TECHNICAL REPORT

ISO/TR 16203

First edition
2016-07-15

Corrosion of metals and alloys — Guidelines for the selection of methods for particle-free erosion corrosion testing in flowing liquids

Corrosion des métaux et alliages — Lignes directrices pour la sélection des méthodes d'essai d'érosion-corrosion exempte de particule dans des liquides en mouvement

Reference number
ISO/TR 16203:2016(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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 on 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 the following URL: www.iso.org/iso/foreword.html.

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

Introduction

Particle-free erosion corrosion is a major problem in industries handling liquids flowing rapidly that are corrosive especially at high temperatures and high pressures. This mode of corrosion usually leads to rapid metal loss with possibly catastrophic consequences. In order to prevent, mitigate and control the problems, it is important to determine the resistance to corrosion of materials accurately. This may be achieved by the use of test methods reproducing a specific mode of erosion corrosion.

Corrosion of metals and alloys — Guidelines for the selection of methods for particle-free erosion corrosion testing in flowing liquids

1 Scope

This Technical Report provides information on the erosion corrosion test of materials in single-phase flowing liquids and guidance for selection of test methods.

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 8044, *Corrosion of metals and alloys — Basic terms and definitions*

3 Terms and definitions

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

3.1
erosion
progressive loss of original material from a solid surface due to mechanical interaction between the surface and a fluid, a multicomponent fluid, or impinging liquid or solid particles

3.2
erosion corrosion
process involving conjoint corrosion and erosion

3.3
particle free erosion corrosion
corrosion of metallic materials in single phase flowing liquids

4 Principles

4.1 Erosion corrosion describes the mechanical removal of metals leading to enhanced corrosion. The process is synergistic in the sense that the localized loss of material can create additional turbulent flow that encourages further film removal or even prevents its formation. The conditions in which erosion corrosion occurs will be a sensitive function of the application but there are a range of laboratory test methods that have been developed to simulate typical service applications and can provide a basis for assessing the relative susceptibility of materials to damage development.

4.2 Erosion corrosion test is conducted either by setting up a uniform flow velocity distribution or by inducing different flow velocities or different rates of corrosion over the surface of test specimen. In the former, corrosion damage increases as the flow velocity of liquid increases, while in the latter, the damage increases as the difference in the corrosion rates becomes larger.

5 Test methods

5.1 Tests for uniform corrosion

5.1.1 Rotating cylinder test

This test uses a cylinder-shaped specimen insulated at the top and bottom end (see Figure 1). The cylindrical surface is the test surface. It is attached with a shaft at the top end with which it is rotated around the longitudinal axis in test solution. The radius of the cylinder may be chosen freely, but needs to be constant along the longitudinal distance, so that a uniform distribution of circumferential flow velocity over the entire surface of specimen is achieved. This test is widely used for elucidating the effect of flow velocity on the uniform corrosion.

Figure 1 — Rotating cylinder test

5.1.2 Test in a pipe or channel

The flat plate specimen installed in the pipe line (the hatched part, upper in Figure 2) and the test specimens embedded in the wall of the duct (the hatched part, lower in Figure 2) are also used for investigating the effect of flow velocity on uniform corrosion. Because of the end effect, the specimen embedded in the wall of the duct is advantageous over the pipe. However, the former has some difficulties in setting the specimen precisely flat with the duct wall.

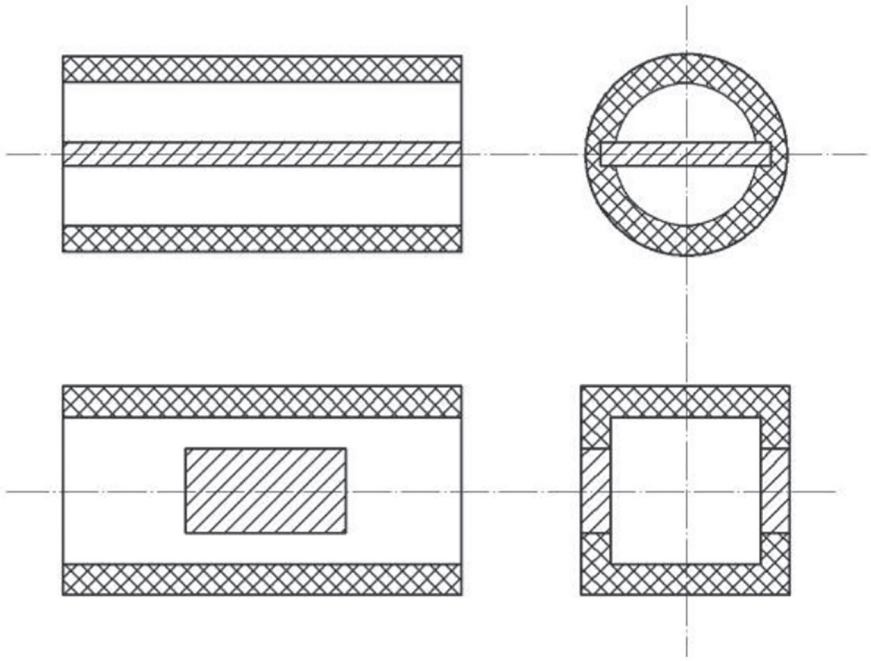

Figure 2 — Test in a pipe or channel with specimen surfaces parallel to the flow direction

5.2 Tests for localized corrosion

5.2.1 Rotating disc test

In this method, a circular disc with comparably smaller thickness is rotated horizontally around the vertical shaft which is attached vertically at the centre (see Figure 3). The test surface is the underside surface of the disc over which the flow velocity distribution is not uniform but distributed. This is the main reason why the localized corrosion of erosion corrosion type can be developed in the rotating disc unlike in the rotating cylinder test. However, the distribution of flow velocity may deviate from the theoretical calculation because the circumferential flow through the disc rotation is overlapped with the radial secondary flow as is shown in Figure 3 with the curved arrows.