BS ISO 17918:2015

BSI Standards Publication

Corrosion of metals and alloys — Evaluation of selective corrosion of Cu alloys and grey cast iron for power plant components by visual inspection and hardness measurement

bsi.

...making excellence a habit.™

Document Sharing Hub

Full document details: BS ISO 17918:2015

National foreword

This British Standard is the UK implementation of ISO 17918:2015.

The UK participation in its preparation was entrusted to Technical Committee ISE/NFE/8, Corrosion of metals and alloys.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2015. Published by BSI Standards Limited 2015

ISBN 978 0 580 79217 5

ICS 77.060

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2015.

Amendments issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 17918:2015

INTERNATIONAL STANDARD

ISO 17918

First edition
2015-07-01

Corrosion of metals and alloys — Evaluation of selective corrosion of Cu alloys and grey cast iron for power plant components by visual inspection and hardness measurement

Corrosion des métaux et alliages — Évaluation de la corrosion sélective des alliages de cuivre et des fontes grises dans les composants des centrales électriques par examen visuel et mesure de la dureté

Reference number
ISO 17918:2015(E)

Documents
Document Sharing Hub

© ISO 2015

Full document details: BS ISO 17918:2015

COPYRIGHT PROTECTED DOCUMENT

© ISO 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 17918:2015

Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Terms and definitions ... **1**
3 Principle ... **2**
4 Procedures ... **2**
4.1 Selection of components sensitive to selective corrosion and components for the test ... 2
4.1.1 Components sensitive to selective corrosion of alloys ... 2
4.1.2 Selection of components subjected to the test for selective corrosion ... 3
4.2 Visual inspection and hardness test for selective corrosion on alloys ... 3
4.3 Procedure of visual inspection for selective corrosion of alloys ... 3
4.4 Procedure of hardness test for selective corrosion on alloys ... 4
4.4.2 Apparatus ... 4
4.4.17 Precision and bias ... 5
5 Responsibility ... **5**
6 Assessment criteria and corrective actions ... **6**
6.1 Assessment criteria ... 6
6.2 Corrective actions for unsatisfactory results ... 7
Annex A (informative) **Data sheet of visual inspection for selective corrosion of alloys** ... **8**
Annex B (informative) **Description sheet for damaged area from selective corrosion of alloys** ... **9**
Annex C (informative) **Evaluation sheet of hardness test results for selective corrosion of alloys** ... **10**
Annex D (informative) **Data sheet of hardness test for selective corrosion of alloys (example)** ... **11**
Annex E (informative) **Photo samples of case histories for selective corrosion** ... **12**
Bibliography ... **21**

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 17918:2015

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 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*.

© ISO 2015 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 17918:2015

Introduction

Selective corrosion occurs when some alloys such as brass, bronze, and cast iron come in contact with stagnant solutions for a long time. Materials suffering from selective corrosion may show various symptoms of deterioration such as localized porous areas (crumbly and fragile), discoloration, change in colour, and so on.

This kind of corrosion occurs when one of the alloying elements in alloys is dissolved from the matrix because of potential differences with other alloying elements. Most common types of selective corrosion are dezincification in brass and graphitization in grey cast iron. Selective corrosion is a very slow and inconspicuous process. Once it occurs, it may have an adverse effect on the integrity of components and structures in the industry. Therefore, it is needed to distinguish the symptoms of selective corrosion and roughly evaluate the soundness of components and structures in the field that are susceptible to selective corrosion before they are subjected to engineering evaluations.

This International Standard specifies the visual inspection and the hardness test for parts made of grey cast iron and uninhibited brass containing greater than 15 % zinc, etc. in systems and components that are sensitive to selective corrosion. Susceptible materials, high temperatures, stagnant flow conditions, and a corrosive environment, such as acidic solutions for brasses with high zinc content and dissolved oxygen, are the causes of selective corrosion. Components include piping, valve bodies and bonnets, pump casings, and heat exchanger components that are susceptible to selective corrosion. These components can be exposed to raw water, treated water, closed cooling water, ground water, water contaminated fuel oil, or water contaminated lube oil.

The criterion is suggested in this International Standard, whether the materials suffering from selective corrosion can be continuously used or should be subjected to engineering evaluation for further and exact examination. The determination of symptoms of selective corrosion and degree of deterioration can be made with the procedures as follows:

— selection of components sensitive to selective corrosion and components for the test (sampling);

— visual inspection for selective corrosion of alloys;

— hardness test for selective corrosion of alloys.

This International Standard provides examples of data sheets for descriptions and information of materials damaged by selective corrosion in the visual inspection. Provided reference photos of case histories can be used in comparing with the real damages of materials on sites. Examples of a description sheet and an evaluation sheet are also provided for the hardness test of selective corrosion.

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 17918:2015

Documents
Document Sharing Hub

INTERNATIONAL STANDARD ISO 17918:2015(E)

Corrosion of metals and alloys — Evaluation of selective corrosion of Cu alloys and grey cast iron for power plant components by visual inspection and hardness measurement

1 Scope

This International Standard specifies procedures of on-site detection and evaluation in order to determine the effects of material deterioration such as material loss from the components and structures that are sensitive to selective corrosion in industrial facilities, including nuclear power plants.

The methodology involves visual inspection and hardness measurements in situ complemented by sample removal. These procedures include (a) representative sampling of components sensitive to selective corrosion, (b) the visual inspection, and (c) the hardness test, respectively. For an exact analysis, additional laboratory testing is recommended.

The methodology is most applicable to grey cast iron and copper alloy with more than 15 % zinc. Extension to other alloys requires supportive evidence of validation.

Assessment criteria orientated to the nuclear power plant application during the past five years before the end of extended operation define the necessity for further engineering evaluation and action like, for example, further sampling, higher frequency of inspection, and component repair or exchange.

This specification is not applicable for components used where the representative sampling of surfaces in contact to the fluid is not detectable optically or detected with the portable hardness tester. Also, in case of non-representative component selection like in HVAC or building service application, this specification is not applicable. For components not used in nuclear power plant, the assessment criteria have to be agreed by the parties. Assessment criteria of hardness test alone is not applicable to the evaluation of structural integrity of Al-bronze, NAB, and Cu-Ni.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
selective corrosion
corrosion of an alloy whereby the components react in proportions that differ from their proportions in the alloy

Note 1 to entry: It is a phenomenon in which one of the alloying elements is electrochemically active and sensitive to corrosion resulting in being selectively removed and the concentrations in other elements being relatively increased in alloys such as bronze, brass, and grey cast iron etc.

EXAMPLE Dezincification, graphitization

[SOURCE: ISO 8044:1999, 3.20]

2.1.1
dezincification
selective corrosion of brass resulting in preferential removal of zinc

Note 1 to entry: It is a phenomenon where the more electrochemically active zinc is preferentially dissolved from copper-zinc alloys with mass fraction of zinc greater than 15 % resulting in a porous copper layer with diminished mechanical properties.

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 17918:2015

[SOURCE: ISO 8044:1999, 3.21]

2.1.2
graphitization
selective corrosion of grey cast iron, resulting in partial removal of metallic constituents, leaving graphite

Note 1 to entry: It is a corrosion process in which iron is selectively dissolved from grey cast iron resulting in remaining vulnerable porous graphite.

[SOURCE: ISO 8044:1999, 3.22]

2.2
visual inspection
one of the non-destructive tests within condition monitoring in which the inspector observes directly the materials, productions, or structures with his own eyes to determine whether surface defects exist on the test bodies

2.3
hardness test
indentation test carried out using a hardness testing machine to measure the hardness of a material

Note 1 to entry: Hardness is local resistance of surface by pressing an indenter with specific load to designate solidness and softness of materials. There is the Brinell hardness which can be used as measuring method with the indenter. An informative calculation to other hardness types (Rockwell hardness, Vickers hardness, etc.) can be helpful.

3 Principle

The result of deterioration from the selective corrosion is the loss of materials followed by a loss of mechanical properties creating a failure.

The loss of materials, which may be the reason for failure, can be determined by the visual inspection and the hardness measurement. The visual inspection identifies corrosion, discoloration, change in colour and local porosity, and the hardness test reveals the change in mechanical properties from the corrosion process at the surface of the test material.

4 Procedures

4.1 Selection of components sensitive to selective corrosion and components for the test

Selection of candidate systems and components for the test and test samples are entirely site-specific considering operating characteristics, sensitivity of materials to degradation, and accessibility. It is recommended that components which are only present in small number in the installation are subjected to 100 % sampling, but that components in large number (e.g. small valves and flanges) are subject to random sampling. In this case, sampling ratio is recommended to be over 10 % of whole components.

NOTE "Large number" means the quantity that the inspectors cannot afford to handle in a limited inspection period such as an overhaul period or an in-service inspection period and vice versa for "small number". Decision shall be made on responsibility of site engineers.

4.1.1 Components sensitive to selective corrosion of alloys

Components sensitive to selective corrosion are mainly made of copper alloys, aluminium-copper alloys, copper-nickel alloys, and grey cast irons, for example:

a) Heat exchangers in component cooling water systems, valves in component cooling seawater systems, pumps and valves in fire protection systems, and components in similar conditions thereof;

© ISO 2015 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 17918:2015