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Specification on welding and brazing for UHV vacuum vessels manufacturing.

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1 Introduction

The Synchrotron SOLEIL is a dedicated high brightness synchrotron light source under construction at Saint Aubin in Essonne, 20 km South of Paris, near Saclay and Orsay.

The accelerator complex includes a 100 MeV LINAC pre-injector, a full energy Booster Synchrotron and a 2.75 GeV electron Storage Ring of 354 m circumference, which provides synchrotron light to 24 photon beam lines. The ten first photon beam lines will be available in 2006 and the rest will be made progressively available until 2009.

In order to guarantee an optimal operation of the facility, the pressure in the storage ring must be in the low 10^{-9} mbar range when a beam is stored. Without beam the expected pressure is in the 10^{-10} mbar range. This means that the vacuum vessels must be fabricated using UHV requirements. In particular welding and brazing shall guaranty a perfect tightness of the vacuum system.

This specification presents the welding procedure for UHV vacuum vessel manufacturing.

2 Cleanliness

- 2.1 All parts shall be cleaned prior to be welded following the specification for cleaning and surface treatment EDMS 386863.
- 2.2 Welding shall be made in a clean area to prevent contamination. During welding, the components shall not be in contact with oily or greasy surface.
- 2.3 In case of electron beam welding or vacuum brazing, the manufacturer shall control the cleanliness of the welding tank or of the brazing oven which could be sources of contamination of the assemblies.
- 2.4 Clean components shall be stored wrapped in an aluminium foil.
- 2.5 Welding and brazing tools shall be cleaned prior the welding or brazing operations.
- 2.6 Vacuum surface of the components shall not be touched directly with bare hands.

3 Welding procedures

- 3.1 Seal weld shall be made from the vacuum side every time it is possible.
- 3.2 If the welding configuration needs to operate from the outside, the welding shall have a full penetration. The welds shall present a smooth aspect exempt of cracks and porosity on the vacuum side. Any later wire brushing or other kind of finishing work is prohibited.
- 3.3 TIG welding of stainless steel shall be done without filler metal. If filler metal is absolutely required the grade of this metal shall be the same of the base material. The filler metal shall be

approved by SOLEIL before use. If filler metal has been used during the vacuum vessel fabrication, the manufacturer shall provide within the required documentation the material certificates of the filler metal.

3.4 TIG welding of aluminium alloy (5000 or 6000 series) can be made with filler metal. In any case the manufacturer shall provide to SOLEIL the grade of the filler metal for approval.

3.5 To prevent oxidation during welding, the welds must be backed by an inert gas purge.

3.6 When a weld made from the vacuum side has to be reinforced, welds on the outside can be added. In this case the outside weld shall be discontinuous in order to avoid virtual leaks.

4 Brazing procedures

4.1 Brazing shall be performed in a vacuum oven or in a dry hydrogen atmosphere.

4.2 For brazing seal exposed to vacuum, no flux shall be used during the brazing process.

4.3 Filler metal shall be sufficient and properly located to fill completely the brazing clearance and to avoid trapped volumes.

4.4 The brazing alloy specification shall be submitted to SOLEIL for approval.

4.5 The seal braze shall not present cracks or discontinuity at the vacuum side.

4.6 Brazing of Glidcop™ shall be done without electroplating of the base metal

4.7 Filler alloy for Glidcop™ brazing shall not contain silver. Diffusion of silver inside the Glidcop™ leads to lower mechanical properties of the metal.

5 Leak detection

5.1 As soon as it is possible the leak tightness of the welds and brazes shall be checked with an helium leak detector.

5.2 The use of vacuum grease to guaranty the tightness of the connection of the component on the leak detector is prohibited.

5.3 The measured leak rate shall be lower than 1.10^{-10} mbar. l.s⁻¹ (limit of sensitivity of the leak detector).

5.4 If at any stage a weld or a braze is shown to be defective, no rectification shall be done without written approval of SOLEIL.

6 Labelling and packaging

6.1 After welding or brazing, the tested subassemblies shall be correctly labelled and protected for storage prior the next stage of assembly.

6.2 The brazed assemblies shall be wrapped in an aluminium foil and put into a polyethylene bag.

7 Quality insurance

7.1 If required by SOLEIL the manufacturer shall be able to provide documentation on the conditions of the welding or brazing which have been used.

7.1.1 For TIG welding the following information could be asked :

- Tungsten electrode diameter
- Shielding gas and flow rate
- AC or DC and polarity
- Current
- For pulsed welding, the pulse time, pulse current, background current and background voltage
- The name of the operator and his certificates of qualification

7.1.2 For electron beam welding the following information could be asked :

- The reference of the EB welding facility
- The pressure in the tank during the welding
- High voltage
- Current
- Focalisation
- Speed of displacement of the beam
- The name of the operator and his certificates of qualification

7.1.3 For vacuum brazing the following information could be asked :

- Identification of the furnace
- The pressure of the vacuum or gas in the brazing zone and composition of the gas (if used).
- Detail of the brazing cycle (temperature and time)
- Detail of the brazing tools and on the position of the components to be brazed.
- Specification of the brazing alloy
- Specification of the surface treatment used prior brazing (metallisation, coating, plating)

7.2 If required by SOLEIL, the manufacturer shall provide samples of braze and welds prior manufacturing of the vacuum vessels for SOLEIL approval. These samples shall be documented with all the information listed before.