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**Determination of resistance to intergranular corrosion of stainless steels —**

**Part 1:**

Austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in nitric acid medium by measurement of loss in mass (Huey test)

*Détermination de la résistance à la corrosion intergranulaire des aciers inoxydables —*

*Partie 1: Aciers inoxydables austénitiques et austéno-ferritiques (duplex) — Essai de corrosion en milieu acide nitrique par mesurage de la perte de masse (essai de Huey)*

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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.

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.

International Standard ISO 3651-1 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 7, *Methods of testing (other than mechanical tests and chemical analysis)*.

This second edition cancels and replaces the first edition (ISO 3651-1:1976), which has been technically revised.

ISO 3651 consists of the following parts, under the general title *Determination of resistance to intergranular corrosion of stainless steels*:

- *Part 1: Austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in nitric acid medium by measurement of loss in mass (Huey test)*
- *Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid*

## Introduction

The term “intergranular corrosion test” denotes the corrosion test carried out by means of preferential attack of the grain boundaries.

Austenitic and ferritic-austenitic (duplex) stainless steels may be subject to such attack when they are held at a temperature between about 500 °C and 1 000 °C. This heat cycle, which may provoke sensitization to intergranular corrosion, may occur during hot forming (forging, rolling) as the result of incorrect solution treatment or during a welding operation.

NOTE — Intergranular corrosion in nitric acid may be associated with one or more of the following:

- precipitation of chromium carbides;
- precipitation of intermetallic compounds such as sigma phase, in molybdenum-bearing grades;
- segregation of impurity elements to the grain boundaries.

The interpretation of the result (for example, maximum rate of corrosion) shall form the subject of an agreement between the interested parties.

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# Determination of resistance to intergranular corrosion of stainless steels —

## Part 1:

Austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in nitric acid medium by measurement of loss in mass (Huey test)

### 1 Scope

This part of ISO 3651 specifies a method for the determination of the resistance to intergranular corrosion of austenitic and ferritic-austenitic (duplex) stainless steels in a nitric acid medium by measurement of the loss in mass (Huey test). It also specifies the purpose which may be assigned to the test.

The method is applicable only to austenitic and ferritic-austenitic (duplex) stainless steels supplied in the form of rolled or forged products, tubes and cast products and intended for use in a strongly oxidizing medium (for example, relatively concentrated nitric acid). In general the Huey test should not be used for grades containing molybdenum unless the material tested is to be used in nitric acid service.

NOTE — It is important to note that the result of the corrosion test is only strictly valid for the corrosive medium used in the test. It constitutes a basis for estimating the resistance to intergranular corrosion but may not be used to check resistance to other forms of corrosion (general corrosion, pitting, stress corrosion, etc.). It is necessary for the user to adapt the specified corrosion test to the use which will be made of the alloy. This test should, in no case, be considered as an absolute criterion of the quality of the alloy.

[ISO 3651-1:1998](https://standards.iteh.ai/ISO/3651-1:1998)

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### 2 Purpose of the test

This intergranular corrosion test may have either of the purposes given in 2.1 or 2.2. If an order specifies this corrosion test, the purpose of the test shall be stated at the time of ordering.

#### 2.1 Verification of the intrinsic resistance of the alloy to intergranular corrosion

This verification applies only to austenitic steel grades which are specially produced for resistance to intergranular corrosion in strongly oxidizing media. The specimen is inspected after having undergone a heat treatment for sensitization (see clause 3).

#### 2.2 Inspection of the efficiency of the solution treatment

This inspection is only carried out on thin products for which the cooling speed may be made sufficiently rapid. The specimen is inspected in the state in which it is delivered to the user, without heat treatment for sensitization.

### 3 Heat treatment of sensitization

In order to verify the intrinsic resistance to intergranular corrosion (see 2.1), it is necessary to carry out a heat treatment for sensitization for stabilized steels and steels with a very low carbon content ( $C \leq 0,03 \%$ ). This sensitization treatment is usually obtained by maintaining the test piece for 30 min at a temperature of  $700\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$  followed by rapid cooling (in water). The duration of the rise in temperature shall not exceed 10 min.

Other sensitization treatments may be used by agreement between the interested parties.

Welded pieces shall not be submitted to a heat treatment of sensitization.

### 4 Corrosion test

#### 4.1 Principle

A test piece, prepared as specified in 4.2.2, is weighed, then immersed in a boiling solution of nitric acid for 5 periods each of 48 h. The criterion for evaluating the test result is loss in mass determined by weighing after each period.

#### 4.2 Test pieces

##### 4.2.1 Dimensions

The test piece taken from the wrought product shall have its largest dimension located in the direction of forming. For wrought products and castings the test piece shall be cut as near as possible to the surface. The test piece dimension shall be determined as a function of the weighing facilities and the volume of solution to be used. The test piece length shall, however, be at least equal to twice its width, and the total surface area of the sections perpendicular to the direction of rolling or the fibres shall be less than 15 % of the total surface area of the test piece. In comparative tests, the ratio of the total surface area to the total area of the sections shall be kept constant.

##### 4.2.2 Preparation

Depending on the purpose of the test (see clause 2), the test piece, either with or without sensitization treatment, shall be prepared as specified in 4.2.2.1 or 4.2.2.2.

Unless otherwise stated on the order, the method of preparation shall be left to the manufacturer and shall be recorded on the test report.

##### 4.2.2.1 Mechanical preparation

The test piece shall be descaled mechanically by grinding on all surfaces and sharp edges, with grade 120 or finer, iron-free abrasive paper or cloth. Over-heating of the test piece shall be avoided.