
**Metallic and other inorganic coatings —
Cleaning and preparation of metal
surfaces —**

**Part 2:
Non-ferrous metals and alloys**

*Revêtements métalliques et autres revêtements inorganiques —
Nettoyage et préparation des surfaces métalliques —
Partie 2: Métaux non ferreux et alliages*

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Contents

Page

Foreword.....	vii
Introduction	viii
1 Scope	1
2 Normative references	2
3 Terms and definitions.....	3
4 Essential information to be supplied by the purchaser to the processor	3
5 Requirements	4
6 Standard cleaning methods.....	5
7 Non-corrosion-resisting steels, cast irons and pure irons	5
8 Corrosion-resisting and heat-resisting steels	6
9 Pretreatment of metals prior to powder coating	6
10 Cleaning and preparation processes.....	6
11 Aluminium and aluminium alloys.....	6
11.1 General.....	6
11.2 General degreasing and cleaning	6
11.3 Removal of corrosion products	6
11.4 Preparation prior to anodizing	7
11.5 Preparation prior to oxide removal treatment (process O) or filming treatment	7
11.6 Preparation prior to adhesive bonding of unanodized items	7
11.7 Preparation prior to electroplating.....	7
11.8 Preparation prior to autocatalytic nickel plating	7
11.9 Preparation prior to conversion coating	7
11.10 Preparation prior to metal spraying.....	7
11.11 Preparation prior to vitreous enamelling	8
11.11.1 Sheet, extrusions and items made from casting alloys.....	8
11.11.2 Other castings.....	8
11.12 Preparation prior to supplementary treatments on physically vapour deposited aluminium.....	8
12 Copper and copper alloys.....	8
12.1 General degreasing and cleaning	8
12.2 Preparation prior to electroplating.....	9
12.3 Preparation prior to autocatalytic nickel plating	9
12.4 Preparation prior to hot tinning (TRI process)	10
12.5 Preparation prior to vitreous tinning	10
13 Nickel alloys	10
13.1 General degreasing and cleaning	10
13.2 Preparation prior to electroplating.....	10
13.3 Preparation prior to autocatalytic deposition	11
13.4 Preparation prior to vitreous enamelling	11
14 Titanium and titanium alloys	11
14.1 General degreasing and cleaning	11
14.2 Preparation prior to electroplating.....	12
14.3 Preparation prior to autocatalytic nickel plating	12
15 Magnesium alloys	12
15.1 General degreasing and cleaning prior to electroplating and conversion coating	12

15.2	Preparation prior to electroplating	12
15.3	Preparation prior to conversion coating	13
15.3.1	General	13
15.3.2	As-cast castings	13
15.3.3	Machined castings	14
15.3.4	Forgings	14
15.3.5	Sheets and extrusions	14
16	Zinc-based alloys	14
16.1	General degreasing and cleaning	14
16.2	Cleaning of corroded items	14
16.3	Preparation of zinc alloy die castings prior to electroplating	14
16.4	Preparation of zinc alloy castings prior to chromate conversion coating or phosphate treatment	14
17	Tin and its alloys	14
18	Tungsten alloys	15
18.1	Preparation prior to electroplating	15
18.2	Preparation prior to adhesive bonding	15
19	Lead and its alloys	15
20	Zinc-, cadmium-, chromium- and gold-coated items	15
20.1	Preparation of zinc-coated items prior to chromate conversion coating	15
20.2	Preparation of cadmium-coated items prior to chromate conversion coating	15
20.3	Preparation of physically vapour deposited cadmium prior to supplementary treatments	15
20.4	Preparation for chromium-coated parts prior to supplementary treatments	16
20.5	Removal of surface contamination from gold coatings	16
21	Pretreatment of metals prior to powder coating	16
21.1	Preparation of aluminium prior to powder coating	16
21.2	Preparation of zinc and hot-dip-galvanized steel prior to powder coating	16
21.3	Preparation of copper and brass prior to powder coating	16
22	Cleaning and preparation processes	16
22.1	Process A — Organic-solvent degreasing and cleaning	17
22.1.1	General	17
22.1.2	Method A1 — Hot solvent, not water-rinsable	17
22.1.3	Method A2 — Cold solvent, not water-rinsable	17
22.1.4	Method A3 — Hot solvent, water-rinsable	17
22.1.5	Method A4 — Cold solvent, water-rinsable	18
22.1.6	Method A5 — Petroleum fuel based mixtures containing emulsifying agents	18
22.1.7	Method A6 — Ultrasonic cleaning	18
22.2	Process B — Alkaline degreasing	18
22.2.1	General	18
22.2.2	Method B1 — General-purpose alkaline degreasing	18
22.2.3	Method B2 — Mild alkaline degreasing	18
22.2.4	Method B3 — Cathodic alkaline degreasing	19
22.3	Process C — Acid emulsion cleaning	19
22.4	Process D — Abrasive cleaning	19
22.4.1	General	19
22.4.2	Method D1 — Coarse-abrasive blasting	19
22.4.3	Method D2 — Fine-abrasive blasting	19
22.4.4	Method D3 — Scouring	19
22.4.5	Method D4 — Tumbling	20
22.4.6	Method D5 — Wire brushing	20
22.5	Process E — Caustic-alkali descaling	20
22.6	Process F — Acid pickling without electrolysis	20
22.7	Process G — Acid dipping	20
22.8	Process H — Anodic pickling	20
22.8.1	General	20
22.8.2	Method H1	20

22.9	Process J — Acid de-rusting	20
22.10	Process K — Alkaline de-rusting	21
22.11	Process L — Chemical smoothing and electropolishing of steels	21
22.12	Process M — Passivation and removal of surface contamination from corrosion-resisting steels and surface preparation prior to electroplating	21
22.13	Process N — Acid pickling of aluminium alloys	21
22.13.1	General	21
22.13.2	Method N1	21
22.13.3	Method N2	21
22.13.4	Method N3	21
22.13.5	Method N4	22
22.13.6	Method N5	22
22.13.7	Method N6	22
22.14	Process O — Oxide removal, i.e. “etching”, treatment of aluminium and aluminium alloys	22
22.14.1	General	22
22.14.2	Degreasing and cleaning	22
22.14.3	Preparation prior to anodizing and adhesive bonding	23
22.15	Process P — Aluminium and aluminium alloys — Removal of corrosion products, etching treatment, chemical polishing, electrobrightening and electropolishing	24
22.15.1	Removal of corrosion products	24
22.15.1.1	Method P1 — Immersion	24
22.15.1.2	Method P2 — Swabbing	24
22.15.2	Etching treatment	24
22.15.2.1	Method P3 — Etching by brushing or spray treatment	24
22.15.2.2	Method P4 — Etching and de-smutting treatment using sodium hydroxide	24
22.15.3	Method P5 — Chemical polishing	25
22.15.4	Method P6 — Electrobrightening	25
22.15.5	Method P7 — Electropolishing	26
22.16	Process Q — Cleaning of copper and copper alloys	26
22.16.1	Method Q1 — Cleaning in dichromate/sulfuric acid solution	26
22.16.2	Method Q2 — Cleaning in ferric sulfate/sulfuric acid solution	26
22.17	Process R — Acid descaling, etching, chemical smoothing and electropolishing of copper and copper alloys	26
22.17.1	Method R1 — Descaling dip	26
22.17.2	Method R2 — Bright dip	26
22.17.3	Method R3 — Chemical smoothing	27
22.17.4	Method R4 — Pickling in nitric acid	27
22.17.5	Method R5 — Electropolishing	27
22.18	Process S — Pickling of titanium and titanium alloys	27
22.18.1	General	27
22.18.2	Method S1	27
22.18.3	Method S2	27
22.19	Process T — Pickling, chemical polishing and electropolishing of nickel and its alloys	28
22.19.1	General	28
22.19.2	Method T1	28
22.19.3	Method T2	28
22.19.4	Method T3	28
22.19.5	Method T4 — Chemical polishing	28
22.19.6	Method T5 — Electropolishing	29
22.20	Process U — Preparation of tin alloy for electroplating	29
22.21	Process V — Removal of surface contamination from gold coatings	29
22.22	Process W — Preparation of aluminium alloys prior to electroplating	29
22.23	Process X — Preparation of nickel alloys prior to electroplating	30
22.24	Process Y — Preparation of titanium alloys prior to electroplating	31
22.24.1	Method Y1 — General method for titanium alloys	31
22.24.2	Method Y2 — Method for titanium and selected titanium alloys	32
22.24.3	Method Y3 — Chemical-etching method	32
22.25	Process Z — Preparation of zinc and zinc alloys prior to electroplating	33
22.25.1	Method Z1	33
22.25.2	Method Z2	33

Annex A (informative) Maintenance of organic and vapour degreasing baths	34
Annex B (informative) The control of acidity in vapour cleaning baths	35
Annex C (normative) Method for the determination of oxidizable material in sulfuric acid	36
Annex D (informative) Method for determining free acidity	37
Annex E (normative) Selection of method of cleaning according to the tensile strength of the steel in zinc-coated steel items prior to chromate conversion coating	38
Annex F (normative) Method M4	40
Bibliography	41

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[ISO 27831-2:2008](https://standards.iteh.ai/catalog/standards/sist/572c2406-0e57-4568-ac70-100460ee67d7/iso-27831-2-2008)

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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.

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 27831-2 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

ISO 27831 consists of the following parts, under the general title *Metallic and other inorganic coatings — Cleaning and preparation of metal surfaces*:

- Part 1: *Ferrous metals and alloys* [ISO 27831-2:2008](https://standards.iteh.ai/catalog/standards/sist/572c2406-0e57-4568-ac70-100460ee67d7/iso-27831-2-2008)
- Part 2: *Non-ferrous metals and alloys* <https://standards.iteh.ai/catalog/standards/sist/572c2406-0e57-4568-ac70-100460ee67d7/iso-27831-2-2008>

Introduction

The adhesion of deposited coatings depends upon the efficiency of degreasing and cleaning processes used on the substrate surface. The removal of grease, oil and dirt and all other forms of contamination left from fabrication processes or due to corrosion/erosion of surfaces in storage or in service is essential for successful production of a pristine, chemically clean active surface for deposition of coatings.

The surface contaminants can be

- corrosion products, mould sand or mould release agents on ferrous and non-ferrous castings;
- corrosion products and mill scales on hot-rolled steel sheet, girders, etc. (broken mill scale is cathodic to the underlying substrate);
- oil and rolling lubricant on cold-rolled steel sheet;
- rolling lubricant on e.g. cold-rolled aluminium sheet;
- corrosion products on delivery or during storage on hot-dip-galvanized steel sheet or angle bars/brackets;
- other undesirable materials from storage and handling.

The difficulty of coating these surfaces is well known.

Cleaning processes for removing surface contaminants are varied, depending, among other things, on the identification and classification of the soil as well as the size and shape of the substrate, the degree of cleanliness required, the availability of the facilities needed, the cost of the processes used and their impact on the environment, and the nature of subsequent processes to which the substrate is going to be subjected.

ISO 27831 includes cleaning processes ranging from mechanical methods (which give the least degree of cleanliness) to chemical and ultrasonic methods (which give a higher degree of surface preparation) and substrate conditioning by glow discharge plasma (sputter cleaning) for vapour deposition.

ISO 27831 describes practices for cleaning a variety of metals and metal alloys prior to the application of a range of coatings or without any coating requirements.

The cleaning processes described in ISO 27831-1 and ISO 27831-2 are indicative only of those most commonly used in practice. However, there are numerous formulations of solutions and numerous proprietary processes available which are not included in ISO 27831-1 or ISO 27831-2. Wherever possible, references to particular processes have been made. For references concerning all other processes included in either part of ISO 27831, the publications given in the Bibliography in the respective part should be consulted.

ISO 27831-1 covers ferrous metals and their alloys, whilst ISO 27831-2 covers non-ferrous metals and their alloys. For ISO 27831-2 to be usable, as far as possible, as a “stand-alone” document, Clauses 1 to 6 of ISO 27831-1 have been included in it as Clauses 1 to 6 and the numbering of the other clauses follows the same sequence as in ISO 27831-1. Additionally, since some of the cleaning and preparation processes specified for ferrous materials in ISO 27831-1 can also be used for non-ferrous metals, the cleaning and preparation processes follow the same sequence, using the same designations, as in ISO 27831-1.

Metallic and other inorganic coatings — Cleaning and preparation of metal surfaces —

Part 2: Non-ferrous metals and alloys

WARNING — This part of ISO 27831 may not be compliant with some countries' health, safety and environmental legislation. It calls for the use of substances and/or procedures that may be injurious to health if adequate safety measures are not taken. This part of ISO 27831 does not address any health hazards, safety or environmental matters, or legislation associated with its use. It is the responsibility of the user of this part of ISO 27831 to establish appropriate health, safety and environmentally acceptable practices and take appropriate action to comply with any national, regional and/or international regulations. Compliance with this part of ISO 27831 does not, of itself, confer immunity from legal obligations.

1 Scope

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This part of ISO 27831 specifies processes for the cleaning of the surfaces of non-ferrous metals and their alloys to remove any irrelevant or unwanted deposits or other material at any stage of manufacture, storage or service and for the preparation of these surfaces for further treatment. It does not cover cleaning operations associated with the preliminary removal of heavy deposits of oil, grease or dirt accumulated during operational service, preparations for welding or the cleaning of electrical contacts. However, many of the processes included in this part of ISO 27831 may be used for these operations at the discretion of the users of this part of ISO 27831.

This part of ISO 27831 covers processes which are needed for the preparation of metal surfaces prior to the application of the following surface coatings:

- electrodeposited metal coatings;
- autocatalytic metal coatings (autocatalytic and displacement types);
- conversion coatings;
- anodic oxidation coatings;
- hot-dipped coatings;
- sprayed metal coatings;
- coatings produced by vitreous enamelling;
- coatings produced by physical vapour deposition of aluminium and cadmium;
- powder coatings.

This part of ISO 27831 describes processes for carrying out the following treatments:

- degreasing;
- descaling;
- pickling;
- etching;
- de-rusting;
- chemical smoothing;
- chemical polishing;
- electrobrightening;
- electropolishing;
- fluoride anodizing (for cleaning magnesium alloys).

This part of ISO 27831 relates the processes described above to the following metals:

- aluminium and aluminium alloys;
- copper and copper alloys;
- nickel alloys;
- titanium and titanium alloys;
- magnesium alloys;
- zinc-based alloys;
- tin and tin alloys;
- tungsten alloys;
- lead and lead alloys;
- zinc-, cadmium-, chromium- and gold-coated items.

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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 2064, *Metallic and other inorganic coatings — Definitions and conventions concerning the measurement of thickness*

ISO 2080, *Metallic and other inorganic coatings — Surface treatment, metallic and other inorganic coatings — Vocabulary*

ISO 4527, *Metallic coatings — Autocatalytic (electroless) nickel-phosphorus alloy coatings — Specification and test methods*

ISO 8078, *Aerospace process — Anodic treatment of aluminium alloys — Sulfuric acid process, undyed coating*

ISO 9587, *Metallic and other inorganic coatings — Pretreatment of iron or steel to reduce the risk of hydrogen embrittlement*

ISO 9588, *Metallic and other inorganic coatings — Post-coating treatments of iron or steel to reduce the risk of hydrogen embrittlement*

ISO 10074, *Specification for hard anodic oxidation coatings on aluminium and its alloys*

ISO 22778, *Metallic coatings — Physical vapour-deposited coatings of cadmium on iron and steel — Specification and test methods*

ISO 22779, *Metallic coatings — Physical vapour-deposited coatings of aluminium — Specification and test methods*

ISO 27831-1:2008, *Metallic and other inorganic coatings — Cleaning and preparation of metal surfaces — Part 1: Ferrous metals and alloys*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064, ISO 2080, ISO 9587, ISO 9588, ISO 22778 and ISO 22779 apply.

4 Essential information to be supplied by the purchaser to the processor

When ordering articles to be processed in accordance with this part of ISO 27831, the purchaser shall provide the following information in writing, e.g. in the contract, in the purchase order or on the engineering drawing:

- a) the number of this part of ISO 27831 (ISO 27831-2);
- b) the specification and metallurgical condition of the material of which the item is made;
- c) the tensile strength of any steel components and the requirements for stress relief and post-cleaning embrittlement relief heat treatments of the steel to reduce the risk of hydrogen embrittlement (see Annex E);
- d) the cleaning method or methods given in this part of ISO 27831 which are to be used, and any deviation from these methods (e.g. the use of a proprietary method for health or safety reasons);
- e) details of any particular requirements for special surfaces;
- f) details of any special procedures (e.g. process H, method H1);
- g) details of any particularly difficult surface condition and any special information regarding coatings to be removed or coatings or inserts to be protected;
- h) where appropriate, details of the surface coating which is to be subsequently applied.

5 Requirements

5.1 Any materials used for cleaning and preparation shall contain not more than a mass fraction of 5×10^{-6} of mercury (Hg). Where items can be regarded as susceptible to degradation by residual arsenic and/or antimony, the following maximum limitations shall also apply:

for arsenic (As): a mass fraction of 15×10^{-6} ;

for antimony (Sb): a mass fraction of 15×10^{-6} .

NOTE 1 The presence of arsenic, reduced sulfur or reduced phosphorous compounds in an acid bath will promote absorption of hydrogen by steel and may reduce the adhesion of subsequently applied coatings.

NOTE 2 Contamination of steel components can occur when antimony-inhibited solutions are used. The resultant deposit of antimony on exposed surfaces can adversely affect the properties of the steel and subsequent processing of the item. If processing solutions become contaminated, this can lead to further items being similarly affected.

5.2 When assembled items are being processed, the treatments chosen shall be suitable for each constituent material and the combination of materials.

5.3 Items will often require a sequence of several degreasing and cleaning treatments. Solvent cleaning may occasionally leave traces of soil after evaporation of the solvent and care shall be taken to remove such contamination. Inorganic contamination may not always be removed by organic solvents. It may therefore be necessary to use additional aqueous processes after final degreasing and cleaning.

5.3.1 The surfaces shall be free from grease, oil, oxide, scale and other foreign matter and shall be in a chemically clean condition, i.e. fully receptive to any subsequent processing.

To test for surface cleanliness, the cleaned surface may be sprayed with, or immersed in, cool, clean water. On clean surfaces, the water will form a uniform film whereas, in the presence of oily soils, the water film will break away from contaminated areas. In cases of gross contamination, the entire film may break down into discrete globules. If the surface to be tested has any residue of cleaning agent containing surface-active agent, a continuous film may be obtained even in the presence of grease. This false effect can be overcome by dipping the surface in dilute acid and rinsing before carrying out the test. Subsequent specified treatments shall be applied without delay.

5.3.2 Abrasives used on any metal or alloy shall not also be used on any dissimilar metal or alloy. Separate abrasive cleaning media shall be used for different alloy families, for example iron and its alloys, aluminium and its alloys. Thus alumina, for example, used for abrasive cleaning of aluminium surfaces, shall not have been used for any other type of material, such as steel or copper-rich alloys, or been otherwise externally contaminated.

Shot peening of the basis metal or substrate, if required, shall be performed before final cleaning and the application of the coating.

5.3.3 The mechanical properties shall not be impaired except where they may be recovered by subsequent heat, or other, treatments forming part of the normal processing sequence.

5.3.4 The dimensions and surface finish shall be such as to enable the finished (e.g. electroplated) items to be within the required drawing or specification limits.

5.4 Where solvent cleaning is used, corrosion of items, particularly those made from light alloys, may occur if they are subjected to heat before all the solvent has disappeared from the surfaces. Thus, solvents which thermally degrade with the liberation of corrosive products shall not be used. Care shall also be taken to ensure that all traces of liquid are removed from items of complex form or containing blind holes. Bundles of items intended for immediate heat treatment shall be shaken to ensure that liquid is not retained by capillary attraction between surfaces in contact. In any event, after removal from the degreaser, items shall not be immersed in a molten salt bath until they are completely dry and have reached room temperature.

It is not good practice to allow an interval between treatments. It shall be borne in mind that degreasing and cleaning procedures produce a surface whose resistance to corrosive attack is low. Consequently, readily corrodible materials need to be protectively coated or further processed immediately.

5.5 Immediately after each treatment in an aqueous solution, the items shall be thoroughly rinsed in clean hot and/or clean cold water, as appropriate, paying special attention to items containing crevices. Immediately after the final rinsing, the metal surface shall not exhibit a water break. Water used for final rinsing after processing shall be discarded or retreated when the conductivity exceeds 10 $\mu\text{S}/\text{cm}$.

5.6 After the final rinsing or other final preparatory treatment, items to be given a protective treatment in aqueous solutions shall be transferred immediately, without drying, to the treatment bath.

5.7 Items to be given further treatment by dry processes and items which are not to be subjected to further processing shall be thoroughly dried.

5.7.1 Where drying in a draught of warm air is recommended, the air shall be free from oil and other contaminants.

5.7.2 The use of chlorinated solvents for drying purposes is not permitted.

5.8 All stages of the degreasing and cleaning procedures shall follow each other without delay.

5.9 The acid and alkaline solutions used in some of the cleaning and preparation processes can have a deleterious effect on unstable materials. When an item is for use with unstable materials, particular care shall be taken to ensure that all such solutions are completely removed by thorough washing with clean water. Special attention shall be paid to irregularly shaped items and to blind holes and crevices.

5.10 Where limits of composition of solutions are known, they are quoted in this part of ISO 27831. Where limits are not quoted, other proportions may be used provided they are within a tolerance of $\pm 10\%$.

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6 Standard cleaning methods

6.1 The processes and methods described in this part of ISO 27831 are indicative only of those most commonly used in practice. However, there are numerous formulations of solutions and proprietary processes available which are not included in this part of ISO 27831. Throughout this part of ISO 27831, the process and method designations in brackets which follow references to cleaning treatments refer to the processes and methods in Clause 22.

6.2 All porous castings shall be degreased, cleaned and dried prior to their impregnation.

6.3 The efficiency of some of the methods may be increased by the use of ultrasonic agitation (process A, method A6), but care shall be taken to avoid damage to delicate items and assemblies such as electrical or electronic equipment and semi-conductor devices.

6.4 To avoid packing or nesting of large volumes of small items in soak cleaners, a barrel cleaning method may be used. This method is not suitable for thin or delicate items.

6.5 Vibratory cleaning methods may be used for the deburring and polishing of fragile components in a moving bed of abrasive medium (process D, method D3) containing a detergent compound.

7 Non-corrosion-resisting steels, cast irons and pure irons

See ISO 27831-1.

8 Corrosion-resisting and heat-resisting steels

See ISO 27831-1.

9 Pretreatment of metals prior to powder coating

See ISO 27831-1.

10 Cleaning and preparation processes

See ISO 27831-1.

11 Aluminium and aluminium alloys

11.1 General

Etching and pickling processes may adversely affect fatigue strength and, for certain high-strength alloys, may cause stress corrosion problems. In particular, sodium hydroxide (method P2) and pickling (process N) can have a severe effect and agreement between supplier and purchaser is necessary for its use. Some authors do not recommend the use of sulfuric acid on aluminium.

The properties of certain heat-treatable aluminium alloys may be adversely affected by prolonged treatment at or above 100 °C. Some aluminium alloys are also susceptible to hydrogen embrittlement.

11.2 General degreasing and cleaning

ISO 27831-2:2008

Degrease and clean by one or more of the following processes and methods, as appropriate:

- a) process A;
- b) process B (method B1) for degreasing unmachined or rough-machined aluminium alloy forgings prior to final inspection;
- c) process B (method B2);
- d) process D;
- e) oxide removal in chromic acid/sulfuric acid solution (process O);
- f) pickling in accordance with process N;
- g) etching in sodium hydroxide solution (method P2);
- h) a chemical or electrolytic polishing treatment (process P).

Drying by chlorinated solvents is not permitted.

11.3 Removal of corrosion products

Use one of the following procedures:

- a) immersion in chromic acid/phosphoric acid solution in accordance with process P (method P1) which results in least attack of underlying metal;

- b) process O, process P (method P3) or process D (excluding method D1) to remove light corrosion products and soil;
- c) process P (method P2) or process D (excluding methods D1 and D4) to remove light corrosion products *in situ*.

NOTE In certain circumstances, fine-abrasive blasting may peen over pits and retain corrosion products.

11.4 Preparation prior to anodizing

Degrease and clean in accordance with 11.2. Carry out the anodizing itself in accordance with ISO 8078, ISO 10074 or another appropriate International Standard.

11.5 Preparation prior to oxide removal treatment (process O) or filming treatment

Degrease and clean in accordance with 11.2.

11.6 Preparation prior to adhesive bonding of unanodized items

Items shall be prepared for bonding by degreasing and cleaning in accordance with 11.2 and then by etching in accordance with process O or P, as appropriate.

11.7 Preparation prior to electroplating

As preparation for the electrodeposition of any required finish, items shall be degreased, pickled in accordance with 11.2, and given an immersion deposit of zinc followed by an electrodeposit of copper (process W) or another metal.

11.8 Preparation prior to autocatalytic nickel plating

Any process providing a good zincate or modified-zincate coating suitable for electroplating is satisfactory for autocatalytic nickel plating.

A typical (recommended) sequence is to apply a double zincate coating prior to application of the autocatalytic coating, as described below:

- a) process W a) followed by process W b) 2) to W d);
- b) immerse in nitric acid (volume fraction 50 %) for approximately 1 min followed by rinsing;
- c) repeat process W d).

The items are now ready for autocatalytic nickel plating in accordance with ISO 4527 or another appropriate International Standard.

11.9 Preparation prior to conversion coating

Degrease and clean in accordance with 11.2.

11.10 Preparation prior to metal spraying

Degrease and clean in accordance with process A (method A1 or A2) and process B (method B2) followed by coarse-abrasive blasting in accordance with process D (method D1) using a non-metallic abrasive.