# SECTION 13 49 26
# MODULAR RFI SHIELDING ROOMS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Modular RFI shielding rooms.

B. Shielding components.

C. Field testing.

### 1.02 RELATED REQUIREMENTS

A. Section 01 23 00 - Alternates: Description of alternate(s) affecting the Work of this Section.

B. Section 09 21 16 - Gypsum Board Assemblies: ~~Interior finish~~ Gypsum wallboard on outboard face of RFI shielding ~~rooms~~ walls.

C. Section 09 51 00 - Suspended Acoustical Ceilings: Non-ferrous lay-in ceiling within RFI shielding rooms.

~~1~~ D. Section 09 54 16 - Luminous Ceilings: False skylights centered over the MRI equipment.

~~2~~ E. Section 09 65 00 - Resilient Flooring:

~~a~~ 1. Flooring within RFI shielding rooms.

~~D~~ F. Section 13 49 23 - Integrated RFI Shielding Assemblies: Architecturally integrated, custom shielding.

### 1.03 PRICE AND PAYMENT PROCEDURES

A. See Section 01 23 00 - Alternates, for product alternatives affecting this Section.

### 1.04 REFERENCE STANDARDS

A. Comply with applicable provisions of state/local building code. Comply with reference standards to the extent referenced in this Section.

1. Exception: Where requirements that are more stringent are indicated on the Drawings or specified herein.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

C. ASTM E413 - Classification for Rating Sound Insulation; 2022.

D. IEEE 299 - IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures; 2006 (Reaffirmed 2012).

E. UL (DIR) - Online Certifications Directory; Current Edition.

### 1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Section 01 30 00 - Administrative Requirements. Review methods and procedures related to MRI shielding including – but not limited to – the following:

1. Required storage space prior to installation.
2. Temporary lighting and electrical power.
3. Sequence and schedule of MRI shielding work in relation to other work.
4. Unimpeded delivery route for shielding materials from truck to the site of the Work.
5. Supplementary radio MRI shielding and filters at penetrations of shielding by piping, ductwork, and conduit.
6. Methods of attaching other construction and equipment to shielding enclosure.
7. Notification procedures for work that requires modifying MRI shielding.

## 1.06 SUBMITTALS - GENERAL

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

## 1.07 SUBMITTALS FOR REVIEW

A. Product Data: Manufacturer's data sheets on each product to be used, marked-up and/or highlighted in sufficient detail to indicate compliance with the Contract Documents and to indicate what is included – and what is NOT included, Include:
   1. Brochures and specifications.
   2. Specimen warranty.

B. Shop Drawings: Obtain approval from manufacturer of MRI equipment before submitting to Architect.
   1. Submit complete floor plans, wall sections, corner details, and penetration details.

## 1.08 SUBMITTALS FOR INFORMATION

A. Deferred/Delegated Design Submittal: Drawings approved by and bearing stamp or seal of licensed professional structural engineer.

B. Certifications: For waveguide products and fabrications, certify compliance with specified requirements.

C. Test and Evaluation Reports:
   1. Where applicable, listing of electrical components in UL (DIR).
   2. Current test results of IEEE 299.

D. Manufacturer's Instructions:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation manual.

E. Field Testing Agency Qualifications.

## 1.09 SUBMITTALS FOR CLOSEOUT

A. Project Record Documents: Record actual locations of penetrations through shielding.

B. Operation and Maintenance Data.

C. Warranty Documentation.

## 1.10 QUALITY ASSURANCE

A. Design Engineer Qualifications: Licensed in North Carolina.

B. Field Testing Agency Qualifications: Independent testing agency having staff experienced in field testing of shielding enclosures who conducts such testing as a normal service and who maintains equipment required for testing.
   1. Approved by Owner.
   2. Able to provide data showing at least five successfully tested installations.

## 1.11 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

## 1.12 WARRANTY

A. Materials and workmanship shall be warranted against defects in materials and workmanship as evidenced by retention of specified RF-shielding characteristics as follows and in accordance with the shielding manufacturer's standard warranty for their product for a period of two years from the date of Substantial Completion.

B. Pass-through warranties provided by subcontractors to the manufacturer will NOT be acceptable.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Modular RFI/EMI Shielding Rooms:
   1. Istra Corp.; Turnkey MR Room with RF Shielding: www.istracorp.com.
      a. Contact: Bob Thayer of BT Imaging Solutions (E-Mail: bthayer11@gmail.com).
   2. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.02 MODULAR RADIO-FREQUENCY INTERFERENCE (RFI) SHIELDING ROOMS

A. Contractor is responsible for designing, furnishing, and installing complete shielded room(s) that meets the requirements of Contract Documents; specified product requirements are minimum requirements.
   1. Certain aspects of design are indicated on Drawings.
   2. Design to comply with applicable building codes.
   3. Modifications necessary to achieve required performance may be made to components that are not exposed to view without prior approval; obtain approval of any modifications to components exposed to view in finished work.
   4. Alternative Solutions: Comply with requirements specified for substitution review.

B. Performance Requirements for Aluminum-Based Design:
   1. RFI Shielding: Reduction of Radio Frequency Waves Emanating from External Transmitters: Attenuation shall be 90dB in the frequency range of between 15MHz and 128MHz.
   2. Total Electrical Insulation: Greater than 3 Kohm.
   3. Sound Insulation: About 25 dBA at 400 Hz.

### 2.03 SHIELDING COMPONENTS - BASED ON BOLTED ALUMINUM PANELS AND STRUCTURE

A. RF Shielding Cage: The cage shall consist of bolted aluminum panels and structure.

B. Floor: Construct the cage floor of aluminum profiles and aluminum panels in which filler panels are placed. Place plates on top of the filler panels and cover with a layer of vinyl sheet flooring.
   1. Wood in the floor's core structure will NOT be acceptable.

C. Walls: Construct the cage vertical walls of aluminum profiles and aluminum panels connected to the floor of the cage and to the ceiling by bolted aluminum angular profiles.
   1. Wood in the walls' core structure will NOT be acceptable.

D. Ceiling: Construct the cage ceiling of aluminum profiles and aluminum panels. The ceiling shall be self-supporting. Anchorages to the parent room ceiling will NOT be acceptable. Wood in the ceiling's core structure will NOT be acceptable.

E. RF Shielding Door: Solid aluminum with an RF gasket around the entire perimeter.
   1. Panels: 1.5mm-thick solid aluminum.
   2. Door Size (Net Clearance): 1.23 x 2.10 (WxH) meters.
   3. Core Structure: Tubular aluminum frame.
   4. Provide two seamless conductive gaskets, one on the door and one on the door frame.
   5. Electromagnets inside the door, shall perform the locking and releasing of the door.
      a. A pneumatic locking/unlocking system will NOT be acceptable.
   6. When the door is closed, the electromagnets shall pull the seamless and conductive gaskets that are installed continuously around the door's width.
   7. The conductive gaskets shall provide electrical continuity between the door itself and the door frame.
   8. The conductive gaskets shall be inspectable for maintenance and shall be easily replaceable without affecting the structure of the door.
   9. Hinge the door to the solid aluminum jamb of the door.

10. Bolt the aluminum jamb to the aluminum RF cage.
11. From an electrical standpoint, configure the door as a shielding panel.
12. Cover the two faces of the door with aluminum sheets.
13. For protection, apply a high-pressure decorative laminate (HPDL) panel.
    a. HDPL Color: As selected by the Architect from the modular manufacturer's full range.
14. The opening and closing operations of the door shall be carried out by an electrical switch (push button) both inside and outside the RF cage.
    a. Door shall be lockable from the outside.
    b. Door shall be openable from the inside without a key or additional device.
    c. Provide for manual operation upon loss of any one power service.
15. The door assembly shall have a Sound Transmission Class of 29 when tested per ASTM E90 and classified per ASTM E413.
16. Wood in the door's core structure will NOT be acceptable.
17. RF fingerstrips will NOT be acceptable.
18. The opening and closing of the door shall be carried out manually, *without* a rotating handle.

F. RF Window: The viewing window shall allow the patient to be monitored during the examination from the control MR room.
   1. Provide Type 304 stainless-steel wire mesh fixed to both faces of window frame.
   2. Electrically connect the window to the rest of the cage through steel gaskets.
   3. Also apply double-sided 1/4-inch-thick protective laminated safety glass.

G. Penetrations: Include RF sealed wave guides as follows.
   1. HVAC Waveguides: Provide RF attenuation while allowing air-flow penetration through the shield, typically for HVAC supply, HVAC return, exhaust, and passive pressure equalization. Waveguides shall consist of aluminum honeycomb vents with integral collars for mounting and attachment to the RF cage. HVAC waveguides shall be provided with plenums made of polycarbonate.
   2. Pipe Waveguides: Provide RF attenuation for medical gasses, cryogenic vents, vacuum, fire sprinkler and other pipe penetrations through the shield. Pipe waveguides shall be compliant with MRI vendor's requirements, mounted in a manner that is electrically contiguous with the shield, and materially, structurally, and mechanically compatible with connections by others.
   3. Quenching Pipe: The quench pipe, located within the RF cage, shall run from the magnet to a designated point on either a wall or the ceiling. Suspend this pipe from the cage ceiling and extend at least one foot beyond the chosen wall or ceiling surface.

H. Cable Trays:
   1. Cable Ladder: Aluminum, composed of pallets or ladders of straight-line segments, components, arm (arm-bracket), hangers, and electrical insulators, constituting the rigid structure of the cable system.
   2. Raceway Cable Tray: Painted aluminum. Raceways shall be dividable into parts by putting partitions in one cross-section. Design cable trays to be installed on the floor.

I. Electrical System:
   1. EMI Electrical Filters: System shall come with electrical filters for RF attenuation of all power circuits and data mounted on dedicated plates, installable on the shielding walls. Electrical filters shall provide a rating satisfactory for the specific application. Filters shall attenuate RF energy on the incoming conductor at 100dB from 1 MHz to 150 MHz
   2. ~~**Power Distribution Panel:**~~
      a. ~~**Prefabricated, complete with power supplies for:**~~
         1) ~~**The LED lighting system.**~~
         2) ~~**Inside electrical circuit with power outlets.**~~

3) ~~**Main and secondary switches.**~~

b. ~~**The panel shall be installable either on the cage or on the parent room walls.**~~

3. Light-Emitting Diode (LED) Lighting System:
   a. MRI-compatible, dimmable white LED panels mounted in the suspended ceiling.
   b. MRI-compatible LED spotlights recessed in the drop ceiling over the patient bed.
   c. MRI-compatible emergency LED Lighting System.

J. Interior Finishes:
1. Walls:
   a. Removable sandwich panels, with an aluminum honeycomb core bonded to two aluminum skins.
      1) Paint Color on Inboard Face: As selected by Architect from manufacturer's full range.
   b. Total Thickness: 10mm.
   c. Aluminum omega-shaped joints shall hold the panels to the cage walls.
   d. Sound Insulation: 40mm, beyond the panels.
   e. Wood in the walls will NOT be acceptable.
2. Flooring:
   a. Filler: 42mm high-density rigid polyurethane (PUR).
   b. Cover Sheets: 5mm medium-density fiberboard (MDF).
   c. Floor 2mm-thick sheet polyvinyl-chloride (PVC).
   d. Structural wood in the floor will NOT be acceptable.
3. Lay-In Ceiling:
   a. Suspended Grid: Aluminum.
   b. Lay-In Panels: Nominally 24- by 24-inch mineral fiber.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation or unacceptable conditions at the Project site before proceeding.

### 3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under Project conditions.

### 3.03 INSTALLATION

A. Install in accordance with manufacturer's detailed installation manual.

### 3.04 FIELD QUALITY CONTROL

A. Perform preliminary inspections and tests as required to ensure that completed shielded room will achieve specified performance when field tested as specified; retesting due to failures will be at Contractor's expense.

B. Field Testing: Comply with requirements of Section 01 40 00 - Quality Requirements.

C. Attenuation Testing: Testing as specified by IEEE 299 will be performed by testing agency or other entity employed by Owner; in addition to the IEEE 299 test points, test points will include perimeters of doors, penetrations, and other points recommended by testing agency.

D. Repair, modify, or replace defective components and portions of shielded room at no extra cost to Owner; retest at Contractor's expense.

### 3.05 CLEANING

A. Clean completed products of dirt, grease, and other contaminants.

### 3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

**END OF SECTION**