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Specification for the cleaning and the surface treatment of stainless steel, copper and aluminium UHV vacuum vessels components

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1 Introduction

This specification is provided by SOLEIL to the contractors in charged of UHV vacuum vessels or UHV component manufacturing.

The use of the chemical compounds listed above in the specification can depend on the local environment regulation. This constraint could be a cause of evolution of the present specification. Nevertheless any deviation from the present specification shall be proposed to SOLEIL for written approval.

The most commonly used materials for the UHV vacuum vessels are :

- Stainless steel (316 L, 316 LN, 304 L)
- OFHC Copper(Cu-C2).
- Aluminium (6060, 6061, 6063)

After machining the different components of the vacuum chamber shall be cleaned prior assembling by welding or brazing. The surface exposed to vacuum shall be treated in order to reduce the final outgassing rate.

In fact, machining needs the use of lubricants which contaminate the surfaces. In addition carbon steel particles from cutting and machining tools can stick on the surfaces and eventually embedded in the surface.

Operations of deep drawing or punching may generate contamination of the surfaces if the forming tools have not be cleaned. All theses mechanical operations are sources of contamination then cleaning is a necessary operation to guaranty a low outgassing rate and a high quality vacuum.

In order to remove contamination in the vicinity of the surface, an acid etching is performed.

The cleaning process shall not be done after assembling of the components in order to avoid trapping of chemical products especially the acid compounds. If necessary, it is important to control that no trap exists.

The procedures for the cleaning of stainless steel, copper and aluminium are described below. The use of a procedure different than the proposed ones shall be approved by SOLEIL.

Handling and protection of the clean components are also described.

2 Cleaning procedure for stainless steel

1. Degreasing

The aim of this operation is to remove oily or greasy traces deposited by the machining lubricants and during the forming operations.

This treatment is made by immersion of the component in a degreasing solution (ex.: Magnus 1 550 x de Henkel) during at least 4 hours.

2. Rinsing

This stage is needed to removed particles which are still stuck on the surfaces.

3. Acid etching

This stage consists of removing oxides and dusts particles embedded on the surface.

This operation is made by immersion of the component during 5 minutes in an acid bath with the following composition :

- 1/3 nitric acid HNO_3 at 53 %
- 1/3 hydro fluoric acid HF at 48 %
- 1/3 desionised water

or an equivalent product (ex. : Netinox from Chimid rouil).

4. Rinsing

This operation consists of removed the acid with high pressure water.

5. Passivation treatment

This operation consists of neutralising the traces of acid still present by an alkaline solution which can be easily removed. The proposed solution is of the type METASILICATE (ex. ALMECO 18 from Henkel, D520 from Diversey). This product is dissolved in demineralised water. The obtained Ph is in the range of 9.

The treatment is made by immersion of the component with ultrasonic agitation and during at least 15 minutes.

6. Rinsing

Rinsing with high pressure water

7. Final rinsing

This operation is made in a bath of demineralised water at 80 °C with ultrasonic agitation and during at least 20 minutes.

8. drying

After removal from water bath, the hot component is almost immediately dry. Traces of water shall be dried with nitrogen.

3 Procedure for copper cleaning

1. Degreasing

Degreasing by spraying or immersion in a solvent authorised by the regulations.

2. Rinsing

Rinsing with high pressure water.

3. Acid etching

Etching by immersion in a solution of sulfo-chromic at 30% in demineralised water during 10 minutes. Possible commercial products : LCB-SI by CHIMIDEROUIL.

4. Rinsing

Immediate rinsing first with high pressure water then with demineralised water.

5. Drying

4 Surface treatment of aluminium

1. Degreasing

Degreasing by spraying or immersion in a solvent authorised by the regulations.

2. Pickling

Immersion in an alkaline solution at 50°C during 1 to 2 minutes.

- 40 g/l NaOH,
- 18 g/l of a mixture containing 80% of sodium gluconate and 20% of sodium carbonate

3. Rinsing with tap water

4. Acid neutralisation

This operation consists of immersion of the component in an acid solution during 2 minutes. The acid solution has the following composition :

- Nitric acid HNO_3 at 50 % in volume
- Hydro fluoric acid HF at 3 % in volume

5. Rinsing with demineralised water

6. Drying in hot air

5 Care to take after cleaning

5.1 After cleaning the components shall only be handled with clean gloves.

5.2 The components shall be wrapped in an aluminium foil.

5.3 The components shall be shipped in adapted packaging to avoid contamination and shocks during transport.

5.4 The components shall not be polished after cleaning with abrasive tools (wire brush, abrasive clothes,...)

6 Quality control

The manufacturer shall be able to provide the following information to SOLEIL is required :

- Name of the sub-contractor for cleaning (if it is the case)
- The exact procedure
- The composition of the chemical products used for the cleaning
- The number of cleaning with the type of materials, processed in the different baths from the product exchange to the cleaning operation made for SOLEIL .