
International Standard



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Aerospace — Surface treatment of hardenable stainless steel parts

Aéronautique et espace — Traitement de surface des éléments en acier inoxydable à durcissement structural

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Aerospace — Surface treatment of hardenable stainless steel parts

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0 Introduction

The corrosion resistance of stainless steels is dependent upon the integrity of a transparent oxide film present on the surface. Discontinuities in this protective film may result from contamination, for example by iron or carbon on the surface or diffused into the surface layers. Furthermore, because the integrity of the film is dependent on the constant availability of fresh oxygen, discontinuities may result from minute oxygen-starved crevices such as occur under particles of dirt, even though those particles might be chemically inert.

1 Scope and field of application

1.1 This International Standard specifies the requirements for the surface treatment of parts made from martensitic, precipitation hardening and maraging stainless steels (for example AISI 400 series, 17-7PH, 17-4PH, 15-5PH, AM350, AM355, PH15-7Mo, PH13-8Mo, Custom 450 and 455). It provides practical methods for removing contaminants and for obtaining suitable corrosion resistance for aerospace applications.

1.2 The surface treatments required during manufacture are mandatory for all surfaces of all parts. The final surface treatments are mandatory except when a surface coating (for example paint, plating) is specified. When such a coating is specified for only a portion of the surfaces of a part, the uncoated portions shall be treated in accordance with the final surface treatment requirements of this International Standard.

1.3 It is the responsibility of the processor to determine, by analysis or history, the condition of the surface prior to treat-

ment to assure conformance to the requirements of this International Standard.

2 Technical requirements

CAUTION — The procedures specified in B.2.3, B.2.4 and annex C may remove significant material from surfaces. Care shall be exercised to allow for such removal so that final dimensional requirements are met.

2.1 Surface treatment during manufacture

2.1.1 Prior to any heating (for example annealing, welding), the steel shall be cleaned to remove all contaminants as specified in 2.1.1.1 and 2.1.1.2.

2.1.1.1 Remove any non-metallic organic contaminants by the appropriate procedure(s) in annex A.

2.1.1.2 Remove any metallic and non-metallic inorganic contaminants by the appropriate procedure(s) in annex B.

2.2 Final surface treatment

2.2.1 After all other manufacturing operations have been completed, surfaces shall be treated as specified in 2.2.1.1 to 2.2.1.4.

2.2.1.1 Remove any non-metallic organic contaminants by the appropriate procedure(s) in annex A.

2.2.1.2 Remove any metallic and non-metallic inorganic contaminants by the appropriate procedure(s) in annex B.

2.2.1.3 After cleaning as specified in 2.2.1.1 and 2.2.1.2, smooth surfaces by the appropriate procedure(s) in annex C, except for the following cases :

- a) when specifically exempted by the cognizant engineering organization responsible for the design;
- b) for large sheet metal parts where it is impractical;
- c) if surfaces have been machined or ground to 1,6 µm or smoother.

2.2.1.4 If the final operation performed in accordance with annex B or C is neither passivating nor electropolishing, passivate in accordance with annex B as a final operation.

2.3 Quality

2.3.1 Appearance

Treated parts shall exhibit a smooth, clean surface with no evidence of localized attack or etching.

2.3.2 Corrosion resistance

Treated parts shall be capable of withstanding the humidity and immersion tests specified in the following without evidence of rust stains or other corrosion products. Periodically, at a frequency (selected by the processor) sufficient to guarantee the above capability, treated parts or specimens shall be subjected to the tests of 2.3.2.1 and 2.3.2.2.

2.3.2.1 Humidity test

Expose the parts to 100 % humidity at 38 ± 2 °C for 24 h in a humidity cabinet.

2.3.2.2 Immersion test

Alternately, immerse the parts in distilled water at room temperature for 1 h and then allow to dry for 1 h at room temperature. Repeat the above cycle until 24 h have elapsed (12 cycles).

3 Preservation and packaging

The treated parts shall be protected by suitable covering so as to preclude contamination or mechanical damage during storage and transportation.

Annex A

Removing organic contaminants

A.1 Application

This operation is required for cleaning non-metallic organic soils from surfaces of stainless steel parts. Oil, grease, dirt, paint, ink, etc. shall be removed by one or more of the procedures specified in clause A.2 before any heating and before other final surface treatments.

A.2 Procedures

A.2.1 Vapour degreasing

Immerse parts in vapour degreaser until condensate dripping ceases. Spray parts with hot solvent as necessary. Chlorinated degreasers should contain inhibitors.

A.2.2 Solvent cleaning

CAUTION – Care shall be exercised to prevent fires when inflammable solvents are used and to prevent health hazards when toxic solvents are used.

Scrub surfaces with a brush or cloth moistened with appropriate solvent. Dry surfaces with a clean cloth; do not allow them to dry by evaporation. Repeat until the surface is clean.

A.2.3 Alkaline cleaning

Immerse parts in alkaline cleaning solution for approximately 10 min, then rinse thoroughly. Repeat until clean and free from water breaks. Dry with a clean air blast or in an oven at 100 to 110 °C, unless another chemical treatment follows immediately.

A.2.4 Emulsion cleaning

Immerse parts in emulsion cleaning solution for approximately 10 min, then rinse thoroughly. Repeat until clean and free from water breaks. Dry with a clean air blast or in an oven at 100 to 110 °C, unless another chemical treatment follows immediately.

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Annex B

Removing inorganic contaminants

B.1 Application

This operation is required for cleaning metallic and non-metallic inorganic contaminants from surfaces of hardenable stainless steel parts before heating and as a final or semi-final treatment. "Metallic contaminants" include invisible minute traces normally present on surfaces which have been in contact with magnetic inspection fluid and, under pressure, with other foreign materials, for example steel cutting tools, zinc forming dies and lead hammers. "Non-metallic contaminants" include scale and discoloration resulting from heating or welding.

B.1.1 Before heating

Removal of oxides, scale, discoloration, etc., is not required. Remove graphite and other carbon-containing contaminants by use of one or more of the procedures specified in clause B.2. Remove metallic contaminants by passivating in accordance with B.2.1, except for the following cases.

B.1.1.1 Passivating is not required for parts made from sheet if the only manufacturing operations performed have been shearing and hole drilling.

B.1.1.2 Passivating is not required for parts made from the annealed steel, type AISI 440C, as severe etching may occur.

B.1.1.3 Passivating is not required when the temperature to which the parts will be heated is below 650 °C and if the only likely contaminants are iron or steel.

B.1.2 Before smoothing (see annex C)

Removal of metallic contaminants is not required. Remove oxides, scale, discoloration, graphite, etc. by use of one or more of the procedures specified in clause B.2.

B.1.3 Final treatment — Machined parts

Passivate in accordance with B.2.1.

NOTE — Applicable to parts containing only surfaces which have been machined or ground to 1,6 µm or smoother.

B.1.4 Final treatment — Large sheet metal parts

First of all, remove oxides, scale, discoloration, graphite, etc. by use of one or more of the procedures specified in clause B.2. Then, remove metallic contaminants by passivating in accordance with B.2.1.

B.2 Procedures

B.2.1 Passivating

Immerse parts in solution of 280 to 710 g/l nitric acid for either 1 h minimum at room temperature or 20 min minimum at 50 ± 3 °C. Rinse thoroughly, then dry in a clean air blast or in an oven at approximately 100 to 110 °C.

B.2.1.1 Prepare passivating solution by adding, to water, 200 to 500 ml of nitric acid (HNO_3 , ρ approximately 1,40 g/ml) for each litre of final solution.

B.2.1.2 It is permissible to add 20 to 30 g/l of sodium dichromate ($\text{Na}_2\text{Cr}_2\text{O}_7$) to the passivating solution to increase corrosion resistance.

B.2.1.3 It is permissible to add approximately 3,5 g/l of molybdic acid (HMoO_4) to the passivating solution to increase the removal rate of thick lead deposits.

B.2.2 Removing pencil markings

Use a soft rubber eraser to remove pencil markings from part surfaces.

B.2.3 Abrasive blasting

Use wet or dry method with clean 180 µm or finer aluminium oxide or garnet. Do not use metallic abrasives or abrasives contaminated with other materials. A scale conditioning treatment may be used to facilitate scale removal.

B.2.4 Wire brushing

Use only brushes made from stainless steel wire. Do not use brushes which have been used on other materials.

B.3 Process control

B.3.1 Solution temperature

The temperature control equipment for solutions used at elevated temperature shall maintain the temperature throughout the working zone to within ± 3 °C of the set temperature. A temperature uniformity survey shall be made at the beginning of each month of operation to ensure that this requirement is being met. The temperature shall be checked at points uniformly distributed throughout the working zone. The minimum number of points checked shall be nine for tanks of 36 m³ and less, and one per 4 m³, or fraction thereof, for tanks over 36 m³.

B.3.2 Solution composition

The composition of solutions shall be determined at a frequency that will maintain all constituents within the limits specified in clause B.2 and preclude excessive contamination. The frequency of analysis shall be at least once a week. Contamination by metallic oxides, calculated as M_2O_3 (where M is the metal), shall not exceed 5 g/l.

B.3.2.1 When the volume of parts being processed each week is low and at least 4 weeks of experience show that weekly analysis is unnecessary, the analysis frequency may be changed to monthly.

B.3.2.2 If a solution has not been used for more than two analysis periods, it shall be analysed prior to being used for processing parts.

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Annex C

Smoothing surfaces

C.1 Application

This operation is required to maximize the corrosion resistance of surfaces of parts made from martensitic, maraging and precipitation hardening grades, except those made from sheet and except for surfaces machined or ground to 1,6 μm or smoother.

NOTE — This operation is recommended for surfaces of parts made from sheet whenever it is practicable. Use of one or more of these procedures is mandatory on as-cast, as-forged and other raw stock surfaces and surfaces which have been

- a) machined to a finish rougher than 1,6 μm ;
- b) abrasive blasted;
- c) wire brushed;
- d) tumble deburred;
- e) discoloured.

C.2 Procedures

C.2.1 Electropolishing

Any of the proprietary methods may be used.

C.2.2 Buffing

Stainless steel buffing compound shall be used. Buffs shall be reserved for use only on stainless steels.

C.2.3 Sanding

Use aluminium oxide or silicon carbide coated abrasives. Finish with 90 μm grit or finer.

C.3 Requirements

After smoothing, surfaces shall be bright. They need not be highly reflective or shiny. They may be frosty bright or milky bright. They shall not be dull or grey.

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