INTERNATIONAL STANDARD

ISO 16048

First edition
2003-02-01

Passivation of corrosion-resistant stainless-steel fasteners

Passivation des éléments de fixation en acier inoxydable résistant à la corrosion

Reference number
ISO 16048:2003(E)

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Published in Switzerland

Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 16048 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 1, *Mechanical properties of fasteners*.

Introduction

In the preparation of this International Standard special attention has been given to the fundamental fact that a surface film of chromium oxide is immediately formed when producing stainless steel or products made of stainless steel. It is this very thin oxide film which can be thickened by passivation. The thickness of the layer is about 0,002 µm.

Passivation of corrosion-resistant stainless-steel fasteners

1 Scope

This International Standard specifies the methods most often used for passivation of corrosion-resistant stainless steel fasteners.

Typical anodic dissolution behaviour of an active-passive-transpassive metal is given in Annex A.

2 Normative references

The following referenced documents are indispensable for the application 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 3506-1:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 1: Bolts, screws and studs*

ISO 3506-2:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 2: Nuts*

ISO 3506-3:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 3: Set screws and similar fasteners not under tensile stress*

ISO 3506-4:—[1)], *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 4: Tapping screws*

3 Terms and definitions

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

3.1
passivation
chemical treatment that increases the thickness of the naturally occurring chromium rich oxide film present on all types of stainless-steel surfaces

3.2
passivity
chemically inactive surface condition of stainless steels

1) To be published.

4 Passivation

4.1 Pickling prior to passivation

Before passivation, a pickling treatment in a bath selected from those listed in Table 1 is recommended.

Before pickling, the fasteners shall be degreased and rinsed.

Table 1 — Pickling baths

Steel grade[a]	Chemicals	Concentration[c] volume %	Temperature[c] °C	Exposure time for fresh bath[c] min
A2 A3 A4 A5 C3[b] F1	HNO_3	20 to 30	20 to 60	10 to 30
	H_2SO_4	8 to 11	60 to 80	5 to 30
A1 C1[b] C4[b]	HNO_3	10 to 15	20 to 60	10 to 30
	H_2SO_4	8 to 11	60 to 80	5 to 30

[a] Steel grades in accordance with ISO 3506-1, ISO 3506-2, ISO 3506-3 and ISO 3506-4.

[b] Prior to pickling, hot forged C1, C3 and C4 fasteners shall be soft annealed to the softest condition and shot-peened in order to reduce the risk of hydrogen embrittlement. For fasteners manufactured from soft annealed and ground C1, C3 and C4 raw material only a shot peening may be necessary.

[c] If necessary, values outside the specified ranges are permitted in adjusting the acid concentration, temperature and exposure time.

4.2 Passivation process

After pickling, the fastener shall be passivated in a bath selected from those listed in Table 2.

Table 2 — Passivation baths

Steel grade[a]	Chemicals	Concentration volume %	Temperature °C	Typical exposure time min
A2, A3, A4, A5 C1 F1	HNO_3	20 to 50	20 to 40	10 to 30
A1 C4	HNO_3[b]	25 to 35	15 to 40	
A1	$HNO_3 + Na_2Cr_2O_7 \cdot 2H_2O$[c]	15 to 25		
C4	$HNO_3 + Na_2Cr_2O_7 \cdot 2H_2O$[c]	2 to 6		

[a] Steel grades in accordance with ISO 3506-1, ISO 3506-2, ISO 3506-3 and ISO 3506-4.

[b] Use preferably this bath.

[c] The addition of $Na_2Cr_2O_7 \cdot 2H_2O$ may be used to minimize the discoloration or etching of high carbon and free-cutting stainless steels.

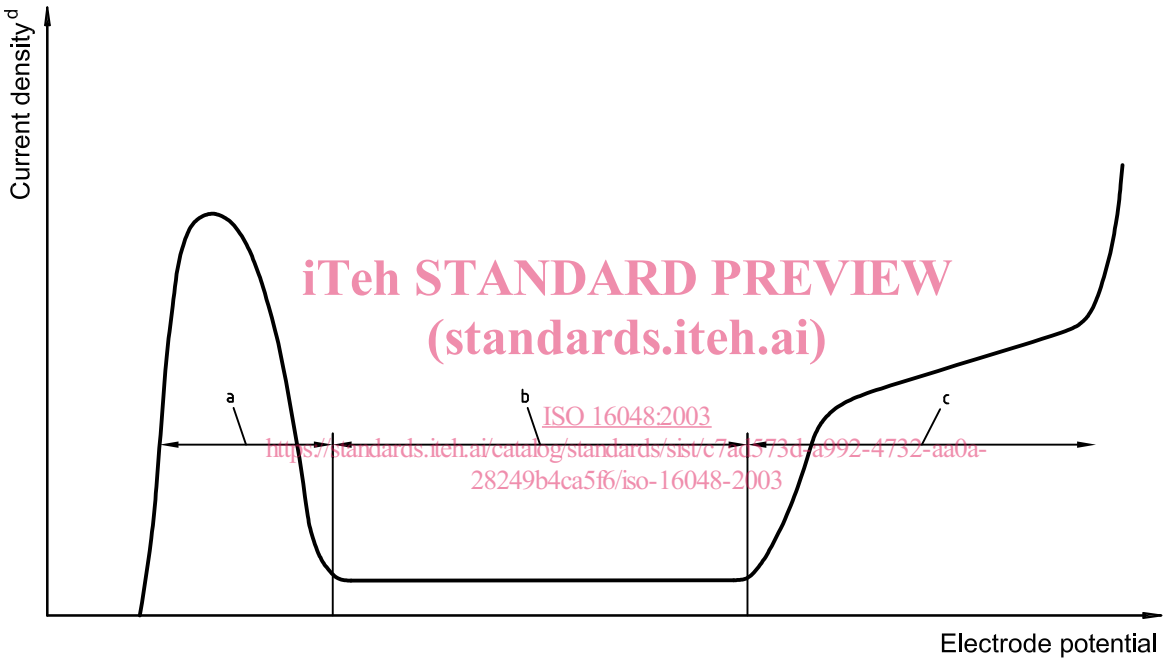
5 Verification of passivation

Passivation shall be verified by the manufacturer's quality assurance system. There is no known referee test method for passivation.

Annex A
(informative)

Passivity

Figure A.1 schematically illustrates the typical behaviour of an active-passive-transpassive metal. The metal initially demonstrates behaviour similar to non-passivating metals, i.e., as the electrode potential is made more positive, the metal follows typical Tafel behaviour, and dissolution rate increases exponentially. This is the active region. At more noble potentials, dissolution rate decreases to a very small value and remains essentially independent of potential over a considerable potential region. This is termed the passive region. Finally, at very noble potentials, dissolution rate again increases with increasing potential in the transpassive region.



a Active

b Passive

c Transpassive

d Logarithmic scale

Figure A.1 — Typical anodic dissolution behaviour of an active-passive-transpassive metal