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SPEC. SNS-003
Revision B
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Specification for Fabrication and Cleaning of SNS Vacuum Chamber Assemblies

Approvals:



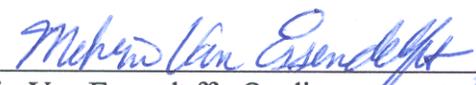
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Specification for Fabrication and Cleaning of SNS Vacuum Chamber Assemblies

1.0 SCOPE

This specification, in conjunction with the associated Statement of Work (SOW), drawing(s) and other applicable documents, defines the design requirements, configuration, materials, quality assurance, workmanship, cleaning, fabrication and packaging for SNS Vacuum Chamber Assemblies (chambers, hereafter).

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issue date or revision level shall be that in effect on the date of the Request for Quote (RFQ). Exceptions shall be approved in writing by BNL.

The following document(s) comprise part of this specification:

BNL QA-101, Seller Quality Assurance Requirements.

2.1 Current Revisions

It is the responsibility of the seller to determine that the Technical Specification(s), and applicable drawing(s) used in the preparation of quotations by the seller and possible execution of the Purchase Order, are the most current revisions. This is emphasized here, in the interest of the seller.

2.2 Order of Precedence

Requirements specifically stated within the applicable SOW and/or other associated technical specification(s), shall take precedence over requirements stated herein in the event of conflicting requirements.

3.0 REQUIREMENTS

3.1 Preproduction (Qualification)

Applicable in accordance with section 4.3 of this technical specification.

3.2 Parts, Materials and Processes

3.2.1 Unless otherwise specified on the applicable drawings, all parts of the chamber, other than knife-edge flanges (e.g., ConFlat) are to be fabricated from ASTM 304L, 316LN stainless steel, 625 or 718 Inconel alloy.

All knife-edge flanges indicated on the applicable drawing(s) shall be ConFlat flanges, or equivalent, fabricated from ASTM 304L, ASTM 316L or ASTM 316LN vacuum arc remelt (VAR) or electro slag remelt (ESR) stainless steel.

3.2.2 Cleaning procedures - The following cleaning procedures shall be used for all component parts of the chambers prior to welding. A procedure determined by BNL, in writing, to be equivalent may also be used. Regardless of which cleaning procedures are used assemblies shall be received at BNL free of all organics and acids.

Cleaning procedure:

- a. Degrease in ZEP Pride E degreaser or other commercial degreaser according to manufacturer's direction for five (5) minutes.
- b. Cold water tap rinse for one (1) minute.
- c. Soak in non-etch alkaline cleaner (e.g., Oakite 166, ENBOND Q567, etc.) for five (5) minutes at $\geq 65^{\circ}\text{C}$ with air agitation.
- d. Rinse in cold running tap water for ≥ 2 minutes. If water beading appears, repeat step c.
- e. Rinse in deionized water (minimum resistivity 500,000 ohm-cm) for ≥ 2 minutes. Parts shall be sequentially rinsed in a minimum of three (3) in-line baths each using the type of deionized water specified above.
- f. Dry parts of all traces of water in an air oven at a temperature $\geq 65^{\circ}\text{C}$.
- g. Wrap the part in lint-free paper and then tightly wrap the part in vacuum grade aluminum foil. Use clean white gloves for handling assembly components.

All Inconel and 300 series stainless steel tube or pipe specified for the chambers shall be pickled prior to welding. Between steps d. and e. above, pickle in Hydrofluoric-Nitric acid solution (one part Hydrofluoric Acid 48%, one part Nitric Acid, 42° Baume, one part distilled water) at room temperature for 5 to 10 minutes or such time as necessary to remove scale and oxide without over etching the surface. The solution may be air agitated or the parts may be scrubbed with a 300 series stainless steel brush, used only on 300 series stainless steel, to help oxide removal. This is followed by a rinse in cold running tap water for ≥ 2 minutes.

Alternate methods of pickling, pickling solutions, Diversey polishing, or electropolishing may be acceptable. Deviations from the procedures listed above may be made only with the written approval of BNL.

3.2.3 Welding procedures - If there is any doubt whether the parts have been contaminated prior to welding, those parts shall be cleaned again. Cleaning of the chambers after welding is not permitted.

All welding shall be performed in a clean area. The welder(s) shall follow guidelines including those specified in section 3.3.2 of this specification. Therefore, clean gloves shall always be worn. All jigs, fixtures, and heat sinks shall be clean. Only clean 300 series stainless steel brushes, used only on 300 series stainless steel, are to be used for removing oxides from welds. Power driven brushes, abrasive papers and abrasive wheels shall not be used.

The chambers shall be welded using the GTAW (Gas Tungsten Arc Weld) process. Unless otherwise indicated on the SCD, all vacuum welds are to be made on the "vacuum side" of the chambers. When indicated that the vacuum welds are on the "outside" of the chambers, the welds shall have 100% penetration and the inside of the chambers shall be purged with Argon throughout the welding operation, and cooldown of the weld.

3.3 Design, Construction and Workmanship

3.3.1 The chambers shall comply with the dimensions, tolerances and notes specified on the applicable drawing(s).

3.3.2 Clean assembly procedures - After cleaning, all component parts shall be handled in accordance with their intended use in an ultra-high vacuum system. They shall be kept free of smudges and blotches, which might stem from handling and contact with dirt or oil.

The following guidelines shall be followed to keep the chambers and its component parts free from contamination:

- a. Assembly, welding, inspection, and packaging of the chambers shall take place in a dedicated clean area. This area shall not be located near machine tools, compressors, oily or dirty parts and tools, etc., which can contaminate the work area with hydrocarbons and dirt. In addition, no eating, drinking, or smoking shall be permitted in this clean area.
- b. Unless the chambers or its component parts are being actively worked on or inspected, the ends of the chambers shall be kept covered. Once cleaned all chamber component parts shall be kept wrapped in clean vacuum grade aluminum foil when not being worked on.
- c. Clean parts shall only be handled with clean white nylon or cotton gloves. Clean gloves should only contact clean parts and tools in the clean work area. If they touch

unclean surfaces (hair, face, chair, floor, tools, door knob, etc.), they should be replaced with clean gloves.

NOTE: Do not use nylon gloves on hot parts or surfaces; they can melt, causing injury.

d. If it is required that the arms or bodies of workers come in contact with the chambers, clean lab coats and separate elastic-cuffed sleeves shall also be worn. The lab coat sleeves and the open ends of the gloves shall be tucked into the elastic-cuffed sleeves to prevent debris (e.g., hair, etc.) from falling into the chambers. The same cleanliness precautions shall be taken with the lab coats and sleeves as is specified for gloves in section 3.3.2(c) of this specification.

e. All tools and inspection gages which come in contact with the clean component parts shall be cleaned in accordance with steps c and d of section 3.2.2 of this specification. When the tools are not in use, they shall be covered and stored to prevent their use on dirty parts. Tools shall not be made of materials which can contaminate the clean parts (e.g., brass, plastic, zinc, and cadmium).

f. Work bench surfaces shall be thoroughly cleaned with detergent, rinsed with water, and then wiped with alcohol before used in the assembly area. The surfaces shall be hard and non-absorbent (stainless steel, formica, etc.). Wood bench tops or similar materials are not acceptable.

3.3.3 Fabrication Requirements - Use water soluble machining lubricants only. Silicon or sulphur based machining lubricants shall not be used when machining any component(s).

All components of the chambers shall be deburred by the seller prior to welding to assure proper fit at assembly, and to prevent a hazard from sharp edges and burrs when the chambers are handled.

There shall be no machining or cleaning operations after welding.

3.4 Performance

3.4.1 Leak Rate

The chambers shall be leak tight to a minimum sensitivity of 2×10^{-10} Atm.cc He/sec. Leak tight is hereby defined as a total allowable leak rate of less than 2×10^{-10} Atm.cc He/sec with the chamber internally under vacuum of $<1 \times 10^{-5}$ Torr and externally pressurized to 760 Torr minimum.

3.4.2 Environment

The chambers shall operate, as specified, throughout the following environmental ranges:

- a) Temperature: -269°C to 300°C
- b) Pressure: internal: vacuum to 27 psia
external: vacuum to 18 psia
- c) Rate of Temperature Change: " 75°C/hour

3.4.3 Outgassing

3.4.3.1 The outgassing rate of the interior surfaces of the chambers shall not exceed 1×10^{-10} Torr Liters/sec cm^2 after pumping on the chambers under vacuum for 100 hours. Conventional all-metal ultra-high vacuum (UHV) practices shall be used in making these measurements.

3.4.3.2 The chambers shall not be contaminated with residual HCl, oils or other contaminants with atomic mass(es) of 35 and greater than 40. As received from the seller, the partial pressures of the evacuated chambers shall be measured with a residual gas analyzer. The sum of mass 35, and all partial pressures between atomic mass 40 and 100, excluding atomic mass 44, shall be <0.01 of the total pressure of the system.

3.4.4 Bakeout Requirements

The chambers shall be bakeable, with internal vacuum, to temperatures of up to 300EC.

3.5 Detail Requirements

3.5.1 Dimensions

The dimensions of the chambers shall be as defined by the applicable drawing(s) when in a relaxed and unrestrained state.

3.5.2 Flange Placement

All flanges shall be placed to allow for easy assembly to a mating flange and gasket with standard tools and hardware.

4.0 QUALITY ASSURANCE

4.1. General

The following Quality Assurance requirements apply to the hardware defined by this specification. Failure of hardware, first article or production, to meet any of the requirements of this specification shall constitute non-conformance and be cause for rejection.

The Statement of Work (SOW) and Technical Specification(s) accompanying a Request for Quote (RFQ) define possible exceptions or additions, if any, to the seller requirements set forth in this document. The seller shall have the required QA provisions in place at the time of RFQ response.

The following BNL-QA-101 clauses are required:

1, 2, 3, 3.1, 3.1.2, 3.2 thru 3.8, 4.0, 4.2 thru 4.4, 4.4.1 thru 4.4.4, 4.5 thru 4.7, 4.7.1, 4.10, 4.10.5, 4.13, 4.16, 4.18, 4.18.2, 4.18.4, 4.19, 4.21, 4.22, 4.23, 4.24 (only where applicable), 4.31, and 4.34.

The buyer reserves the right to carry out inspections and to witness seller tests specified herein prior to delivery to the buyer. The seller shall inform BNL at least three (3) weeks prior to conducting the seller tests specified herein, such that arrangements can be made for BNL representatives to witness the seller tests.

4.2. Responsibility for Inspections and Tests

The seller shall be responsible for the performance of all inspections and tests required by this technical specification. All verifying test data submitted to BNL shall be of the form required by sections 4.16 of BNL-QA-101. BNL reserves the right, at BNL facilities and BNL expense, to re-perform any of the inspections and/or tests set forth in this specification. BNL reserves the right, on a non-interference basis, to witness the inspections, tests, and analyses conducted by the seller on nonconforming articles returned by BNL.

Exception to the above: Any test noted as **(BNL Test)** shall be performed at no cost to the Seller at BNL. All chambers are required to pass all BNL Tests, as well as, seller performed tests.

4.3 Pre-production Tests

The pre-production (qualification) tests and inspections performed on the first article chambers, if applicable, shipped to BNL shall be in accordance with section 4.4 (i.e., Acceptance Tests) of this specification.

This shall be done to verify that articles supplied under the contract meet all the technical requirements of this specification.

4.4 Seller Performed Acceptance Tests (Quality Conformance)

Acceptance tests shall be performed on all articles supplied under this contract. Acceptance or approval of material during the course of manufacture shall not be construed as a guarantee of its acceptance in the finished product. All articles shall pass the applicable seller performed acceptance tests prior to delivery. Furthermore, all articles shall pass all BNL Tests. Evidence of noncompliance with the above shall constitute cause for rejection.

4.4.1 Scope of Seller Performed Acceptance Tests

Acceptance tests include Dimension Inspection, Leak Rate and Outgassing Tests.

4.4.1.1 Dimensional and Flange Inspection

Dimensions of the chambers shall be measured for conformance to sections 3.5 of this specification. The inspection shall include the location of the welds, the penetration of external welds, any dents or damage to the chambers, and the cleanliness of the chambers. The inspection shall also include conformance to all sections of 3.0 of this specification.

4.4.1.2 Leak Rate Tests

To test for conformance to section 3.4.1 of this technical specification, a helium mass spectrometer leak detector with a minimum sensitivity of $\# 2 \times 10^{-10}$ Atm.cc He/sec shall be used. This leak detector shall be calibrated at the beginning and ending of each working shift with a standard traceable to the National Institute of Standards and Technology (USA). Records shall be kept of the calibration process.

Special care shall be taken not to contaminate the vacuum side of the chambers with backstreaming rough pump oil. Viton O-rings may be used as temporary seals for leak detection. No lubricants or greases of any kind are to be used on the O-ring seals. After leak checking, the chambers shall be vented to atmospheric pressure with dry, high purity (99.99%) water pumped nitrogen bottled gas or nitrogen from an evaporated liquid source. The vacuum venting valve is to be separate from the pumping system to prevent pump oil from being blown into the chambers when the chambers are being vented. Immediately after leak checking, the flanges shall be wrapped with clean lint free paper and then wrapped with clean vacuum grade aluminum foil, such that debris can not fall into the chambers. Over this foil, additional protection in the form of either cardboard or plastic caps shall be used to prevent damage to the knife-edge of the flanges.

4.4.1.3 Outgassing Measurements (**BNL Test**)

To test for conformance to section 3.4.3.1 of this specification, conventional all-metal ultra-high vacuum (UHV) practices shall be used in making the outgassing measurements. During initial pumpdown for the outgassing measurements, a residual gas analyzer scan shall be taken for atomic mass 0 to 100. The results of these readings shall be used to determine conformance with sections 3.4.3 of this specification.

4.4.2 Certificate of Conformance

With each chamber delivered, the seller shall supply to BNL a Certificate of Conformance, in accordance with sections 4.16 of BNL QA-101.

5.0 PREPARATION FOR DELIVERY

5.1 The chambers shall be packaged individually by the seller in clean, transparent chloride-free plastic bags. The chambers shall be shipped to BNL in boxes which are durable enough to facilitate subsequent storage at BNL after completion of incoming inspection without damage.

6.0 NOTES

6.1 Performance Objectives

6.1.1 The seller is encouraged to bring to the attention of BNL any improvement in performance or reliability which would result from the use of materials, parts and processes other than those specified. A request for approval of any such improvement shall be submitted to BNL for consideration. Each request shall be accompanied by complete supporting information at least fourteen (14) days prior to bid submittal date. Changes may be made only with the **written** approval of a representative of the BNL Purchasing Department.

6.1.2 Definitions

6.1.2.1 Failure - A failure shall be defined as any occurrence including one time non-repeatable anomalies either sudden or gradual in nature, which causes the article performance to deviate from specified limits.

6.1.2.2 Non-Conformance - A condition of any article in which one or more characteristics do not conform to the specified requirements.

6.1.3 Sellers Article Uniformity

6.1.3.1 The Seller shall ensure uniformity of all deliverable articles in accordance with section 4.18.4 of BNL-QA-101. Acceptance tests not designated a (**BNL Test**) shall be performed prior to shipment to BNL on each deliverable article.

6.2 Seller Subcontracting

The seller may subcontract all or part of the work defined by this specification and the contract. However, the seller is responsible for fulfilling all of the conditions given in this Technical Specification, and the requirements of the Terms and Conditions outlined in the contract.