SUBMITTALS: Manufacturer's date and installation instructions. Manufacturers offering products to comply with requirements for general toilet & bath accessories include the following: Bobrick Washroom Equipment, Inc.; Bradley Corporation; approved equal.

General: Provide toilet and bath accessories as indicated on schedule. Install units at locations and heights as indicated, plumb and level, firmly anchored, in accordance with manufacturer's instructions.

MATERIALS: Stainless Steel: AISI Type 302/304, w/ polished No.4 fin.. 22 gauge min. unless other indicated.

SCHEDULE: Provide the following accessories by Bobrick or as noted below or approved equal.

1. **Grab Bars:** stainless steel w/ polished finish. pinned grip surface, 1-1/2" o.d. x 18 Ga. as follows:
   H/C toilets: 36" (behind toilet); 42" (side of toilet, 2 grab bars if stall is less than 5' wide).
   H/C showers: Two @ 24" (at both ends) and one @ 48" (verify shower size).
2. **Toilet Paper Holder:** (1 per toilet stall)- Bobrick B-2740 (two roll) @ solid partitions
3. **Soap Dispenser:** Bobrick B 2111 wall mounted
4. **Mirror:** Bobrick B-165 2448 stainless steel frame mirror 1/4" plate glass, concealed hanger, theft-resistant mount, & shock absorbing material back.
5. **Utility Shelf w/ Mop/Broom holders & rag hooks:** Bobrick B-239 – Two (2) utility shelf holders at all Janitor Storage.
6. **Electric Hand Dryer:** Bobrick B-750- Provide at all restrooms throughout project. (1) at single lavs, (2) @ 2 to 4 lavs, & (3) @ 5 to 6 lavs, & (4) at over 6 lavs.
7. **Shelf with Coat Hooks:** Bobrick-968 – (1) at each Dressing Rm. throughout project.
8. **Sink Protective Cover:** Under sink drain piping, angle valve, and supply covers equal to "Basin Guard" by Truebro- submit colors for approval. Quantity: one (1) per H/C sink.
9. **Lav. Protective Cover:** White under sink drain piping, angle valve, and supply covers equal to "Lav Guard" by Truebro model #103. Quantity: one per H/C lav.
10. **Sanitary Napkin Disposal:** Bobrick B-254 (H/C) classic series surface mounted sanitary napkin disposal. Provide (1) at each @ all Female restrooms. Provide (1) napkin disposal at all Unisex restrooms.

Adjust toilet accessories for proper operation and verify that mechanism function smoothly. Clean and polish all exposed surfaces after removing protective coatings.

STRUCTURAL STRENGTH: grab bars, tub & shower seats, fasteners, mounting devices shall be as follows:
(1) Bending stress in a grab bar or seat induced by the maximum bending moment from the application of 250 lbf (1112N) shall be less than the allowable stress for the material of the grab bar or seat.
(2) Shear stress induced in a grab bar or seat by the application of 250 lbf (1112N) shall be less than the allowable shear stress for the material of the grab bar / seat. If the connection between the grab bar or seat and its mounting bracket or other support is considered to be fully restrained, then direct and torsional shear stresses shall be totaled for the combined shear stress, which shall not exceed the allowable shear stress.
(3) Shear force induced in a fastener or mounting device from the application of 250 lbf (1112N) shall be less than the allowable lateral load of either the fastener or mounting device or the supporting structure, whichever is the smaller allowable load.
(4) Tensile force induced in a fastener by a direct tension force of 250 lbf (1112N) plus the maximum moment from the application of 250 lbf (1112N) shall be less than the allowable withdrawal load between the fastener and the supporting structure.
(5) Grab bars shall not rotate within their fittings.

General: Install toilet accessory units in accordance with manufacturer's instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations indicated. Toilet paper holders shall be mounted on masonry wall whenever possible.

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13096 - RADIO FREQUENCY SHIELDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes.

1. Radio Frequency Shielding.
2. Radio Frequency Door(s) and Window(s).
3. Radio Frequency Mechanical Penetration Waveguides.
4. Radio Frequency Electrical Filters.
5. Radio Frequency penetrations required by the magnetic equipment manufacturer.

B. Work coordinated through this Section, but provided by other Sections, shall include the following:

1. Construction work in preparation for shielding installation including foundations, floor, walls, and overhead structures, and door, window, and magnet access apertures.
2. All external connections to shield or shield components by other trades, including those of a structural, electrical, mechanical, or MRI system nature.
3. All internal connections to shield or shield components by other trades, including furring, finishes, electrical, mechanical, and MRI system related items.

C. Work required by this Section, but provided by other Sections, shall include the following:

1. Site access and delivery path for shielding materials.
2. Staging area adjacent to MRI exam room with forklift access.
3. Three electrical convenience outlets.
4. All conventional construction work enveloping and internal to the shielding system, including concrete work, structural and partition walls, ceilings, floors, finishes, etc.
5. All electrical and communications work and materials including inside and outside enclosure connections to electrical filters provided and mounted by the shielding vendor.
6. All mechanical work and materials including inside and outside enclosure connections to duct and pipe penetrations provided and mounted by the shielding vendor.
7. Installation, mounting, or anchoring of MRI equipment vendor's materials or equipment.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Participate in a pre-installation teleconference if requested by the Owner or General Contractor.

1.4 ACTION SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details that disclose methods for attaching or connecting items to the shielding or its penetrations.
4. Clearly indicate what materials and labor is provided by others.

1.5 CLOSEOUT SUBMITTALS

A. Performance Test Report: A copy of all test reports shall be provided to the Owner. Report must show date and time of test, personnel present, specific test methodology, equipment and calibration data, measurements taken and results obtained.

B. Operation and Maintenance data

C. Manufacturer's Warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products

B. Performance testing shall be in strict accordance with MRI equipment vendor requirements. Refer to MRI equipment vendor requirements and documents for specifics. Test enclosure in accordance with IEE-299 modified for MRI system installation.

1.7 PROJECT CONDITIONS

A. MRI exam room and staging area shall be weatherproofed, dry (non-condensing), and temperature controlled between 60° F and 80° F. MRI Exam room shall be free of clutter and debris and the floor broom-swept. Verify conditions before shielding contractor delivers RF shielding components to the site.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of RF Shielding that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year(s) from date of Substantial Completion for: shielding system materials (walls, floor, and ceiling elements) and passive penetrations (waveguides and screened apertures).
2. Warranty Period: 1 year from date of Substantial Completion for doors and active penetrations (electrical filters, switches etc.)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. PDC Facilities, Inc.
   700 Walnut Ridge Drive
   Hartland, WI 53029-0900
   (262) 367-7700
   (262) 367-7744 Fax

2.2 RF SHIELD DESCRIPTION

A. Shield Type: Nickel/Copper polyester non-woven shielding fabric manufactured by Laird Technologies.

B. Walls and Ceiling: Fastening hardware or structural components that contact any element of the shielding system must be made of stainless steel. These shielding elements must be fashioned in such a way that they will accept standard furring and finishes without compromise to RF integrity.

C. Floor: As above. Additionally, the floor must be electrically isolated from the concrete below, preferably with a layer of dielectric epoxy or rigid plastic sheet, not film or paper. Floor underlayment design must be adequate to protect RF shield from damage due to magnet positioning or moisture resulting from normal use and maintenance. Underlayment must accept standard finish flooring methods.

D. Panel systems are not acceptable.

2.3 RF SHIELDING COMPONENTS

A. RF Door:

1. Door shall be manufactured out of aluminum with an unfinished wood veneer insert on both faces. All exposed aluminum shall be polished prior to installation.
2. Door frame shall be manufactured utilizing an aluminum extrusion. The door frame shall be polished before installation.
3. Provide factory mortised, fit and hung door dimensioned as indicated in the Drawings.
4. Door must be self-sealing and fit with conventional hospital grade hardware and lockset. Hinges must be ball bearing type and number three (3) per door.
5. Minimum Size: 48 inches wide by 84 inches high.
6. Door Hardware:

   a. Lockset: Sergeant Part Number is SC-11G37 LB 26D. Heavy-Duty Classroom Style Door Lock, L-style Rose and B-Style Lever.
   b. Interlock Switch: Manufacturer's standard.
   c. Pneumatic Latch Assembly with air delivery system, push plates, and keyed power control.
   d. RF gasketing must be fabric-over-foam type. RF finger stock may not be used. RF sealing shall not be made by use of air. Retractable RF seals are not acceptable.

e. Threshold must rise no more than 3/8-inch from finish floor.

B. RF Windows:

1. Provide factory-fabricated window unit ready to mount in shield wall, dimensioned as indicated in Drawings.
2. 3/16 inch tempered safety glass each side of window, with two (2) layers electrically-bonded metal mesh, free of Morie pattern and coated to eliminate specular reflection and enhance contrast and light transmission
3. Frame: Plated copper with soldered corners

C. Ventilation Penetrations:

1. Provide tubular waveguides with integral mounting flange and external dielectric break.
2. Honeycomb type waveguides are only acceptable in areas where tubular types will not fit.
3. Coordinate number and sizes with HVAC consultant.

D. Pipe Penetrations:

1. Provide tubular waveguides with integral mounting flange. Dielectric break provided by others
2. Coordinate number and sizes with mechanical consultant.

E. Electrical and Communication Penetrations

1. Provide filters for all electrical conductors passing through the RF shield.
2. Power filters are to be UL/CSA rated devices
3. Coordinate number and sizes with electrical, communications and MRI equipment consultants.

F. Cryogenic Gas Exhaust Vent Wave Guide

1. Wave guide below cutoff type, size as required by MRI equipment manufacturer.
2. Wave-guide constructed of suitable material to maintain shielding effectiveness equal to that of the shielded enclosure, and to resist failure during a magnet quench event.
3. Provide dielectric connection to the exterior side of the cryogen vent of suitable material to maintain 1000-ohm minimum resistance to earth ground.

G. MRI Equipment Penetrations:

1. Provide mounting aperture and necessary mounting hardware for the MRI equipment filter panel(s) and other equipment-related penetrations as identified by the MRI equipment vendor.
2. Penetrations must meet the minimum attenuation requirements of the RF Shield.

H. Grounding:

1. Provide a ground buss bar per the MRI equipment vendor's requirements.
2. In the absence of a specific requirement, mount the bar adjacent to the MRI equipment filter panel.
3. Provide 1000-ohm minimum electrical isolation between primary support structure and earth ground.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify on-site conditions affecting the work of this section. Coordinate any discrepancies with Design Architect, General Contractor and MRI equipment vendor.

B. Start of shielding installation indicates that site conditions are acceptable to shielding contractor.

C. Install materials by, and under supervision of qualified employees of shielding contractor.

D. Install materials consistent with industry construction standards and in accordance with any special requirements of MRI equipment vendor

E. At completion of installation, shielding contractor's supervisor shall make final review with General Contractor before leaving the job site of proper procedures and details required by other subcontractors who shall provide work in diagnostic room.

F. If the MRI Magnet is not delivered while the RF contractor is on site, an employee of the shielding contractor must return to open and reseal the magnet access panel when magnet delivery occurs.

3.2 FIELD QUALITY CONTROL

A. During shielding construction, ground isolation shall be monitored at all times using "continuity" indicator.

B. Performance testing will be in strict accordance with MRI equipment vendor requirements and IEE-299. Refer to MRI vendor documentation for specifics. In the absence of MRI vendor requirements, testing will be as follows

1. Acceptance Test: At the completion of the shield installation, prior to the installation of the MRI equipment vendor's penetrations and magnet, and prior to application of internal walls, ceiling, and finishes, and prior to making any external connections to the shield, the RF contractor will test the enclosure for ground isolation and shielding effectiveness. Ground isolation resistance in ohms will be conducted using calibrated ohmmeter.
2. Ground isolation test must be performed before equipment or power systems are connected.

END OF SECTION 13096

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes: X-Ray radiation protection products
   1. Lead sheet.
   2. Lead plate.
   3. Interlocking lead bricks.
   4. Lead-laminated gypsum board.
   5. Lead-laminated plywood.
   6. Structural laminated steel sheet.
   7. Radiation shielding leaded glass.
   8. Radiation shielding leaded acrylic.
   9. Lead-lined telescopic view window frames
   10. Lead-lined two-piece slip window frames
   11. Lead-lined radiation-shielded solid core wood doors
   12. Lead-lined hollow metal door frames
   13. Related accessories.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry
   2. Section 08 11 13 - Hollow-Metal Doors and Frames
   3. Section 08 14 16 - Flush Wood Doors
   4. Section 09 22 16 - Non-Structural Metal Framing Interior metal framing to receive radiation protection products.
   5. Section 09 29 00 - Gypsum Board: Joint taping and finishing of lead-laminated gypsum board.
   6. Section 09 91 00 - Painting: Field-applied primers and finish painting.

1.2 DEFINITIONS

A. Lead Equivalence: Thickness of lead that provides same attenuation (reduction of radiation passing through) as material in question under specified conditions Lead equivalence specified for materials used in diagnostic X-Ray rooms is measured at 150 kV unless indicated otherwise

1.3 REFERENCES

A. American National Standards Institute – ANSI
   1. Fire Resistance Ratings – ANSI / UL 263

B. American Society of Testing and Materials.
   1. ASTM B749 – Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
   2. ASTM C 954: Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
   3. ASTM C 1002: Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
   4. ASTM C 1396 – Standard Specification for Gypsum Board.
   5. ASTM C 1629 – Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
   6. ASTM - D 3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
   7. ASTM E 119 – Fire Tests of Building Construction and Materials.

C. American Wood Products Association (AWPA) C27 - Fire Retardant Treatment by Pressure Processes.

D. Federal Specification QQL-201 F Grade C

E. Hollow Metal Manufacturers Association (HMMA) 840 – Installation and Storage of Hollow Metal Doors.

F. National Council on Radiation Protection and Measurements (NCRP).

1. NCRP Report No. 145 – Radiation Protection in Dentistry
2. NCRP Report No. 147 – Structural Shielding for Medical X-Ray Imaging Facilities.
3. NCRP Report No. 151 – Structural Shielding Design and Evaluation for Megavoltage X- and Gamma Ray Radiotherapy Facilities.

G. Steel Door Institute (SDI)-100 – Recommended Specifications for Standard Steel Doors and Frames.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meetings: Conduct pre-installation meeting to coordinate radiation protection survey and verify project requirements and substrate conditions

1.5 ACTION SUBMITTALS

A. Submit under provisions of "Section 01 33 00 Submittal Procedures."
B. Product Data: Manufacturer's data sheets on each product to be used.
C. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5 For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5 For products and materials required to comply with requirements for regionally manufactured materials Include statement indicating cost for each regionally manufactured material.
a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Product Data for Credit IEQ 4.1 For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.
5. Laboratory Test Reports for Credit IEQ 4 For adhesives used to laminate gypsum board panels to substrates, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings:
1. Indicate layout of radiation-protected areas
2. Indicate details, dimensions, finishes, and interface with adjoining work.
3. Indicate lead thickness or lead equivalencies of components.

E. Initial Selection Samples: For each finish product specified two complete sets of color chips representing manufacturer's full range of available colors and patterns
F. Verification Samples: For each finish product specified two samples, minimum size 6 inches (152 mm) square, representing actual product, color, and patterns

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificates:
1. Certificate that leaded glazing capabilities meet or exceed specified requirements.
2. Certificate of compliance with applicable provisions of the National Council of Radiation Protection (NCRP).

B. Manufacturer's Instructions:
   1. Preparation and installation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
C. Qualification Statements:
   1. Manufacturer. 2. Installer 3 X-ray physicist.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: Cleaning instructions for leaded and acrylic glass.
B. Record Documentation: Record Drawings. with dimensions showing locations of radiation protection.
C. Radiation Protection Survey: Record copy of physicist's Radiation Protection Survey indicating measurements and evaluation of measurements of installed radiation shielding materials.
D. Manufacturer's Certification: Upon completion of radiation protection work, Manufacturer and Installer shall furnish a certificate of compliance that all materials are in accordance with the specifications and physicist's radiation protection survey.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with minimum of five (5) years successful experience specializing in manufacturing radiation protection products similar to those specified in the section.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience.
C. Radiation Protection Work: Comply with National Council of Radiation Protection (NCRP) Report No. 049 - Structural Shielding Design and Evaluation for Medical Use of X-Rays and Gamma Rays of Energies up to 10 MeV.
   1. Comply with requirements of local regulatory agencies where local standards and criteria exceed requirements of NCRP Report Nos. #145. #147 and #151
D. Single Source Responsibility: Obtain radiation protection materials and accessories produced or distributed as standard products from single manufacturer regularly engaged in production of X-Ray shielding materials, equipment, and accessories.
E. Mock-Up: Provide a mock-up of type and size as directed by Architect for testing purposes to verify the protection integrity of the work of this section and to establish application workmanship.
   1. Locate mock-up where directed by Architect
   2. Rework mock-up area as required to produce acceptable work.
   3. Do not proceed with remaining work until protection integrity and workmanship are approved by Architect.
   4. Approved mock-up may remain as part of the Work

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instruction for receiving handling. storing, and protecting materials.
B. Deliver materials in manufacturer's original. unopened undamaged containers with identification labels intact.
C. Store materials in original packaging, protected from exposure to harmful environmental conditions, including static electricity, and at temperature and humidity conditions recommended by manufacturer.
D. Exercise care to prevent edge damaged materials

1,10 FIELD CONDITIONS

A. Ambient Conditions: Maintain temperature. humidity and ventilation condition within limits recommended by manufacturer for optimum results. Do not install products under ambient conditions outside manufacturer's absolute limits.
B. Lead-Laminated Gypsum Board:
   1. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent
   2. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

3. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape
   b. Indications that panels are mold damaged include. but are not limited to, fuzzy or splotchy surface contamination and discoloration

1.11 COORDINATION

A. Coordinate the work of this Section with the respective trades responsible for installing interfacing work.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: **SANTA ROSA LEAD PRODUCTS. INC.**. , TEL: 800-916-5323 / 707-431-7757, FAX: 707-431-1749, Email: sales@santarosalead.com. Web http://www.santarosalead.com

1. Substitutions: Submit for approval
2. Substitutions: All other manufacturers shall submit substitution request in accordance with "Section 01 25 00 - Product Substitutions."

2.2 RADIATION PROTECTION SYSTEM DESCRIPTION

A. Design Requirements:
1. Provide materials and workmanship including joints and fasteners, that maintain continuity of radiation protection at all points and all directions equivalent to materials specified in thicknesses (**1/16"**) and locations indicated.
   a. Employ a physicist knowledgeable in radiation protection for medical facilities to determine thicknesses and configurations of lead-lined materials.
2. Lead-Lined Assemblies: Provide lead thickness in gypsum board, plywood, doors, door frames, window frames, and other items located in lead-lined assemblies, not less than that indicated for assemblies in which they are installed unless indicated otherwise
3. Lead Glazing: Provide lead equivalence not less than that indicated for assembly in which glazing is installed unless indicated otherwise

2.3 LEAD SHEET

A. Lead Sheet: 99.9 percent or better pure unpierced virgin lead. free from dross, oxide inclusions, scale, laminations, blisters, and cracks.
1. Sheet Lead shall meet or exceed the Federal Specification QQL-201 F Grade C and ASTM B749-03 Standard Specification for Lead and Lead Alloy Strip Sheet, and Plate Products, see NCRP reports #145, #147 and #151.
2. Thickness: As determined by Radiation Protection Survey, but not less than 1/16 inch (1.5 mm) if not indicated.
3. Variation in Sheet Thickness: Not to exceed five (5) percent.

2.4 LEAD PLATE

A. Lead Sheet: 99.9 percent or better pure virgin lead free from dross, oxide inclusions, scale, laminations, blisters, and cracks.
1. Sheet Lead shall meet or exceed the Federal Specification QQL-201 F Grade C and ASTM B749-03 Standard Specification for Lead and Lead Alloy Strip Sheet, and Plate Products, see NCRP reports #145, #147 and #151.
2. Thickness: As indicated on Drawings

3. Variation in Sheet Thickness: Not to exceed five (5) percent.

2.5 LEAD BRICKS

A. Interlocking Lead Bricks: 99 percent pure virgin lead free from dross, oxide inclusions, scale, laminations, blisters, and cracks. Fabricate bricks with tongue and groove sides

1. Size: 3/4 inch (19 mm) by 4 inches (102 mm) by 12 inches (305 mm).
2. Size: 1 inch (25 mm) by 4 inches (102 mm) by 12 inches (305 mm).
3. Size: 1-1/2 inches (38 mm) by 4 inches (102 mm) by 12 inches (305 mm).
4. Size: 2 inches (51 mm) by 4 inches (102 mm) by 8 inches (204 mm).
5. Size: 2 inches (51 mm) by 4 inches (102 mm) by 12 inches (305 mm).
6. Size: 2-1/2 inches (63.5 mm) by 4 inches (102 mm) by 12 inches (305 mm).

2.6 LEAD-LAMINATED GYPSUM BOARD, GENERAL

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by UL (Underwriter's Laboratories Inc.) or other independent testing agency.

1. Lead-laminated gypsum panels shall be identified with the UL label affixed to the lead side indicating shielding material manufacturer and current fire-resistance listing and UL classification per the current UL Certifications Directory and as tested in accordance with the standard fire tests of building construction and materials per ANSI/UL 263.

B. Recycled Content of Gypsum Panel Products Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent

C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered as well as manufactured, within 500 miles (800 km) of Project site.

D. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

E. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.7 LEAD-LAMINATED GYPSUM BOARD

A. Lead-Laminated Gypsum Board: Single unpierced layer of sheet lead laminated to back of gypsum board.

1. Fire-Resistance Rated Gypsum Board Type X ASTM C 1396.
   a. Core: Fire-resistant rated gypsum core
   b. Surface paper: 100% recycled content paper on front, back and long edges
   c. Long Edges: **Tapered**
   d. Thickness: **5/8 inch**
2. Fire-Resistance Rated Gypsum Board With Enhanced Mold And Mildew: Type X, ASTM C 1396.
   a. Core: Mold and moisture resistant fire-resistance rated gypsum core
   b. Surface paper: 100% recycled content moisture/mold/mildew resistant paper on front, back and long edges.
   c. Long Edges: **Tapered**
   d. Thickness: **5/8 inch**
   e. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

2.8 LEAD-LAMINATED PLYWOOD

A. Lead-Lined Plywood: PS 1 Structural grade Grade C-C or better. sanded; APA span rated to suit application.
   1. Thickness: **3/4 inch**
   2. Fire-Retardant-Treated Plywood: Where indicated on Drawings, provide fire-retardant-treated plywood complying with performance requirements in AWPA C27
      a. Type: Interior Type A, unless otherwise indicated

2.9 STRUCTURAL LAMINATED STEEL PLATE

A. Steel/Lead/Steel Laminated Panels:
   1. Outer Steel Case Thickness: Thickness as indicated or as recommended by manufacturer.
   2. Adhesive: High-strength epoxy adhesive
   3. Core: Pure lead core up to 3" thick
   4. Edges: Standard steel shapes as required
   5. Sizes: Up to 80" x 120"

2.10 RADIATION SHIELDING LEADED GLASS

A. Radiation Shielding Leaded Glass: Clear leaded glass containing 48 percent lead oxide (by weight) and 15 percent barium. Thickness as required to provide radiation protection equivalent to that provided by sheet lead in partition in which lead glass is installed.
   1. Thickness: 8.0 mm (5/16") yielding an equivalency of 2 0 mm (1/16").

2.11 RADIATION SHIELDING LEADED ACRYLIC

A. Radiation Shielding Leaded Acrylic: Clear Pb lead-plastic
   1. Thickness: 7.0 mm yielding an equivalency of 0 3 mm

2.12 LEAD-LINED TELESCOPIC VIEW WINDOW FRAMES

A. Lead-Lined Telescopic View Window Frames Construct of 16 gage welded steel frames adjustable from 4 inches to 6¼ inches wall thickness. Frames shall be capable of accepting any thickness of radiation shielding leaded glass, radiation shielding X-Ray safety glass or radiation shielding leaded acrylic. Frame corners shall be fully welded and ground smooth.
   1. Provide radiation protection equivalent to that provided by sheet lead in partition in which view window is installed.
   2. Provide ½" (13 mm) removable, reversible stops Predrill and countersink to allow for:
      a. Two panes of 5/16" leaded shielding glass (equivalency of 1/16" thickness).
   3. Provide frames with voice transmission slots

2.13 LEAD-LINED TWO-PIECE SLIP FRAMES

A. Lead-Lined Telescopic View Window Frames Two-piece slip lead lined frames manufactured to a specific throat dimension to suit wall thickness. Frames shall be capable of accepting any thickness of radiation shielding leaded glass, radiation shielding X-Ray safety glass. or radiation shielding leaded acrylic. Frame corners shall be fully welded and ground smooth.
   1. Throat Dimension: As required to suit wall thickness
   2. Metal Thickness: [16] [14] gauge.
   3. Provide radiation protection equivalent to that provided by sheet lead in partition in which view window is installed.
   4. Provide ½" (13 mm) removable. reversible stops Predrill and countersink to allow for:

a. Two panes of 5/16" leaded shielding glass (equivalency of 1/16" thickness).

5. Provide frames with voice transmission slots

2.14 LEAD-LINED SOLID CORE WOOD DOORS

A. Flush veneered construction using single layer of sheet lead in center of door. Laminate wood cores under hydraulic pressure on each side of lead.

1. Extend sheet lead lining to door edges providing X-Ray absorption equal to partition in which door occurs.
2. Shield cutouts for lock sets with sheet lead lapping lead lining of lock sets or door lining, of equal thickness lead as used in door of same opening
3. Further bond cores with 6 poured lead dowels at the following locations:
   a. 2 at 8 inches (203 mm) from top and 4 inches (102 mm) sides, 2 at center 4 inches from sides, and 2 at 8 inches (203 mm) from bottom and 4 inches (102 mm) sides.
4. Edge Strips: Minimum thickness of 2 inches (51 mm) each edges of door.
   a. Species: Same as wood face veneer
   b. Glue strips to cores before face veneer is applied
   c. Extend vertical edge strips full height of door and bevel 1/8 inch (3 mm) for each 2 inches (51 mm) of door thickness..
5. Secure glass with hardwood stops of same species as face veneer. Secure frame to door with wood screws.
6. Face Veneer for Transparent Finish RE Specifications Section 8211.

2.15 LEAD-LINED HOLLOW METAL DOOR FRAMES

A. Lead-Lined Hollow Metal Door Frames:

1. Construction: Line inside of frames with single unpierced strip of sheet lead of not less than same thickness as lead in doors and walls in which installed
   a. Form lead sheet to match contour of frame on radiation exposure side of frame, continuous in each jamb and across head and over lap into formed stop.
   b. Form lead shields around areas prepared to receive hardware.
   c. Fabricate lead lining wide enough to maintain an effective 1/2" (13 mm) minimum overlap lap with lead of adjoining shielding.
   d. Design lead-lined door frames to accommodate lead lining up to 1/2 inch (13 mm) thick.
2. Door Frame Supports: **RE: door details**.
3. Jamb Depth: **4 ½" thru 14", in 1/8" increments**.
4. Jamb Profile: **2"**
5. Head Profile: **4"**
6. Frame Thickness: **14** gauge.

2.16 FINISHES

A. RE: Door Elevations and specifications, Section 09 91 00 Painting

1. Colors: As selected.

B. Prefinished Surfaces: Colors as selected

2.17 ACCESSORIES

A. Lead Discs: 5/16 inch (8 mm) diameter lead discs for use with screw heads.

B. Lead Strips: 2 inches (51 mm) wide, unless indicated otherwise, by same thickness as sheet lead laminated on gypsum board.

C. Lead Angles: Leak-proof, lead angle system providing complete coverage of gamma rays used in lieu of lead strips and lead discs where sheet lead thickness is greater than 1/8 inch (3 mm) thick.

D. Gypsum Board Fasteners:
   1. Screw Fasteners for Metal Framing Type S bugle head drill screws complying with ASTM C 954, length as required, for applying lead-laminated gypsum board to light gage metal framing having thickness of 0.033 to 0.112 inch [0.84 to 2.84 mm] thick
   2. Screw Fasteners for Metal Framing Self Tapping Type S, bugle head self-piercing tapping screws complying with ASTM C 1002, length as required for applying lead-laminated gypsum board to light gage metal framing having thickness of 0 033 to 0 112 inch [0.84 to 2.84 mm] thick.
   3. Screw Fasteners for Wood Framing Type W bugle head screws complying with ASTM C 1002, length as required, for applying lead-laminated gypsum board to wood framing and furring.

E. Adhesive: Acceptable to radiation protection product manufacturer and capable of adhering lead sheets where required.

F. Tie Wire: Leaded steel, annealed.

PART 3- EXECUTION

3.1 EXAMINATION

A. Verify that existing framing, surfaces and substrates are ready to receive work and opening dimensions are as indicated on Shop Drawings or as instructed by the manufacturer

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LEAD-LAMINATED GYPSUM BOARD

A. Comply with manufacturer's recommendations

B. Lead Strips: Adhere lead strips on face of studs at joints in lead-laminated gypsum board, including inside and outside corners. Use 2 inches (51 mm) wide strips by same thickness as sheet lead laminated on gypsum board.
   1. Lead strips are not required on 49" or greater lead sheet widths.

C. Shim studs and other framing members as necessary to provide flat, flush finished surfaces.

D. Install lead angles per manufacturer's recommendations

E. Install lead-laminated gypsum board on framing with screws spaced not more than 8 inches (203 mm) on center along edges of board and 12 inches (305 mm) on center in field of board.

F. Adhere lead discs to fastener heads. In each case use method that provides continuous radiation shielding.

G. Where lead-laminated gypsum board is final substrate apply joint treatment on fasteners and joints per "Section 09 29 00 - Gypsum Board."

Where second layer of gypsum board occurs over lead-laminated gypsum board, comply with "Section 09 29 00 - Gypsum Board" for application of second layer

3.3 LEAD-LAMINATED PLYWOOD

A. Comply with manufacturer's recommendations

B. Adhere lead strips on face of studs at joints in lead-laminated plywood, including inside and outside corners. Use 2 inches (50 mm) wide strips by same thickness as sheet lead laminated on plywood.

C. Shim studs and other framing members as necessary to provide flat, flush finished surfaces.

D. Lead Angles: Install lead angles per manufacturer's recommendations.

E. Install lead-laminated plywood on framing with screws spaced not more than 8 inches (203 mm) on center along edges of board and 12 inches (305 mm) on center in field of board.

F. Adhere lead discs to fastener heads. In each case use method that provides continuous radiation protection.

3.4 INSTALLATION OF DOORS AND FRAMES

A. Lead-Lined Frames: Install lead-lined steel door frames in accordance with "Section 08 11 13 - Hollow-Metal Doors and Frames." Comply with NAAMM HMMA 840 unless otherwise indicated. Set frames accurately in position, plumb, and braced securely until permanent anchors are set.

1. Secure door frames with steel stud anchors if lead lining is below 1/8 inch (3 mm) thick.
2. Door Frame Supports (utilize if lead thickness is 1/8 inch (3 mm) or greater):
   a. Run steel angle supports full height on each door frame jamb and fasten to structure above.
   b. Spot-weld supports at 6 inches (152 mm) along jambs and at corners of jambs and head frame.
   c. Anchor frame to substrate with fasteners appropriate for substrate.
   d. Apply coat of asphalt mastic or paint to lead lining in door frames where lead will come in contact with masonry or grout.
3. Provide 3 anchors per jamb, located adjacent to hinge on hinge jamb, and at corresponding heights on strike jamb.
4. In metal stud construction, use wall anchors attached to studs with screws.
5. Lap lead lining of frames over lining in walls at least 1 inch (25 mm).
6. Lead Lining of Frames: Line inside of frames with lead of thickness not less than that required in doors and walls in which frames are used. Form lead to match frame contour, continuous in each jamb and across head, lapping stops. Form lead shields around areas prepared to receive hardware. Lap lining over lining in walls at least 1 inch (25 mm)

B. Lead-Lined Wood Doors:
1. Install lead-lined wood doors in accordance with "Section 08 14 16 - Flush Wood Doors" unless otherwise indicated
2. Install doors in frames level and plumb aligned with frames and with uniform clearance at edges.

C. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. Refer to "Section 08 71 00 Door Hardware" for other installations requirements.

D. Touch up damaged finishes with compatible coating after sanding smooth.

3.5 INSTALLATION OF WINDOW FRAMES

A. Set unleaded side of frame plumb and square in wall opening on control room side of wall with shims.
B. Set leaded side of frame plumb and square in wall opening on X-Ray side of wall.
C. Compress sides together against faces of wall
D. Install setting blocks, shims, and glazing tape in glazing channel to prevent galls from touching steel frame.
E. Install radiation resistant glazing in telescopic frame
F. Place steel stops in position and mark location of stop and frame retaining holes on steel frame.
G. Remove glazing and drill holes in steel frame
H. Place glazing and stops and hand drive setting screws

3.6 INSTALLATION OF PENETRATING ITEMS

A. At penetrations of lead linings; provide lead shields to maintain continuity of protection.
B. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.
C. Cut wall penetration covers from lead sheet of equal or greater thickness than backing on adjacent wall panels. Cut wall penetration covers to size required to cover wall penetrations with laps 1 inch (25 mm) minimum wide as indicated on penetration detail drawings.
D. Adhesive-apply lead sheet penetration covers on penetrating boxes and raceways and return penetration covers to backside of lead-backed wall panels with 1 inch (25 mm) minimum laps.
Do not use penetrating fasteners unless indicated otherwise
E. Outlet Boxes and Conduit: Install between studs using steel telescoping mounting brackets. Cover or line with lead sheet lapped over adjacent lead lining at least 1 inch (25 mm). Wrap conduit with lead sheet for 10 inches (250 mm) in from box.

3.7 INSTALLATION OF WALL PENETRATION COVERS

A. Duct Penetrations With 8 PSF or Less Lead Sheet
   1. Wrap ducts with wall penetration covers lapping lead joints 1 inch (25 mm) minimum.
   2. Secure lead sheet in place with 1 inch (25 mm) minimum width steel bands spaced not more than 12 inches (305 mm) on center.
   3. Do not cut into lead sheet with tightening steel bands

B. Duct Penetrations with Greater than 8 psf Lead Sheet and Where Duct Shielding Exceeds 24 Inches (610 mm) in Width:
   1. Laminate wall penetration covers to plywood or other similar structural panels conforming to shape of duct, lapping lead joints 1 inch (25 mm) minimum
   2. Secure lead laminated panels to ducts with mechanical fasteners located at duct seams and corners.
   3. Where necessary to prevent lead laminated panels from overloading duct supports, independently suspend panels from hangers secured to overhead building structure.
   4. Cover fastener heads with lead sheet matching thickness of adjacent lead.

C. Piping: Unless indicated otherwise, wrap piping with lead sheet for 10 inches (250 mm) from point of penetration.

3.8 ACCESSORY INSTALLATION

A. Comply with manufacturer's recommendations

B. Wherever lead protection is penetrated, cut or punctured assure continuity of shielding by use of sheet lead, lead plugs or other approved method.

C. Install sheet lead lining within steel door frames to provide radiation protection to levels indicated or levels required to match adjacent wall protection.

D. Wrap electrical outlet boxes, view window frames and other penetrations through lead barrier material with sheet lead to provide radiation protection to levels indicated or levels required to match adjacent wall protection.

3.9 FIELD QUALITY CONTROL

A. Radiation Protection Survey: Employ a registered X-Ray physicist, certified by American Board of Radiology, for testing specified radiation protective Work and to conduct radiation protection survey of facility after radiation shielding materials are installed.
   1. Take radiation measurements and indicate evaluation of measurements in report. Submit report to Architect and Owner upon completion of report
   2. Take radiation measurements in locations indicated by Architect.

B. Correct deficiencies in, or remove and replace, radiation protection Work that testing indicates does not comply with specified requirements.

3.10 ADJUSTING

Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

3.11 CLEANING

A. Remove excess materials from site and leave Work areas broom clean.

B. Leave exposed surfaces ready for site finishing

3.12 PROTECTION

A. Lock radiation-protected rooms once door hardware is installed Limit access to only those persons performing Work in radiation-protected rooms or as directed by Owner

B. Tape temporary paper signs on radiation-resistant walls with the following text:
   1. "Do not mount equipment on this wall without covering penetrating fasteners with lead sheet of thickness required by Contract Documents."

SCHEDULES

Room No.: **107, CT Scan**; North; South; East; and West wall 1/16 inch lead from floor to above ceiling.

END OF SECTION 13 4900