

SECTION 13095

RADIO FREQUENCY & MAGNETIC SHIELDING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: The work included in this section is furnishing and installing a prefabricated engineered modular Radio Frequency Shielded Enclosure and Magnetic Shielding to house a Magnetic Resonance Imaging Unit.

1.02 GENERAL

- A. The RF shielded enclosure will be of fully demountable, prefabricated panel construction, capable of being erected, disassembled and shipped and re-erected entirely from its interior without special tools. The panels will be joined by a framing system designed to provide electrically conductive joints between panels through constant pressure contact with the panels, and provide the attenuation that is specified herein. The framing system and the type and location of the screw fasteners will be such as to provide rigid substantial construction that will not interfere with the application of wall, floor and ceiling finishes. All panels and other components to the extent consistent with the required dimensions of the enclosure will be readily accessible from within the enclosure.
- B. The construction will be such that soldering and welding are not required. When assembled, the enclosure will be rigid, with vertical lines plumb, horizontal lines level, and all surfaces fair and true. All work including materials and all accessories necessary to complete the specified enclosure will be provided even though such work may not be shown or specified. The work includes:
 - 1. Prefabricated shielding materials and panels
 - 2. Framing members, fittings, and hardware
 - 3. Door assemblies including all hardware
 - 4. Filters
 - 5. RF air vents
 - 6. Ceiling and wall penetrations and fittings, where applicable for water, air, gas, and fMRI requirements
 - 7. M36 Silicon Steel magnetic shielding
 - 8. Coordination with other trades and equipment suppliers
 - 9. Installation of the RF shielded enclosure
 - 10. Installation of the magnetic shielding

11. Performance test and certification

- C. The enclosure will be subject to varying movable floor loads, repetitious use of the access doors, possible disassembly and reassembly and continuous use of the filters. In order to withstand such usage, adequate safety factors must be incorporated in the design of all components of the enclosure, accessories and ancillary equipment.
- D. There will be no penetrations of the shielded enclosure except as specified herein.

1.03 SUBMITTALS:

- A. Shop Drawings: Include floor plan of space, enclosure elevations, construction, sections, and locations of RF shielded penetrations.
- B. Coordination instructions for the work of other trades
- C. Written guarantee of the RF shield performance

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

- 1. Shall have been engaged in manufacture and installation of radio frequency shielded enclosures and magnetic shielding of like size and complexity of that required for this Project for a period of not less than eight (8) years
- 2. Shall demonstrate, if required, that all components of required enclosure are manufactured directly by manufacturer within manufacturer's own plants
- 3. Shall demonstrate that no parts, subassemblies, components or systems are remanufactured, reconditioned, or used
- 4. Shall have within its direct employment experienced and properly equipped installation and erection crews
- 5. Shall have within its direct employment experienced and properly equipped engineering, drafting, and project management departments

1.05 WARRANTY

- A. Warrant the system to be free of defects in materials and workmanship as evidenced by retention of specified shielding characteristics for periods as follows:
 - 1. Basic Enclosure: Five (5) years
 - 2. EMI Electrical Filters, RF Shielded Doors, RF Shielded Windows, Pipe Penetrations and RF Air Vents: One (1) year

PART 2 – PRODUCTS

2.02 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Universal Shielding Corporation, 20 W. Jefryn Boulevard, Deer Park, NY 11729; Tel: 631-667-7900, Fax: 631-667-7912, info@universalshielding.com; www.universalshielding.com
- B. Owner approved equal

2.03 COMPONENTS

- 1. RF enclosure personnel door shall be designed to afford equal shielded effectiveness as the rest of the enclosure when the door is closed. The door should be lever controlled with the roller cam action requiring not more than 20 pounds of operating force on the handle.
 - a. Furnish and install RF shielded door and seal of the Recessed Closure Mechanism (RCM) type, which provide a recessed contacting mechanism consisting of two sets of beryllium copper contact fingers in a pocket, designed in such a manner that it is impossible for the contacting fingers to become accidentally damaged. Fingerstock will conform to specification Q-C-533, condition HT.
 - b. The fingerstock shall not be soldered or fastened in place but will be easily inserted and removable from the doorframe pocket without the use of any special tools. The contacting surfaces of both the door and frame shall be extruded brass sections specifically designed for the RCM contacting system. The entire brass extrusion shall be factory soldered to the shielding surfaces as a continuous electrical mechanical bond. All mitered joints of the extruded brass channel shall be factory welded and ground smooth.
 - c. The door shall be equipped with a latching mechanism for tight, RFI/EMI secure holding. It shall be operable from both sides of the door and have permanently lubricated ball bearings at all points of pivot and rotation. Contact with the strike shall be by roller.
 - d. With the door leaf at rest and with the knife-edge in light contact with fingerstock, but without any force being exerted, the mechanism shall, on rotation of the handle, draw the door into its final closing position. Force on the handle, required to seat the door, shall not exceed 20 pounds. Reverse rotation of the handle shall force the door outward until the fingerstock is free of the leaf with no more torque than that specified for the closing operation.

- e. RF shielded door to contain a key cylinder deadbolt locking mechanism accessed from the outside. At the inside surface a turn knob will allow for easy door locking/unlocking function.
 - f. RF door is to contain a wood veneer or plastic laminate finish to match other hospital doors as selected by Architect. Wood door is to be installed by shielding contractor unfinished to be stained at site by General Contractor.
2. RF Shielding Floor Protection:
- a. Supply and install vapor barrier over magnetic shielding on floor slab
 - b. Supply and install 1/8" masonite hardboard isolation layer in accordance with specification LLL-H-35, Class 1.
 - c. Supply and install RF floor system over dielectric material to maintain 1000 ohms ground isolation above earth potential.
3. RF Shielded Control Window System: Provide a proven RF seal design that is easily maintained and serviced. RF window assembly shall maintain a shielding effectiveness equal to that of the shielded enclosure.
- a. Construct RF shield window of a double layer of copper screening and place layers in a horizontal orientation to each other so that resultant distortion eliminates moiré pattern.
 - b. Copper RF screen to be painted black to increase image visibility.
 - c. Copper screen is to be protected at both sides with 1/4" plexi-glass glazing.
4. RF Air Vents: Each supply and return air duct will be provided with an RF waveguide air vent where it enters the shielded enclosure.
- a. Cores will be fabricated of steel and each individual guide will be permanently and continuously bonded to all adjacent guides. The RF air vent will be mechanically held into the RF panel with a "hat" and "flat" frame for cleaning after long periods of usage.
 - b. Each RF air vent will have an electromagnetic attenuation loss of not less than 100 dB from 14 KHz.
 - c. The maximum pressure drop will be 0.1" water gauge at an air velocity of 1,200 ft/min.
 - d. Mechanical contractor is to provide a canvas collar (dielectric) connection at the outside collar of the shielded enclosure to maintain RF shield isolation.

5. Cryogenic Gas Exhaust Wave-Guide Vent: Construct wave guide vent of stainless steel, minimum 1/8" wall thickness continuously welded tube to maintain shielding effectiveness and to resist structural failure during a magnet quench.
 - a. Waveguide diameter is to be determined by mechanical contractor. Minimum waveguide length must be 4 times the waveguide tube diameter.
 - b. Waveguide to consist of a flanged bolted connection at the interior and exterior joints with connecting pipe by mechanical contractor.
 - c. The mechanical contractor shall provide a dielectric connection to the exterior side of the cryogenic vent of a suitable material to maintain a minimum of 1000 ohms resistance to ground.
 6. Mechanical Pipe Penetrations: Construct pipe penetrations of a material suitable to conditions of service on which it is installed, and to maintain shielding effectiveness. General Contractor is to provide dielectric union at exterior of shielded enclosure.
 7. Medical Gas Pipe Penetrations: Provide and install copper medical gas pipe penetrations as close as possible to MRI vendor penetration panel. General Contractor is to provide dielectric union as allowed by local codes.
 8. EMI Rated Power Line and Signal Electrical Filters: All incoming electrical lines will be provided with radio frequency filters. A filter will be provided for each electrical conductor (hot and neutral).
 - a. The filtered conductors will penetrate the enclosure through threaded pipe nipples secured by means of hexagonal nuts, and will be mounted so as not to degrade the attenuation of the enclosure.
 - b. Filters will provide an insertion loss of 100 dB throughout the frequency range from 14 KHz to 10 GHz measured in accordance with MIL-STD-220A, load condition.
 9. Brass Ground Stud: A ground stud of solid brass not less than 3/8" diameter will be installed adjacent to RF/EMI filters and MRI vendor penetration panel. It will extend through and be bolted to the RF shielded enclosure panel and serve as a single ground point for the completely assembled shielded enclosure both internally and externally.
- B. Magnetic Shielding: All magnetic shielding is to be provided and installed as per MRI Vendor specifications for locations and thicknesses. Magnetic Shielding materials to be engineered and provided by the shielding contractor as follows:
1. Magnetic shielding to consist of Armco DI-MAX M36 Silicon Steel of 0.024" thickness
 2. Silicon steel sheets to be pre-engineered and cut to fit site dimensions and shown on shielding vendor shop drawings.
 3. General contractor is to provide 3/4" fire-treated plywood surface at parent room walls to accept silicon steel magnetic shielding.

4. Silicon steel layers applied to walls to be mechanically fastened to fire-treated plywood substrate at a minimum of 12" apart in both the horizontal and vertical directions.
5. Silicon steel installed at ceiling to rest above plywood platform located atop I-Beams serving as the structural support for the RF shielded enclosure or to be fastened to contractor supplied platform.

2.04 PERFORMANCE

- A. The function of the shielded enclosure is to provide a highly conductive medium (material conductivity of 1 or greater) that will attenuate externally generated electromagnetic energy to a level acceptable for proper operation of the installed MRI Imaging System.
- B. The installed enclosure shall as a minimum, provide functional EMI attenuation to reduce radio frequency waves emanating from external transmitters. The required attenuation is 100 dB in the frequency range of 15-128 MHz. The RF shield must be tested before and after magnet placement in the RF Room and after the MRI Vendor RF filter panel is installed.

PART 3 - EXECUTION

3.02 INSTALLATION

- A. Installation shall be performed by the manufacturer of the shielded enclosure. Installation shall proceed after site temperature and weatherproof conditions are met.
- B. Installation to be performed by shielded manufacturer factory trained personnel. No work shall be subcontracted.
- C. Assemble enclosure RF panels into straight walls with true level and plumb surfaces. Align and secure RF joints.
- D. The locations of waveguides and RF filters will be agreed upon by the General Contractor and Shielding contractor supervisor.
- E. Shielding contractor shall provide a ground monitoring system that must be operational at all times during the construction of the MRI scan room, including all interior finishes.

3.03 PERFORMANCE TESTING AND GUARANTEE

- A. Test enclosure in accordance with MIL-STD-285, as modified for MR system installation. Demonstrate the required attenuation as detailed under Performance paragraph.

1. Qualification Testing: Perform immediately after completion of the enclosure and prior to installation of architectural surfaces within or outside the enclosure. Make no trade connections to enclosure until successful completion of test process.
 - a. Testing will be witnessed by a representative of Owner, and by the MR supplier.
 - b. Furnish a written test report to Owner and Architect.
2. Acceptance Testing: Perform immediately after installation of the MRI and closure of the RF entrance panel.
 - a. Testing will be witnessed by a representative of Owner, and by the MRI supplier.
 - b. Furnish a written test report to Owner and Architect.
3. Ground Isolation Monitoring: The RF shield supplier shall monitor ground isolation during entire phase of the initial RF shield construction for a minimum of 1000 ohms above earth potential. The shield supplier shall immediately correct deficiencies found that are the result of a fault condition caused by the enclosure supplier. The general contractor shall be required to monitor the shield for ground isolation after the initial RF shield construction and first RF test are completed. Immediately report deficiencies found to be caused by other trades during this period to the RF/magnetic shielding contractor.
 - a. Testing of actual ground isolation will be witnessed by a representative of Owner, and the MR supplier.
 - b. Furnish a written test report to Owner and Architect

END OF SECTION