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	NOTIFICATION OF SPECIFICATIONS REVISION	
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DOCUMENT NO. 4102020101-00015

TECHNICAL SPECIFICATION

FOR

BM FRONT END FIXED MASK AND PHOTON SHUTTERS

WBS 1.4.1.2.2.1.1
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1.0 SCOPE

1.1 This Technical Specification establishes the requirements for the fabrication, inspection, testing, and delivery of the BM First Fixed Mask, BM Second Fixed Mask, BM Third Fixed Mask, and Photon Shutter assemblies in the quantities listed in Section 2.1 of the Statement of Work 4102020101-00016.

1.2 The fixed masks are water-cooled devices, which constrain the X-ray photon beam and protect the downstream components. The photon shutters are water cooled heat absorbers which completely intercept the X-ray photon beam. The photon shutters shall be able to close in 1 second to protect the vacuum valves and safety shutters from damage by the high power BM beam. Because the photon shutters are devices crucial to both the personnel and equipment safety, fail-safe design and the ability to indicate their fully opened and closed positions are critical. Both the fixed masks and the photon shutters shall be capable of operating for 100,000 thermal cycles or more without fatigue failure. To assure the integrity of the ultra-high vacuum (UHV) systems, water and vacuum joints are prohibited. Adequate welding method shall be carefully applied to all the vacuum joints between OFHC (oxygen-free- high-conductivity) copper and stainless steel to prevent vacuum-leak problems.

2.0 APPLICABLE DOCUMENTS AND /OR SPECIFICATIONS

2.1 Application.

2.1.1 Deviations. The documents listed in paragraphs 2.2 through 2.4 of the exact issue shown form a part of this standard to the extent specified herein. Any deviations from these documents or their requirements shall be requested by the contractor and approved by the Laboratory prior to any contractor action being taken. Requests for Deviations shall be made on a Supplier Disposition Request (ANL-311).

2.1.2 Conflicts. Any conflicts between the requirements of this Technical Specification and those of any applicable document shall be brought to the attention of the Laboratory' s Subcontract Administrator prior to any related action on the part of the contractor.

2.1.3 Exceptions. Where the materials or standards to be employed in the manufacture of any part are not identified in this Technical Specification or the documents referenced herein, the contractor shall submit for the Laboratory's approval the materials or standards he proposes to use.

2.1.4 Referenced Documents. Documents which are referenced without citation of section or paragraph shall apply in their entirety. Where there is a citation of section or paragraph, only that cited portion is applicable.

2.1.5 Sub-Tier References. When a referenced document cites additional references, those sub-tier references shall not apply unless the Technical Specification or the Statement of Work specifically mentions them as required documents.

2.2 Drawings.

The following drawings, and their associated sub-tier drawings, specify the fixed mask and photon shutter assemblies which are to be fabricated by the contractor. These drawings, and their associated sub-tier drawings, are attached to this Technical Specification.

Drawing Number	Title
4102020101-210000	M3 BM First Fixed Mask Assembly
4102020101-220000	M3 BM Second Fixed Mask Assembly
4102020101-230000	M3 BM Third Fixed Mask Assembly
4102020103-200000	P3 BM Photon Shutter Assembly

2.3 Welding.

2.3.1 Weld Symbols. Weld symbol interpretation shall be in accordance with the Standard Symbols for Welding, Brazing and Nondestructive Examination, ANSI/AWS A2.4-86.

2.3.2 Weld Practice. The following specifications and their sub-tier documents are required documents of this specification.

2.3.2.1 Electric arc welding practice shall conform to AMS 2685C, Class A, Welding, Tungsten Arc, Inert Gas (GTAW Method).

2.3.2.2 Electron Beam welding practice shall conform to AMS 2680A, Electron Beam Welding for Fatigue Critical Applications.

2.3.3 Nondestructive Examination. The ultrasonic examination of explosive bonded materials shall conform to ASTM A578/A578M-90, Straight beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications.

2.4 Vacuum Requirements.

The vacuum requirements for the devices listed in section 2.2 of this specification shall conform to ANL specification 410201-00095, Vacuum Requirements Of Ultra High Vacuum Devices For Beamlines. ANL specification 410201-00095 and its sub-tier documents are required documents of this specification.

2.5 Materials.

2.5.1 Copper. Copper materials shall conform to the ASTM specification B170-93, Standard Specification for Oxygen-Free Electrolytic Copper-Refinery Shapes.

2.5.2 Stainless Steel. Stainless Steel materials shall conform to the following applicable specification:

2.5.2.1 ASTM specification A666-92, Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

2.5.2.2 ASTM specification A479/A479M-92, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.

2.5.2.3 ASTM specification A269-92, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

2.5.2.4 ASTM specification A511-90, Standard Specification for Seamless Stainless Steel Mechanical Tubing.

3.0 TECHNICAL REQUIREMENTS

3.1 Design Requirements.

The designs of the BM fixed masks and photon shutter are defined in the drawings, and their associated sub-tier drawings, which are listed in Section 2.2 of this Technical Specification.

3.2 Material Requirements.

The contractor shall use the materials specified in the drawings, and their associated sub-tier drawings, which are listed in Section 2.2 of this Technical Specification, and certification of materials used in the fabrication shall be submitted to ANL.

3.2.1 General. All materials shall be capable of withstanding 200° C and a high radiation environment.

3.2.1.1 All seals and rod wipers of pneumatic cylinders shall be Viton. The use of nitrile, butyl, urethane and other materials are not allowed.

3.2.1.2 No Teflon materials, coatings, grease or oils are allowed.

3.2.1.3 Pneumatic cylinders specifically shall be lubricated by careful application of Microseal dry lubricant from E/M Corporation.

3.2.2 Copper. OFHC copper shall comply with ASTM B170-93, Grade 1 copper, UNS C10100.

3.2.3 Stainless Steel. Stainless steel Type 304L, UNS S30403 or Type 304LN, UNS S30453 shall be used in welded structures and either Type 304, UNS S30400, Type 304L, UNS S30403 or Type 304LN, UNS S30453 in unwelded parts. Tubing for water cooling shall be Type 316, UNS S31600.

3.3 Fabrication Requirements.

Fabrication of the BM fixed masks and photon shutter shall be in accordance with the drawings which are listed in Section 2.2 of this Technical Specification.

3.3.1 Vacuum Requirements. The fabrication requirements of ANL specification 410201-00095, Vacuum Requirements Of Ultra High Vacuum Devices For Beamlines. apply to these vacuum component parts.

3.3.2 Welding Requirements.

3.3.2.1 Parts must be clean prior to welding. It is recommended that the cleaning and electropolishing as required in specification 410201-00095 (see paragraph 3.3.1 above) be done prior to welding.

3.3.2.2 Vacuum seal welds shall be on the vacuum side of the joint where feasible. When such welds must be made from the opposite side, complete penetration with a positive underbead must be achieved. No porosity, cracks, inclusions, cold shuts, undercut or underfill of the weld bead is permissible. When it is necessary to weld both side of a joint, the vacuum side shall have a continuous weld to form the vacuum seal, and the opposite side shall have an intermittent or a drilled weld to permit leak checking of the vacuum seal weld.

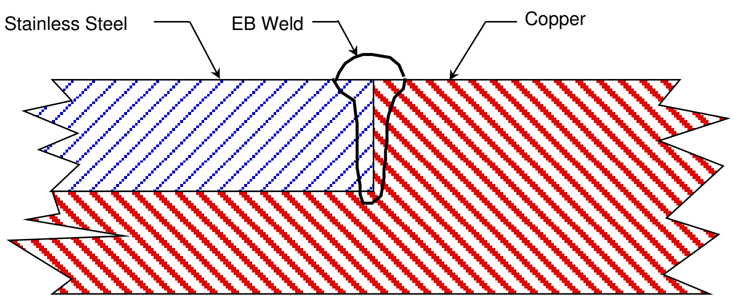
3.3.2.3 All vacuum seal welds are to be autogenous.

3.3.2.4 Surface of parts must be clean before, during and after welding.

3.3.3 Electron Beam Welding.

3.3.3.1 Vacuum chamber for Electron Beam welding shall be evacuated to a vacuum of 1×10^{-5} Torr prior to welding. The part must cool for at least 30 minutes after welding prior to venting the welding chamber.

3.3.3.2 The parts must be properly fixtured to keep the joint tight during EB welding. Tacking the part prior to the seal weld pass is advised. The copper to stainless steel are designed with a step in the copper such that the copper backs the weld of the bimetal joint. The weld shall penetrate the joint to the backing copper, but shall not penetrate more than one half the thickness of the backing copper as shown in the figure below.



3.3.4 Leak Check. Weldments shall be leak checked prior to assembly. Leak checking procedure is defined in specification 410201-00095 (see paragraph 3.3.1 above).

3.3.5 Fasteners. All bolts and screws in vacuum or used in ConFlat type vacuum flanges shall be silver plated. All screws used in blind tapped holes shall be vented.

3.4 Assembly and Workmanship.

3.4.1 The parts shall be free of burrs and sharp edges, and free of dents, gouges and scratches.

3.4.2 The parts shall be clean and free of dirt, oil and grease with the exception of the appropriate lubrication on moving bearing surfaces. Bearing surfaces shall be lubricated as required by the assembly drawing.

3.4.3 All assemblies shall be leak checked. Leak checking procedure is defined in specification 410201-00095 (see paragraph 3.3.1 above).

3.4.4 All assembly requirements for alignment marks, keying or pinning specified on the appropriate assembly or sub-tier drawing shall be done after verification that the assembly meets the dimensional requirements of the drawing.

3.4.5 All fasteners on moving devices shall be locked by means of wires, jam nuts, set screws, spring washers or similar locking devices to prevent loosening. All drilled head screws shall be wired to lock them in place.

3.5 Drawings.

3.5.1 Since the drawings and documents listed in section 2.2 completely define the fabrication requirements of the BM fixed masks and photon shutters, the preparation of new drawings by the contractor will not be required unless alternate designs and/or modifications to the designs submitted by the Laboratory are proposed by the contractor.

3.5.2 The contractor is required to review the drawings and other documentation provided by ANL for errors and inform ANL of any discrepancies and errors. Any changes or corrections must be documented by the contractor as "marked drawing" changes to the engineering drawings for the affected item and submitted for ANL's approval. If approved, revised drawings will be issued by ANL.

3.5.3 The marking and submission of marked drawings to ANL to indicate any "as-built" changes is the responsibility of the Contractor.

3.5.4 The drawing numbers in most cases will be preceded by a "P" prefix on the drawing itself. After the acceptance of the first unit of a given item and any corrections as detailed in 3.6.2 and 3.6.3, the "P" prefix on the drawing number on the drawing will be dropped.

3.5.5 Drawings can be furnished to the contractor on disk or by E-mail in AutoCAD (version 12) format (DWG) as the preferred format or in DXF format. The contractor should submit any corrected or modified drawings to ANL for approval in AutoCAD format.

4.0 QUALITY ASSURANCE AND TEST REQUIREMENTS

The following examination requirements shall comprise the minimum acceptable for the BM fixed masks and photon shutters.

4.1 Certification.

All certification of materials, hardware, processes, calibrations and test data shall be signed by a contractor representative authorized to sign such certifications.

4.2 Examination Requirements.

4.2.1 Materials Examination. All raw materials shall be examined visually to detect suspect or counterfeit parts, obvious defects and the state of cleanliness.

4.2.2 Fabrication and Weld Examination.

4.2.2.1 General. All items shall be subjected to visual and dimensional examination to verify conformance with drawing requirements.

4.2.2.2 Liquid Penetrant Examination. All welds outside vacuum (no penetrant on a vacuum surface) shall be examined by the liquid penetrant method in accordance with the appropriate specification, AMS 2680A for EBW, or AMS 2685C, Class A for GTAW. The use of liquid penetrant materials from aerosol spray cans using Freon as the propellant is prohibited on austenitic stainless steel.

4.2.2.3 Radiographic Examination. All vacuum seal fusion welds will be radiographically examined in accordance with the appropriate specification, AMS 2680A for EBW, or AMS 2685C, Class A for GTAW.

4.2.2.4 Examination of Weld Repairs. Weld repairs shall be reexamined by the examination method(s) which revealed the original defect. In addition, other nondestructive examination methods which will assure the quality of the material has been maintained may be used upon agreement between the contractor and the Laboratory.

4.2.2.5 Ultrasonic Examination. All explosive bonded materials shall be ultrasonically inspected according to ASTM A578/A578M with the following supplementary requirements. S1. Scanning shall be continuous over 100% of the plate surface. S2. Acceptance standard shall be no discontinuities in the bonded area to be utilized in the final part.

4.2.3 Calibration and Control of Instruments. Accuracy of instrumentation used during tests shall be verified by the contractor by means of periodic calibration traceable to the National Institute of Standards and Technology. The Laboratory shall be given timely notice of any calibration discrepancies or problems. Calibration records shall be available to the Laboratory's personnel.

4.2.4 Marking and Identification. When raw materials are cut or sectioned, all markings shall be transferred to the unmarked portion of the material.

4.2.5 Examination of Lifting, Handling, and Shipping Fixtures. Following proof load testing of lifting, handling, shipping fixtures and attachment lugs, all structural welds of these items shall be examined by the magnetic particle or liquid penetrant method,. In addition, all slings and hooks, not containing structural welds, used in lifting the item shall, as a minimum, be visually examined for structural defects.

4.2.6 Acceptance Testing. The acceptance testing shall be performed in accordance with the ANL approved contractor's test plan, and the results submitted to the Laboratory for approval. The following items are the minimum requirements for inclusion in the acceptance tests.

4.2.6.1 Verification of Fiducial Holes. The size and location of fiducial holes for each fixed mask assembly will be verified for compliance with the engineering drawings.

4.2.6.2 Verification of Overall Dimensions. The maximum width and height of the assemblies with respect to the appropriate reference surfaces shall be verified to be in conformance with the assembly drawing for the item.

4.2.6.3 Verification of Axis motion. The motion of each moving or adjustable axis shall be tested for the following: Range of motion, Binding, Locking, and where applicable Trueness of motion (square, straight, and linear), and Repeatability.

4.2.6.4 Bellows Cycle Test. The photon shutter shall be actuated 500 times to cycle the bellows through its normal stroke. These tests shall be done prior to the vacuum leak test of the assembly.

4.2.6.5 Vacuum tests. The vacuum acceptance tests shall be performed in accordance with specification 410201-00095, Vacuum Requirements Of Ultra High Vacuum Devices For Beamlines.

4.2.6.6 Water Pressure and Flow Tests. Only deionized water shall be used with a maximum conductivity of 1 micromho/cm. The use of tap water is prohibited. After testing, the water lines shall be dried by blowing them out with clean, dry, oil free nitrogen.

4.2.6.6.1 Water cooling lines shall be pressure tested to 300 psi after vacuum leak tests. No evidence of leakage is permissible.

4.2.6.6.2 Water cooling lines shall be flow tested for continuity with 3 gpm minimum flow required at 10 psi or less pressure drop for the fixed masks and 20 psi or less for the photon shutters.

5.0 PREPARATION FOR DELIVERY

5.1 Each assembly shipped shall be identified by the appropriate purchase order number, assembly number and a sequential identity or serial number.

5.2 Any moving components on an assembly must be firmly secured for shipment in a manner that precludes damage from motion and vibration.

5.3 Vacuum components must be prepared for shipment in accordance with specification 410201-00095, Vacuum Requirements Of Ultra High Vacuum Devices For Beamlines.

5.4 Assemblies must be secured for shipment in fashion that protects the assembly from dust, dirt and weather or water damage. The assemblies must be securely fastened, padded, boxed and/or crated for shipment in a suitable manner for prevention of shipment damage to any assembly and its weather/dust protection and insure their safe delivery to the Laboratory.