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DOCUMENT NO. 410201-00101

TECHNICAL SPECIFICATION

FOR

LEAD COLLIMATORS AND RATCHET WALL SHIELDING

WBS 1.4.1.2.1.1.2
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1.0 SCOPE

1.1 This Technical Specification establishes the requirements for the fabrication, inspection, testing, and delivery of the Lead Collimators And Ratchet Wall Shielding installation in the quantities listed in Section 2.1 of the Statement of Work.

1.2 The lead collimators are blocks of lead 12" deep which are able to absorb all Bremsstrahlung radiation and the radiation produced in the front end. The cross section of this block is 18" x 4" with a cut-out in the center to allow for the vacuum chamber to pass through it. The block is formed by stacking 12 identical lead bricks around the vacuum chamber to form a block. The vacuum chamber is mounted on supports above a base plate that permits lead bricks on the base to slide in under the vacuum chamber, so that the lead block may be assembled or dismantled without disturbing the vacuum chamber alignment . All lead bricks are made from the same extrusion, and all the lead collimators for the APS front end are similar except for the horizontal opening. The Contractor is responsible for the installation of the ratchet wall shielding, working with ANL personnel from the APS Front End Survey and Alignment team as the APS personal will install and align the cover plates and vacuum chamber of the Ratchet Wall collimator. Oversized polyethylene plates must be tailor cut in the field, to snug fit around the cavity and provide support to the vacuum chamber. The lead bricks must be installed and firmly supported, and the cavities must be completely filled with lead shot. Proper precautions must be taken to avoid any lead contamination. The shielding installation must be very carefully performed since the vacuum chamber cannot be misaligned more than 0.005" total in the horizontal or vertical direction.

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 lead collimators and ratchet wall shielding 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	Description
4102010102-210000-00	K1 ID First Collimator Assembly
4102010102-210000-00	K1 ID Ratchet Wall Collimator Assembly
4102020102-210000-00	K2 BM First Collimator Assembly
4102020102-220000-00	K2 BM Second Collimator Assembly
4102020102-230000-00	K2 BM Ratchet Wall Collimator Assembly
4102020102-240000-00	K2 BM Side Shielding 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).

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

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

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

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

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

2.5.2 Lead. Lead materials shall conform to the following applicable specification:

2.5.2.1 ASTM specification B29-92, Standard Specification for Refined Lead.

2.5.2.2 Federal Specification QQ-L-171E, Lead Pig

3.0 TECHNICAL REQUIREMENTS

3.1 Design Requirements.

The designs of the lead collimators and ratchet wall shielding 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 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.

3.2.2 Lead.

3.2.2.1 Lead, used for the lead bricks in the collimators, shall be UNS L51121, and in compliance with ASTM specification B29-92.

3.2.2.2 Lead pellets shall be in the form of #6 chilled shot (0.11 in. Ø), and the material shall comply with Federal Specification QQ-L-171E, Grade B.

3.3 Fabrication Requirements.

Fabrication of the lead collimators and ratchet wall shielding 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 bead is permissible.

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 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).

3.3.4 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.

3.3.5 Lead Bricks. Lead Bricks must be manufactured by extrusion, injection molding or die cast. No mold cast bricks are allowed.

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.

3.4.3 All vacuum chamber 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 lead bricks must fit snugly around the vacuum chambers to form proper collimators.

3.4.6 The polyethylene plates in the ratchet wall shielding must fit snugly between the vacuum chamber and the bottom of the wall cavity, supporting the center section of the chamber.

3.4.7 Lead shot must fill the ratchet wall cavities completely to the top.

3.5 Drawings.

3.5.1 Since the drawings and documents listed in section 2.2 completely define the fabrication requirements of the lead collimators and ratchet wall shielding assemblies, 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 lead collimators and ratchet wall shielding assemblies.

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 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 2685C, Class A for GTAW.

4.2.2.3.1 As an alternative to the above stated inspection requirements, the Contractor shall provide Weld Schedule and Process Certification Plans. Both plans shall include the development of suitable weld schedules for each weld, with the schedule verified by the production and testing of weld coupons, the performance of the production welds to the certified weld schedule documented and certified with appropriate operational logs and signatures, and the production of test coupons to the certified weld schedule at periodic intervals (each batch of units) for QA testing. All welding and testing to be done according to the cited weld specification (AMS 2685C Class A). The Laboratory shall review and approve the Plans and all changes thereto prior to implementation by the Contractor.

4.2.2.3.2 It is the intent of the alternative allowed in section 4.2.2.3.1 above that the Contractor either comply with the NDT requirements of the specification paragraph 4.2.2.3 or offer suitable alternatives. A simple leak check indicating no leakage is insufficient. These articles will be repeatedly stressed mechanically and thermally, and we expect some Quality Assurance that the welds are sound and defect free, so that they will still be leak tight several years from now. The alternatives should be proposed by the Contractor for our approval as suitable alternatives to the specification requirements radiographic examination of the welds. The use of certified welding programs is an alternative technique used for critical welds that are difficult or impossible to do satisfactory NDT inspection. These programs have, but are not limited to, the following characteristics in general:

4.2.2.3.2.1 The weld procedure (see 3.5 of AMS 2685C) for a particular weld joint is verified by welding coupons that simulate the joint in question. The coupons are then tested using NDT and/or destructive testing programs that demonstrate that the weld joints produced by the procedure are sound and meet the specification requirements (see section 3.6 of AMS 2685C).

4.2.2.3.2.2 The welding of production parts (each assembly or daily lot of parts) is preceded by a coupon weld for testing (typically sectioning) to verify the welder and equipment are properly reproducing the weld.

4.2.2.3.2.3 A welding log is maintained that permits the certification of the welding. The following are non-exclusive samples of what information is logged:

a. The welder (operator) and equipment ID indicating same for **welds** as for coupon.

b. The weld parameters used to perform the welding thus recording compliance with the weld procedure.

c. Any unusual occurrences or problems.

d. Supporting documentation - welder certification (see Section 3.2 of AMS 2685C): equipment calibration documentation; shop traveler documents that indicate the weldment had the appropriate preweld treatments and cleaning.

4.2.2.3.2.4 The welding is then certified by a person authorized by the Contractor to do so as having been properly executed after that person reviews all pertinent information. All records and test coupons are maintained as verification of the certification and can be subject to review by ANL.

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.

4.2.3 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 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.

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

4.2.6.3 Verification of Fit. During the installation of the ratchet wall collimators, the fit of the polyethylene plates to the vacuum chamber and the ratchet wall cavity, and the fit of the lead bricks to the vacuum chamber, forming the collimators at each end of the vacuum chamber, shall be verified and documented by the contractor with appropriate photographs.

4.2.6.4 Verification of Fill. During the installation of the ratchet wall collimators, the contractor shall verify and certify that each ratchet wall cavity was filled completely to the top with lead shot, and the weight of lead shot installed in each cavity shall be recorded

4.2.6.5 Verification of Alignment. The alignment of the vacuum chamber in the ratchet wall must be verified as correct by ANL, after the packing of all the lead shot, for the installation to be accepted.

5.0 PREPARATION FOR DELIVERY

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

5.2 Moving Components: Any moving components on an assembly must be firmly secured for shipment in a manner that precludes damage from motion and vibration. The contractor shall advise ANL prior to shipment on the intended means of securing the tungsten blocks for shipment. If removal of the blocks is intended, the removal and handling of the blocks must be compatible with specification 410201-00095 (see 5.3 below), and the contractor must make arrangements with ANL for the installation of the blocks into the shutter-collimator assembly at ANL.

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

5.4 Protection: 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.