volume of solution in the test cell to the specimen area shall be at least 100 ml/cm^2 specimen area.

5.2 Potentiostat shall be capable of controlling the electrode potential to within ±1 mV of a preset value.

5.3 Electrode potential-measuring instrument with a high input impedance of the order of 10^{11} Ω to 10^{14} Ω, to minimize current drawn from the system during measurement. The sensitivity and accuracy of the instrument shall be sufficient to detect a change of 1,0 mV.

5.4 Current-measuring instruments capable of measuring a current to within 2 % of the actual value. The current in the circuit is evaluated from the potential drop measured across a known resistor.

NOTE In many potentiostats, this measurement is made internally, but measurements can also be made externally by locating a resistor in the current line from the auxiliary electrode to the auxiliary connection on the potentiostat.

5.5 Temperature controller capable of increasing the temperature of the surface of the specimen from 2 °C to 100 °C at a controlled rate. This is achieved by heating or cooling the solution. Above 10 °C, the average rate of temperature change of the specimen shall be controlled to within ±30 % of the desired value, where the average is calculated over a temperature range of 10 °C.

NOTE At temperatures above 85 °C, avoid evaporation by suitable equipment.

5.6 Temperature measurement instrumentation capable of measuring the temperature of the test solution with an accuracy of ±1 °C.

5.7 Crevice formers or specimen holders of different types can be used in this International Standard.

NOTE Annex B describes examples of different crevice formers and relevant aspects concerning these. Other different types of crevice formers can be used if relevant parties agree.

5.8 Test solution, commonly containing of chlorides.

5.9 Auxiliary electrode of high-purity platinum or other materials inert to the test solution. The auxiliary electrode may be constructed in the form of thin foil, a sheet, a rod, or in the form of a gauze. It can also be supported on a glass frame. The area of the auxiliary electrode shall be at least the area of the specimen.

5.10 Reference electrode shall be maintained at ambient temperature external to the test cell and connected to the test cell via a Luggin capillary probe.

NOTE The silver/silver chloride electrode is preferred but there are other alternatives. The potentials of these Ag/AgCl electrodes at 25 °C relative to the standard hydrogen electrode at 25 °C are given in Annex D.

6 Procedure

6.1 Preparation of reference electrodes

6.1.1 The difference in potential between the reference electrode and two validation electrodes shall be measured. These electrodes shall be traceable to the standard hydrogen electrode and used and maintained solely for the purpose of validation. If the potential difference is greater than 3 mV, the test electrode shall be rejected.

6.1.2 The validation electrodes shall be stored in optimum conditions and regularly compared. Replacement shall be undertaken if the potential difference between these varies by more than 1 mV.

6.2 Preparation of specimen

6.2.1 The minimum specimen area of 1 cm^2 shall be used but the dimensions shall be compatible with the crevice former or the crevice holder used for the test. Examples of specimens are given in Annex A.

6.2.2 The surface finish shall be as reproducible as possible. Any test surface may be tested but it is recommendable that all surfaces exposed to the test solution, including cut edges and drilled holes, shall be abraded down to a surface finish of at least P 80grit paper. Care shall be taken to avoid overheating the surface.

NOTE Ultrasonic cleaning can be used after the preparation.

6.2.3 The specimens shall be left in air, at a temperature higher than the dew point temperature for at least 24 h before testing, to be able to form a stable oxide.

The time elapsed between grinding and immersion can have an influence on the subsequent crevice corrosion behaviour. The elapsed time selected will depend on the purpose of the test, but should be standardized for a particular set of tests. Little variation in surface film thickness occurs after 24 h, and hence a minimum elapsed time of 24 h is often useful.

6.2.4 The specimen shall be cleaned immediately prior to immersion in the solution by degreasing, rinsing in high-purity water with a conductivity less than 1 μS cm^{-1} (according to ISO 3696, grade 2),