

SECTION 13095

RADIO FREQUENCY SHIELDING

GENERAL

1.01 DESCRIPTION

- A. The work of this section includes furnishing all labor, materials, equipment, tools and related items to provide, fabricate, deliver and test all radio frequency (RF) shielding for the MRI scan room as shown on the drawings as specified therein.

1.02 WORK NOT INCLUDED

- A. The following work is not included in this section of the specification, but this work shall be coordinated with the RF shielding manufacturer.
1. All electrical connections to the RF filters.
 2. Any ductwork to and from the waveguide type RF air vents.
 3. Any piping to and from the RF pipe penetrations.
 4. Field painting and/or any other final finishes.
 5. Any construction work in connection with conventional construction enveloping the shielded rooms. Preparing surfaces to receive the RF shielded environment.
 6. Any filtering for penetration or set up panels, RF signals and/or related imaging equipment.
 7. The MRI scan room area must be weatherproofed prior to installing the RF enclosure. The concrete slab must be cured and heated to a minimum of 68 degrees prior to installing the floor shielding. Excess moisture emanating from new concrete work must be avoided.
 8. The owner's structural engineer must verify structural supports, and/or structural integrity of the RF enclosure to accept the weight of the magnet. Structural steel or slab integrity below the magnet is elsewhere covered.

1.03 SUBMITTALS

- A. Submit shop drawings for approval prior to fabrication. A copy of the shop drawings to be supplied to the magnet manufacturer for information. Shop drawings shall reflect the typical floor plan, elevation(s), typical construction section, penetration, any other applicable details and other conditions, which may affect the installation, performance or integrity of the RF enclosure.

1.04 APPLICABLE STANDARDS

- A. The following codes and standards of the issue listed below form a part of this specification, and where referred to be applicable to the extent indicated.
1. MIL-STD-285: Method of attenuation measurements for Electromagnetic Shielding Enclosures for Electronic Test Purposes.
 2. MIL-STD-220: A method of Insertion Loss Measurements for RF Filters.

1.05 GUARANTEE

- A. Guarantee enclosure against defective materials and workmanship and to retain the specified radio frequency shielding characteristics for a period of five years from date of acceptance test. Filters, door system and all moving parts for a period of one year.

PRODUCTS

2.01 MANUFACTURERS

- A. All enclosures shall be equal to those supplied by Radiation Shielding Systems Inc., 203 Black Meadow Road, Chester, NY 10918; phone: 888-631-2278; fax: 888-631-2276; email: estimating@13095.com.
- B. Other enclosures are acceptable provided two layers of shielding are provided in all walls, floors, and ceiling. Single layer shielding techniques are not acceptable.
- C. Galvanized steel is the preferred shielding material due to its higher performance. Other mediums are acceptable provided they meet MRI vendor's performance requirements.
 - 1. The manufacturers must have been engaged in the manufacture and installation of RF shielded enclosures for a minimum of five years.
 - 2. The submittal shall include a list of at least 10 successful installations of similar complexity and size. Test results from those sites shall also be included.

2.02 RF SHIELDING-SOLID CORE MODULAR PANEL SYSTEM

- A. All wood used in shielding framing must be fire resistant treated wood per BOCA 603.1.
- B. The basic enclosure shall be constructed to the proper dimensions consisting of pre-engineered modular panels and they're related framing system. All components should be pre engineered and pre cut at the factory to minimize site installation time.
- C. Wall, floor and ceiling panels. All shield panels shall be rigid structural panels, faced on both the interior and exterior sides with fully galvanized 28 gauge steel skins.
- D. Panel interlocking system: shall consist of 11 gauge pre-engineered zinc plated metal framing members. The framing element shall consist of shapes, which will provide a clamping action on both the interior and exterior panel edges. A uniform and constant pressure contact shall be maintained against the entire perimeter of each shielded panel.
- E. Trihedral corners are to be framed with machined cast bronze corner cap assemblies.
- F. Fasteners used within the framing system shall be hardened steel, self-tapping type 'F' screws set at 90 inch pounds of torque and spaced on maximum 4" centers for the entire perimeter of all shielded panels.
- G. Floor System:
 - 1. Magnet room floor systems shall be dual skinned galvanized steel with zinc-plated framing.
 - 2. Fasteners: All fasteners utilized within the floor system shall be flat head type 'F' screws mounted within the framing system. Each unit set at 90 inch pounds of torque on maximum 4" centers.

2.03 GENERAL

- A. In no case shall any fastening system be employed that utilizes screws, nails or other projections through the shield medium. On dual skin panels, items may be mounted directly to the interior skin face as long as the mounting mechanism does not penetrate the exterior skin and proper mounting techniques are utilized. Attachments to the RF

walls will be approved by the RF vendor prior to penetrating RF shield. Approval is to be requested in writing by the requesting trade.

2.04 RF SHIELDED DOOR

- A. The RF shielded door assembly shall provide full RF integrity while presenting the appearance of a conventional door.
1. Door Leaf: Shall consist of a solid core, with wood laminate finish leaf with full perimeter brass contact strip. The leaf shall be hung from two (2) extruded aluminum radial thrust bearing hinges. One layer of the shielding medium shall be laminated to the interior (unseen) surface of the leaf and electrically bonded to the perimeter brass contact strip to provide the RF shielding effectiveness. A user serviceable brass contact strip with integral beryllium copper contact fingers shall be attached to the leaf bottom.
 2. Door Latch: To consist of a standard “classroom” type, lockable from the outside only. Door handle shall provide a smooth quick door seal with not more than 20 pounds pressure. A pressure of no more than 20 pounds of force shall release the door. Door shall not require slamming to close or excessive force to open.
 3. Jamb: Shall be of polished brass, integrated into the RF panel system.
 4. RF Contact Fingers shall consist of a single row of heavy-duty beryllium copper alloy spring temper contact finger strips. Contact strips shall be compression mounted to the interior side of the doorjamb. Under no circumstance shall contact fingers be mounted directly to the door leaf where they will be exposed to unnecessary contact and damage. This mounting location will ensure protection of the contact fingers from the passage of carts and equipment. All contact fingers are to be user serviceable and repairable.
 5. Threshold: Shall consist of pre-formed brass, tapered ramp mounted directly into the shielded doorjamb. This brass sill shall provide the necessary RF seal. The RF contact fingers shall be mounted to the bottom of the door leaf.
 6. Floor Coverings: Due to the inherent design of RF shielded doors, acceptable finish floor coverings shall not exceed 1/8” in total thickness, and in no case shall be higher than 3/8” from the top of the brass sill.

2.05 RF SHIELDED WINDOW OPENINGS

- A. RF Windows: Shall consist of a double layer of RF shielding conductive mesh material, with a non reflective coating to improve vision. This window shall not degrade the RF shielding effectiveness of the shield. Plate glass shall be factory assembled to both sides of the RF window, with an aluminum-retaining frame, to prevent the ingress of dirt and debris during final construction. Moiré patterns are to be minimized; mullions to be employed on oversize windows to alleviate vision degradation through larger RF window units.

2.06 RF SHIELDED ACCESSORIES

- A. Filters shall provide an attenuation which is satisfactory for the intended application and be mounted on the RF panels where indicated on the Architectural plans. Electrical conductors shall pass through waveguide fittings, which are an integral part of the filter. A means of securing the filter to the RF panel shall be an integral part of each filter. Power filters to be UL listed where applicable. Refer to MIL-STD-220-A as applicable.

- B. Waveguide Air Vents shall be used to provide intake and exhaust air to provide necessary ventilation. Each ventilator shall be of the waveguide below cut-off type. Vents shall be 3/16" steel hex cell 1" deep, with attachment collars for the HVAC duct work both inside and outside the RF room. Mechanical contactor shall be responsible for the dielectric connection outside of the RF enclosure (canvas collar or equivalent).
- C. Grounding. Single Point Service Ground: Shall be accomplished with a 3/8" diameter threaded solid brass-grounding stud located on the RF panel per the magnet manufacturers direction.
- D. Mechanical Penetrations shall be RF shielded waveguide type pipe penetrations for all pipes entering the shielded enclosure. Dielectric connections shall be the responsibility of the respective trades.
- E. Removable Magnet Access Panels shall be provided as indicated on the contract drawings. Threshold, clip angles, through bolts and miscellaneous hardware per manufacturer's standard details for complete access panel assemble.

2.07 RADIO FREQUENCY SHIELDING PERFORMANCE

- A. The function of RF construction is to permit an interference free environment with a single ground point using industry standard construction techniques.
- B. For this purpose the interference free environment must meet these minimum functional requirements:
 - 1. Attenuation to Magnet Field: As required by the magnet supplier.
 - 2. Attenuation to Electric Field: As required by the magnet supplier.
 - 3. Attenuation to Plane Waves: As required by the magnet supplier.
 - 4. The environment must be constructed ungrounded with a minimum resistance to ground of 1,000 ohms.

EXECUTION

3.01 COORDINATION

- A. Refer to mechanical, electrical and plumbing drawings for utility penetration of the shielding.
- B. Items furnished by other section for installation into the work of this section shall be installed in accordance with the requirements of such other section, providing such requirements do not violate the RF shield integrity.
- C. Items furnished by this section for installation into the work of other sections shall be furnished sufficiently early to the proper section for timely installation.
- D. Perform work for this section in proper sequence with the work of other sections and trades and in strict conformance with approved shop drawings.
- E. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades that interface with the work of this section.

3.02 INSPECTION

- A. Shielding contractor shall examine the areas and conditions under which the RF shielded enclosures are to be installed and notify the architect in writing of conditions detrimental to the proper and timely completion of work.
- B. The general contractor shall level floor substrate to a tolerance of 1/8" in 10 feet. Slab area at the patient entrance door and all other RF doors shall be rendered flat and true with no greater than 1/16" deviation in level within 8 feet of the door swing.

3.03 INSTALLATION

- A. Refer to shop and erection drawings for location, type and thickness of shielding materials.
- B. Shielding shall be continuous within its limits, with electromagnetically tight seams; where other work, materials or accessories penetrate the shielding, install shielding patches or sleeves to provide continuity of the shielding.
- C. Installation shall be by the manufacturer's certified field service technicians.
- D. Prefabricated floor panels shall be laid on 6-mil vapor barrier and one layer of dielectric material placed on the structural floor of the parent room before any other work is placed thereon. Over this layer, additional dielectric material shall be furnished as required, to provide uniform ungrounded support for the panels.
- E. All panels shall be laid in a straight line with true level and even surfaces, and the joints shall be in alignment. Exposed surfaces shall be thoroughly cleaned of all dirt, finger marks and foreign matter resulting from handling or installation, and all areas shall be left free from defects.
- F. The environment for the RF shield must be weather tight, and be a minimum of 50 degrees Fahrenheit and minimum 35% humidity (sustained) prior to RF shielding material delivery.
- G. A staging area (minimum 20% of the MRI room floor area) adjacent to the MRI room location, and reasonable access for the RF shielding materials, must be provided.

3.04 CLEANING

- A. Immediately remove all spots, smears, stains, residues, adhesives, etc., from the work of this section and/or upon adjacent area or surfaces that result from the work of this section.
- B. Upon completion of the work of this section, dispose of all debris, trash, containers, residue, remnants and scraps that result from the work of this section.

3.05 PROTECTION

- A. Exercise care in handling and protection materials and finishes during fabrication, shipment, erection and finishing as necessary to prevent damage to finish surfaces and shielding linings.
- B. Protect work of this section against damage. Should damage occur prior to substantial completion of the work, it shall be removed and replaced at no additional expense to the owner.

3.06 TESTING

- A. At the owner's and/or magnet supplier's option, one RF test is to be performed prior to magnet delivery. The RF enclosure is then to be partially dismantled by the RF contractor prior to magnet delivery.
- B. Once the magnet has been installed, but prior to ramp up, an RF test is to be performed by an INDEPENDENT test agency (not the RF vendor), in accordance with MIL-STD-285 (modified per the magnet manufacturer's requirement). The test agency may, at the owner's discretion, be pre approved for which a test plan and tester qualifications shall be supplied.
- C. The tested areas shall, where possible, include the walls, floor, ceiling, RF door, RF window, power filter(s), RF penetration panel (magnet manufacturer supplied item,

- installed by RF vendor), penetrations for HVAC, water, sprinkler systems, medical gasses, etc. as appropriate.
- D. The RF enclosure is to be tested for isolation from ground, and the result duly recorded in the test results.
 - E. The test results are to be formalized into a printed report, with certification included. Any variation from the magnet manufacturers specification is to be duly noted by the RF tester. RF tests are to be witnessed by a representative of either the owner or magnet manufacturer.

END OF SECTION 13095